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DICTIONARY OF MEDICINE

VOL. II

A
DICTIONARY OF MEDICINE

INCLUDING GENERAL PATHOLOGY, GENERAL THERAPEUTICS
HYGIENE, AND THE DISEASES OF WOMEN AND CHILDREN

BY VARIOUS WRITERS

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NEW EDITION, REVISED THROUGHOUT AND ENLARGED

VOL. II. MACROCHEILIA—ZYME

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DICTIONARY

OF

MEDICINE

M

MACROCHEILIA (*μακρός*, great; and *χεῖλος*, the lip).—A condition, usually congenital, in which the lips are hypertrophied.

MACROCYTE (*μακρός*, great; and *κύτος*, a hollow).—A form of large red blood-corpuscles met with in some kinds of anæmia. *See* ANÆMIA, PERNICIOUS.

MACRODACTYLIA (*μακρός*, great; and *δάκτυλος*, a finger).—Hypertrophy of one or more fingers, either congenital or developing in childhood.

MACROGLOSSIA (*μακρός*, great; and *γλῶσσα*, the tongue).—Fr. *Macroglossie*; Ger. *Zungenvorfall.*

The term 'macroglossia' is applied to an enlargement of the tongue, which sometimes goes to the extent of protrusion of the organ from the mouth. This affection seems to depend on dilatation of the lymphatics, with lymphstasis, leading to hyperplasia of the connective and lymphoid tissues. It is sometimes associated with idiocy or imbecility. The cause of the lymphangiectasis, which is probably the fundamental condition, is undecided. *See also* TONGUE, Diseases of.

MACROSOMATIA (*μακρός*, great; and *σῶμα*, the body).—Fr. *Macrosomatie*; Ger. *Riesenwuchs.*—A condition in which the whole body becomes enlarged in a monstrous degree. *See* HYPERTROPHY.

MACROSTOMIA (*μακρός*, great; and *στόμα*, the mouth).—A congenital enlargement of the mouth, due to imperfect closure of the mandibular fissure upon one or both sides. It is a rare deformity, and is generally accompanied by malformation of the auricle, by an accessory tragus, or by a mandibular tubercle. Excessive closure of the mandibular fissures may also occur, leading to *microstoma*.

MACULÆ (*macula*, a spot or stain).—SYNON.: Fr. *Macules*; Ger. *Flecke.*

Willan's definition of macula is 'a permanent discoloration of some portion of the skin;' and that author adopted the term as the title of his eighth order of cutaneous affections, including sunburn, nævus, and spilus. The term 'maculæ' is likewise applied to a hyperæmic state of the skin, which may be simply chronic without being permanent, such as those which have received the name of *maculæ syphiliticæ.* Maculæ, therefore, may be merely pigmentary, and located in the rete mucosum alone; or they may be hæmorrhagic, and seated in the derma and subcutaneous tissues. Sunburn, freckles, liver-spot, bronzed and melasmic spots, and the stains left on the skin after the dispersion of certain cutaneous eruptions, such as psoriasis, acne, lichen planus, syphilis, and leprosy, are examples of pigmentary maculæ; whilst leucodermic spots and blotches represent an absence of pigment. The maculæ resulting from a permanent hyperæmia of the blood-vessels of the skin, such as flat vascular nævi and the claret-stain nævus, disappear under pressure; whilst the hæmorrhagic maculæ are represented by the escape of the red corpuscles of the blood from the vessels, and their diffusion in the connective tissues, such as occurs in purpura and in bruises.

ERASMUS WILSON.

MADEIRA, North Atlantic Ocean. Moist, mild, equable climate; absence of dust; well protected. Mean temperature 61° F. *See* CLIMATE, Treatment of Disease by.

MADNESS.—*See* INSANITY.

MADURA-FOOT.—A synonym for fungus-foot of India. *See* FUNGUS-DISEASE OF INDIA; and ACTINOMYCOSIS.

MAGGOTS.—A popular term for the parasitic larvæ of various insects, including bots. *See* ŒSTRUS; and NOSE, Diseases of.

MAGNETISM, ANIMAL. — This name was formerly applied to the imaginary new force or principle, supposed to be akin to magnetism, and to be in operation when individuals were 'mesmerised.' This hypothetical new force was thought to be called into play by the mesmeriser; and it was deemed to be by virtue of its influence that the will, thoughts, and actions of the 'medium,' or person mesmerised, are capable of being modified in the so-called mesmeric trance or sleep. This view as to the nature of the causal conditions is now regarded as altogether erroneous and devoid of all foundation in fact, although certain remarkable effects may unquestionably be produced on many persons (by so-called 'mesmeric passes,' by concentration of attention associated with some strain of ocular muscles, by attention to a series of weak monotonous sensations, or other related means), owing to the induction in such persons, under physiological conditions, of some at present imperfectly understood state or modification of cerebral activity (*see* Mesmerism). This state is now generally spoken of as the 'hypnotic condition,' 'hypnotic sleep,' or 'hypnotism'; or more rarely as 'induced somnambulism.' On the other hand, when such a state is induced, as a therapeutic means or agency, it has been spoken of as 'Braidism' (*see* Braidism). The latter appellation has been given in honour of the Manchester surgeon, James Braid, who first showed in an unmistakable manner that all the real phenomena displayed by mesmerised persons were not due to any new force or principle, akin to magnetism, which had been made to operate in or upon them, but were attributable to the fact that certain altered functional states of the brain had been self-induced by the individual under the influence of one or other of the exciting conditions already mentioned. In these altered brain-states the functional activity of certain parts of the cerebrum is annulled, whilst that of others is often remarkably exalted. The freedom with which such altered brain-states may be induced varies greatly in different persons; and the states themselves also vary much in their degree of intensity in different individuals, or in the same individual at different times. This latter side of the question has been greatly elucidated by Charcot and others during recent years. Charcot, in fact, regards what is known as the 'hypnotic state' as variously composed (on different occasions) by phenomena pertaining to one or more of the three simpler conditions, known as (1) 'induced somnambulism,' (2) catalepsy, and (3) lethargy. Nothing is more remarkable in connexion with this subject than the rapidity with which persons may be made to pass from one to the other of these stages, and the simplicity of the means by which such changes of state may be effected. Important side-lights have, moreover, been thrown upon the relations and genetic conditions of such causally obscure neuroses as somnambulism and catalepsy. *See* Mesmerism.

H. Charlton Bastian.

MALACOSIS (μαλακός, soft).—A term for the morbid softening of structures. *See* Softening.

MALACOSTEON (μαλακός, soft; and ὀστέον, a bone).—A peculiar disease of bone, characterised by softening. *See* Mollities Ossium.

MALAGA, in South of Spain.—Dry, mild, bracing, equable climate. Mean temperature in winter, 55° F. Winds: N.W. (*Terral*), dry and dusty; E. (*Levante*), cold and damp. Drawbacks: bad drainage and cookery. *See* Climate, Treatment of Disease by.

MALAISE (Fr.)—Synon.: Indisposition; Ger. *Missbefinden.*—In cases of simple digestive derangement, in ague, and in the stage of invasion of many acute diseases, the patient very commonly first becomes aware that his health is disturbed by a feeling of general illness, which is known as malaise.

Description.—Under the circumstances just mentioned, the ordinarily unconscious feeling of being well, or *bien-être*, which accompanies perfect health, is replaced by a painful and depressing feeling, which the patient probably cannot describe otherwise than as a sense of being weak, languid, listless, and disinclined to bodily or mental exertion. Malaise is commonly associated with bodily debility, chilliness, or actual rigors, moderate pyrexia, general pains or aches, giddiness, headache, and anorexia. In the course of the more serious diseases in which it occurs, malaise either passes off or soon gives place to more urgent symptoms—such as depression, apathy, delirium, or stupor; but in other instances it persists, and constitutes the chief subjective phenomenon of the disease, as in some cases of typhoid fever.

Treatment.—The treatment of malaise will depend upon the nature of the cause of the feelings just described, and should be directed to its removal or remedy.

J. Mitchell Bruce.

MALARIA (Ital.)—Synon.: Marsh Miasm; Fr. *Mauvais Air*; *Intoxication des Marais*; *Intoxication Tellurique*; Ger. *Malaria.*

Definition.—An earth-born poison, generated in soils the energies of which are not expended in the growth and sustenance of healthy cultivated vegetation. By almost universal consent this poison is the cause of all the types of intermittent and remittent fevers, commonly called *malarial*, and of the degeneration of the blood and tissues resulting from long residence in places where this poison is generated.

The Italian word *malaria* is now employed to convey the meaning expressed in the above definition. It is certainly preferable to the term *marsh miasm*, which implies that marshes are the sole source of the poison. M. Léon Colin, Professor of Military Medicine in the Val-de-Grace, who has written an instructive work on malarial fevers, does not use the term 'malaria' to distinguish the agent that causes them; he prefers the term 'telluric poison,' *intoxication tellurique*, proceeding from the energy of the soil, when that energy is not absorbed by its natural consumers, crops or plants—in a word, healthy cultivated vegetation.

ESSENTIAL NATURE.—What is this fever-generating agent to which the term 'malaria' has so long been applied? The writer, in the first issue of this Dictionary, while unable to assent to the so-called *Bacillus malariæ* of Tommasi-Crudeli and Klebs, as the cause of malarial fevers, did not withhold what they had written on the subject. This supposed bacillus is now on all hands allowed to be non-existent, and will never more be heard of. The theory now in fashion is based on the observations of Marchiafava and Celli, on the blood of malarial patients in the Santo Spirito Hospital in Rome; of Laveran, in Algiers; Osler, of the Johns Hopkins Hospital, Baltimore; and Dr. Vandyke Carter, principal of Grant College, Bombay. They describe a parasite, possessing amœboid movements, which is found in the red corpuscles, and have named it 'Plasmodium malariæ,' or, according to Laveran, *Microbe du paludisme*; they believe that it only occurs in cases of malarial fever, and consider the parasite to be one of the Mycetozoa. It is readily stained with methylene blue. Marchiafava and Celli maintain that it appears at the onset of the fever, becomes more numerous as the fever increases, and disappears with the fever. *See* MICRO-ORGANISMS.

The occurrence of anæmia in the course of malarial fevers is an old and familiar fact; and the rapidity with which this sometimes occurs is remarkable (*see* INTERMITTENT FEVER). The authors of the theory under notice explain the phenomenon by the action of the microbe on the red corpuscles, on which it preys, leaving nothing in their place but the dark pigment so commonly seen in the organs of malarial subjects. Dr. Vandyke Carter announces a discovery which, if confirmed by other observers, is of great interest. He further describes leucocytes in the blood in ague, the *raison d'être* of which is to prey upon the *microbe du paludisme*. The question is, assuming the entire accuracy of the observations given above in outline, does the existence of this parasite explain the cause of malarial fevers? The authors of the theory maintain that it does. They did the same in the case of the mythical bacillus malariæ. This is, in the judgment of the writer, a verdict not supported by the facts. This plasmodium malariæ has never been seen outside the body, and there is no evidence that it has ever been artificially cultivated. It is inconceivable that such an organism can exist and propagate in the great variety of soils and climatic conditions where malarial fevers are found.

GENETIC RELATIONS.—When we consider that in many regions of the globe two-thirds of the mortality is caused by the fevers, and their sequels, to which this poison gives rise, we can understand why all that relates to malaria is important to the statesman, the soldier, the sanitarian, and the physician. 'Fevers,' says Dr. Cornish, the Sanitary Commissioner of Madras, 'one year with another destroy twice as many people in India as small-pox, cholera, and all other epidemic causes put together.' The late Dr. Parkes has well said 'that when a climate is called "unhealthy," it is simply meant that it is malarious.' This remark is especially true of tropical climates. Malaria has generally been said to be the product of heat, moisture, and vegetable decomposition. The terms *marsh miasm* and *paludal fevers*, long employed to distinguish the poison and the fevers to which it gives rise, mark the almost universal belief that the air of marshes alone is endowed with the power of generating them. That low, moist, and warm localities are generally noted as malarious is indisputable. Marshes are not, as a rule, dangerous when abundantly covered with water; it is when the water level is lowered, and the saturated soil is exposed to the drying influence of a high temperature and the direct rays of the sun, that this poison is evolved in abundance. The production of malaria on a great scale in this way was seen in the district of Burdwan, in Bengal. The soil is alluvial, but dry; and, until within the last few years, Burdwan was more salubrious than the central or eastern districts of the Lower Gangetic delta. The drainage of the district became obstructed by the silting up of its natural and artificial outlets, and the result was a waterlogged condition of the soil, the development of malaria, and an alarming increase in the death-rate.

Malaria is, however, generated under conditions apparently widely different from the above. When the British army under Wellington was operating in Estremadura, the country was so arid and dry for want of rain that the rivers and small streams were reduced to mere lines of widely detached pools; yet it was assailed by a remittent fever of such destructive malignity 'that,' says Ferguson, who records the fact, 'the enemy and all Europe believed that the British host was extirpated.' A fever of like malignity scourged the same army in the bare open country by which Ciudad Rodrigo is approached from the side of Portugal, at a time when, says the same author, 'the vegetation was so burned up that the whole country resembled a brick-ground.' It must, however, be kept in mind that both districts are in the rainy season flooded with water, at which time they are healthy, until the drying process begins under the action of a powerful sun.

Malaria is notoriously rife in soils, the upper strata of which are rich in organic matter, and are from any cause left to nature uncultivated, and to the influence of the sun. The Roman Campagna is a well-known example of this kind. M. Léon Colin has explored this tract of country in search of the commonly recognised sources of malaria, and reports it everywhere dry and free from stagnant water. But the cultivating hand of man has long been withdrawn from this once fertile region, and the energies of its rich soil, instead of being directed to food-producing ends, are wholly given up to the development of malaria, for which it is notorious.

It is well known that so-called malarial fevers prevail in some of the most sterile regions of the earth. Here, it is often said, 'there is no organic matter, no vegetative energy running waste, on which to fall back for an explanation.' Yet many of those desert places, to all appearance under the curse of perpetual barrenness, do contain organic matter, and are in reality so full of vegetative energy, that water only is wanted to fit them for the productive labour of the husbandman. There are millions of acres in India, now supplying abundant harvests, which, if water was withdrawn, and the cultivating hand of man withheld, would quickly relapse into deserts fruitful only in malaria.

We need not go to tropical countries in search of examples of this kind: our own country can furnish them in abundance. So late as the reign of the sister of Elizabeth 'to whose name a horrible epithet adheres,' large tracts of country from political causes fell out of cereal cultivation, and forthwith malarial fevers became epidemic, attended with a heavy mortality.

The disturbance of soil that has long been fallow is often followed, both in hot and temperate climates, by the evolution of malaria. A familiar example was the prevalence of intermittent fever in Paris during the construction of the Canal St. Martin; also during the excavations for the fortifications of the same city, in the reign of Louis Philippe; and on a larger scale in different parts of France when the railways were in process of construction.

Malaria is freely generated at the bases of mountain ranges in tropical climates. The strip of land extending along the base of the Himalaya, called the *terai*, is a notable example of this kind. The soil of this region is immensely rich, well supplied with water, and covered with dense forests, which with the vast mountain range makes free perflation of air impossible. At particular seasons of the year it is almost certain death to enter this region.

Some rocks in a state of disintegration, when freely exposed to the drying action of the sun and air, are in tropical countries often highly malarious, and give rise to severe forms of fever. The example most familiar to the writer from personal knowledge is the island of Hong Kong. The soil, according to the late Dr. Parkes, contains only about 2 per cent. of organic matter; but like all granitic rocks it is highly absorbent of water; and Friedell, quoted by the same authority, affirms that it is permeated by fungi. The writer was encamped on this island before it was ceded to the British Government. At this time the soil was but little disturbed, and the troops did not suffer. But when excavations were made at a subsequent time, for the construction of the city of Victoria, on the side of the island facing the harbour, a fatal form of remittent fever appeared, which caused great mortality among both the civil and the military populations.

Parkes (*Practical Hygiene*) thus sums up his account of the soils with the largest organic emanations: '1. Alluvial soils, old estuaries, deltas. Peaty soils are much less malarious. Marshes overflowed regularly by the sea are often healthy, while the occasional admixture of salt water increases the emanations. 2. Sands, if there is an impermeable clay or marly subsoil. Old water-courses. 3. The lower parts of the chalk, where there is a subsoil of gault or clay. 4. Weathered granitic or trap rocks, if vegetable matter has become intermixed; such soils absorb both heat and water. 5. Rich vegetable soils at the foot of hills.'

When malarial fevers appear in ships returning from unhealthy climates, the explanation is to be looked for under one or other of the following causes: (*a*) the sufferers may have had their systems charged with malaria before embarkation, as is constantly seen in the case of invalids returning from India; (*b*) they may have used water on board drawn from a malarious locality; (*c*) the source of the malaria may be in the ship, from decayed vegetable matter mingling with the bilge-water, in ships under a bad sanitary *régime*;[1] or (*d*) it may be derived from malarious mud, as in the case of H.M. ship 'Powerful,' returning from India, when a severe outbreak of fever was traced to this cause. There is, however, reason to believe that when fever has been observed to follow the consumption of unwholesome water at sea, it has sometimes been not malarial but enteric, from the unsuspected presence in it of the specific germs of that disease.

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[1] The writer is indebted to the late Dr. Mansfield, R.N., for an instructive example of a fatal form of yellow malarial fever on board H.M. ship 'Egmont,' long used as a storeship at Rio. The ship was found to be in a state of decay: the timbers were permeated by fungi of a white or cream colour, giving off a sickening and offensive odour.

Instances are also recorded, in which symptoms having a periodic character, and yielding to the treatment which is effective in malarial diseases, have resulted from exposure to decaying vegetable matter, a connexion of which with a special marsh poison could not well be traced.

ATTRIBUTES.—Malaria, however generated, possesses certain properties well known to those who live in malarial localities. Temperature exercises great influence over its development and activity; many places can be visited with impunity in winter which are dangerous in summer and autumn. Wenzel made observations on the effect of temperature in the development of malaria during the construction of the fortified port of Jahde; he observed that the increase of attacks of malarial fever was coincident with a rise in the temperature. In the charts constructed by him to illustrate the point, a constant precedence of the temperature curve by twenty or twenty-five days of the sickness curve of attacks is to be seen; so that in a temperate climate like that of Jahde, three weeks of increased temperature appeared to be necessary for the genesis of the malarial poison, and the outbreak of sickness. When in any year the medium summer temperature did not reach 12° R. (59° F.) the sickness remained at its minimum.

Malaria drifts along plains to a considerable distance from its source, when aided by winds sufficiently strong to propel, but not to dispel it. Under the influence of currents of heated air it can ascend, in dangerous concentration, far above its source, and buildings elevated some hundreds of feet above a malarious plain are often more under its influence than those on the plain itself. When favoured by ravines and currents of heated air, it can scale mountains to a height which appears to differ in different climates, varying from four or five hundred to two or three thousand feet. It is unsafe to place human habitations on the edge of such ravines on mountain tracts generally considered above 'fever range.' A belt of forest interposed between any malarial place and human habitations affords considerable protection, and a sheet of water similarly placed exercises an absorbing power—facts long familiar to sanitarians. Soils protected from the sun's rays by forest trees are generally healthy; but when exposed to the sun after the forests have been cleared away, malaria is evolved until the land is brought under cultivation.[1]

PATHOLOGICAL RELATIONS.—The physician can demonstrate the existence of malaria by the best of all tests, namely, its pathological action. This action has been recognised for ages in the property it possesses of producing a class of *fevers* distinct from all others in their symptoms and sequels, to which the name of *malarial* or *paroxysmal* has been given; the latter term from the almost clock-like regularity of the periods of apyrexia and recurrence. This subject is fully discussed in a separate article (*see* INTERMITTENT FEVER). Pathologists have also recognised its power of impressing on other disorders, in a lesser degree, the same stamp of periodicity, and its more insidious but not less dangerous endowment of inducing that 'slow blight of the constitutional powers' to which the term *malarial cachexia* is now applied. The most striking features of this condition are easily recognised. The sufferers appear much older than they are; the skin assumes a brownish yellow tint, of various shades, according to the natural complexion of the person, and the length of residence in an unhealthy climate. They become anæmic, with an immense increase in the white corpuscles of the blood. The rapidity with which this anæmia is developed is surprising. Professor Kelsch has shown by carefully conducted observations made by Malassez's method, that in twenty-four hours a man affected with intermittent fever lost more than a million of globules per cubic millimètre. This condition of the blood often gives rise to murmurs, not confined to the cardiac region, but heard also in the large vessels, misleading unwary observers into a false diagnosis of organic disease. Persons whose blood is thus affected are prone to attacks of a fatal form of pneumonia, if exposed to cold when not protected by sufficiently warm clothing. Their digestive and heat-generating powers are impaired, and they are liable to diarrhœa from slight causes, often of an intractable kind. The liver is generally enlarged; but the most characteristic lesion is enlargement of the spleen, which often attains such a size as to occupy a large part of the abdominal cavity. There is in the pathological museum at Netley a preparation of the section of a spleen taken from the body of a small drummer-boy, who had been under the care of the writer. This lad had spent some years of his brief life in the Peshawur valley. The weight of the spleen was 10 lb. 15 oz., that of the liver 9 lb. 10 oz. The condition was alike in both organs, an immense development of connective tissue having taken place. These two organs made up one quarter of the total body-weight of the boy. Both spleen and liver, and sometimes even the brain and spinal cord, are deeply pigmented. The urine is sometimes albuminous, with œdema of the lower extremities—symptoms suggestive of Bright's disease, leading to a grave prognosis, often ill-founded, as the above symptoms usually disappear under good climatic and therapeutic means.

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[1] A popular belief has arisen that the blue-gum tree of Australia, Eucalyptus globulus, is particularly efficacious in this way. This tree is now popularly known as the 'fever tree,' and is being extensively planted for protective purposes in the malarious parts of Italy. Its supposed virtues are said to be due to the camphoraceous constitution of the leaves of this noble, gigantic, and rapidly growing tree. It is a notable fact that the extensive pasture lands of Australia are very free from malaria, and the fact is there attributed to the existence of vast forests of the blue-gum tree.

All the species of eucalyptus grow with amazing rapidity; wherever they are planted they are great consumers of moisture, and thus exercise a drying influence on the subsoil, which must have a considerable effect on the climate where they exist in large numbers.

Neuralgic affections, varied and numerous, are common sequels of malarial poisoning; 'brow ache' is a familiar example. To the above may be added palpitation of the heart, rheumatic pains in limbs and joints, and amenorrhœa; and if, as often happens, scurvy be engrafted on the malarial cachexia, such of the above affections as may be present are at once seriously aggravated.

Tropical dysentery prevails in its worst forms in malarial localities; the same is true of suppurative inflammation of the liver. It seems probable that when malaria acts as a predisposing cause of dysentery, it is taken into the system through the medium of water. It is a significant fact, elsewhere insisted on by the writer, that exactly in proportion as we have banished malaria from the soil of the British Islands, so has dysentery disappeared as an endemic disease.

The late Dr. Cutcliff, of the Bengal army, noticed that in some very malarious districts in the Bengal Presidency, large numbers of males were impotent, the women proving fruitful with males from other non-malarious regions. In such localities, also, the children of those affected are often born, not only with the external signs of the malarial cachexia, but also with the visceral changes and pigmented organs described above.

Since we cannot yet affirm that the essential nature of the malarial poison has been discovered, we may notice two other theories that have been advanced. It need only be said of the few who maintain that the grave pathological changes attributed to malaria are all explicable either on the hypothesis of 'chill,' according to Dr. Oldham, or 'certain electrical conditions,' according to Dr. Munro, that they have a difficult thesis to support. If 'chill' will account for the loss of 10,000 men at Walcheren, for the frightful disaster of a like kind at Carthagena, for the terrible visitation of paroxysmal fevers in the Mauritius, and countless examples of the same kind, and for the yearly loss of life in India from fevers—the country in which Dr. Oldham serves—why, seeing that mankind are exposed to 'chill' everywhere, are not such fevers with their sequels universal in their prevalence, instead of being confined to places under one or other of the conditions described in this article? Why, above all, in a country like Great Britain, where vast multitudes of the population are hourly exposed to every variety of atmospheric change, have paroxysmal fevers, once endemic here, disappeared, save in such exceptional places as are still under one or other of the conditions here indicated? No satisfactory answer has been given to this question. As for the 'electrical conditions' of the other hypothesis, when its author can explain what these conditions are, and why they no longer exist in the British Islands, or do not produce their usual effects, we shall be prepared to discuss their value from a pathological point of view.

W. C. Maclean.

MALARIAL.—Pertaining to or connected with malaria; for example, *malarial fever*, *malarial region*, *malarial poison*. *See* Malaria.

MALFORMATIONS (*male*, amiss; and *formo*, I fashion).—Synon.: Fr. *Malformations*; Ger. *Missbildungen.*

Definition.—Deviations from the normal standard, in the size, form, number, or situation of any part or organ of the body.

Varieties and Ætiology.—The malformations of the human body may be conveniently considered under two distinct heads, namely —(A) *Acquired* malformations, more commonly called *deformities*; and (B) *Congenital* malformations.

(A) Acquired Deformities.—Acquired deformities may be the result of disease, affecting, for instance, the spine, which may become curved, or the joints, or the tendons. Similarly, the bones may be the seat of deformity, as from rickets, mollities ossium, or osteitis. Certain injuries and accidents, such as burns, scalds, fractures, and dislocations, lead also to a great number and variety of deformities. Various habits, customs, and occupations, by giving rise to pressure on certain parts of the body, by altering the amount of blood circulating through them, or by interfering with their due innervation, bring about changes in the relative size and shape of the bony or soft textures, and so lead to malformations. It is thus that the brow is flattened by certain tribes of American Indians; the waist deformed, and the corresponding viscera compressed and dislocated, by means of the tight-lacing practised by more civilised peoples; and the feet distorted by many nations, especially the Chinese. Not only is such a striking example as the common depression of the lower part of the sternum in shoemakers a deformity, but the huge development of certain groups of muscles at the expense of others induced by some occupations must be looked upon in the same light, for these, too, are deviations from the normal outline of the human figure. Besides these cases, which may be termed primary deformities, many others of a secondary kind—that is, dependent on some antecedent change or lesion—are frequently seen. These may occur in organs correlated in growth, as the absence of hair on the face and pubes, and the increase of subcutaneous fat, if from any cause the testicles waste, or if they are removed before puberty. Absence of, or disease in, any part which causes the disuse of other parts, also induces a secondary deformity, as the atrophy and degeneration of a group of muscles, or of a limb, when the nervous supply is in any way interrupted either at the centre or the periphery. The brief reference which has been made to these acquired malformations will suffice, and this article will be devoted to a consideration of the large class of congenital deformities, and of these to such only as are of a general character. Special malformations of organs will be noticed with the diseases of those organs, such as the brain, heart, and liver. Deformities of the chest, which are a subject of the greatest interest to the practitioner, are also separately discussed. *See* CHEST, DEFORMITIES OF.

(B) CONGENITAL MALFORMATIONS.—Since the appearance of the classic work of Isid. Geoffroy St. Hilaire, congenital malformations have been grouped and classified, and their causes determined with such approximate accuracy, that, in place of the superstitious beliefs and incredible absurdities which formerly prevailed, a distinct branch of pathological anatomy has been established—namely, that of Teratology. Instead of considering a monstrosity as a presage of some misfortune, a proof of divine vengeance, an effect of witchcraft, the result of intercourse with the lower animals, with demons, or even with women during menstruation or pregnancy, we now trace it either to a malformation of the original germ, or to some cause interfering with its development, and inducing either an excess or a deficiency of parts or organs. Starting from the normal standard, we find varieties in development of all kinds in two complete series—namely, an ascending series, from a mere supernumerary digit to double or even triple monsters; and a descending series, from the mere default of a digit or organ, or the union of digits, to monsters with scarcely a trace of human structure, forming an almost shapeless mass. Besides these, we may have excess or defect in the size and development of various organs and parts, or of the body *en masse*, leading to the formation of giants and of dwarfs. In other cases, development and size are normal, but the viscera are transposed; and this, too, may be either general or partial. Defects of union, of closure, and of undue division of parts are very frequent. From the moment of fecundation the ovum is exposed to various influences which may alter its normal development; and it depends on whether it is subjected to these at an early or a late stage, as to whether complex or simple anomalies result.

1. **Malformations by Excess.**—Reference will first be made to the formation of monsters by excess. Two ova may be formed in one Graafian vesicle, for double-yelked eggs are well known; but there is no evidence to show that these would form a double monster. Indeed, Professor Allen Thomson found, on incubating a dozen of such eggs, that not one produced a double embryo; whilst Wolff observed two completely separate fœtuses developed upon a single yelk. The arrival of two impregnated ova in the uterus at the same time will probably give rise, not to double monsters, but to twins, and their fusion seems almost impossible. We are thus led to the opinion that monsters by excess depend on an error of development taking place in a single germ by fission or by budding; and this idea is the more readily tenable since Allen Thomson has shown that, in birds, two primitive grooves may be formed on one yelk and in one *area germinativa*, for in this way the most complete cases of double monstrosity can be explained. In confirmation of this theory, the researches of Lereboullet may be quoted. This observer has seen, instead of the single budding of the blastoderma, which is ordinarily developed into the embryo of the fish, two or even three buds marked off; and these, during the process of development, would meet at some point, and in this manner produce parts of distinct embryos where they are separate, whilst a corresponding region of a single organism only would be formed at the point of junction. According to the mode and extent of the junction of the blastodermic buds, the monsters would vary; and so would be derived all the different varieties, from a duplicity of the face or head, or of the upper or lower extremities, to such extreme cases as the Hungarian sisters and the Siamese twins, who were joined by the xiphoid cartilage only, and the twin negresses (Millie and Christine), united by their lower lumbar vertebræ, sacrum, and coccyx. In these cases all the viscera are not completely isolated and double, for in the Siamese twins three peritoneal prolongations were found in the connecting band, and there was a vascular communication between their two livers. In the case of Millie and Christine, there existed a single anus and a single vulva, but two hymens, two clitorides, and very probably two vaginæ and uteri. The Hungarian sisters, Helen and Judith, had but one vaginal orifice, although the upper part of that organ was divided into two, and the two intestines met in a single anus, placed between the four thighs. The Bohemian sisters, Rosalie and Josepha, more recently exhibited, in whom

there is a junction of the posterior wall of the pelvis, presented apparently a single urethra and a single anus, but a double vagina. Still more curious are the monstrosities which are only united by their vertex, as the *cephalopages*, where the two fœtuses are placed end to end; and the *metopages*, where they are placed parallel, face to face, and sternum to sternum. In one of these cases, two normal brains, completely separated by their membranes, were found on dissection. These compound monsters always have a single chorion, a single amnion, and a single placenta, though the umbilical cord may be double. They are always of the same sex, and their capability of living depends on their having an almost completely double organisation, or on one individual being reduced to such a state of atrophy as to be a mere appendage to the other, who is almost normal in other respects. The condition of the brain and of the heart are the most important factors with regard to their viability. They have never transmitted their peculiarities to their offspring.

2. **Parasitic Monsters.**—The parasitic family of monsters are characterised by a more or less rudimentary individual being implanted on, and growing at the expense of another who is fully formed. This parasite may either exist as a supernumerary head, or limbs, or may be almost complete; it may grow from the head, maxillæ, or lower part of the trunk; and when the genitals exist, it is found to be of the same sex as the chief individual. Some of these cases attain to adult life, and if they have any children, these are well-formed. From such instances the transition is easy to those monsters in which the parasite is either included under the skin, or even, during the approximation of the visceral laminæ, becomes implanted inside the abdominal cavity, as is well seen in a specimen in the Hunterian Museum of the College of Surgeons. In these an arm, a leg, or a hand may be found; fragments of bone are common; and even nervous, muscular, or glandular structures may occur. A fibrous capsule is formed around these vestiges, and if they are sufficiently nourished, they may live a kind of vegetative life; but more frequently they degenerate or decompose by contact with the air, and so cause the death of their host.

3. **Malformations by Deficiency.**—In the case of monstrosities by deficiency, we again have every grade, from those almost without human form, to the simplest malformation due to a non-development or defective union of some parts of the embryo. The acardiac monsters are always products of a twin conception; and the amount of their development depends on the period of its arrest, and on the degree of anastomosis between their umbilical vessels and those of the normal fœtus. Slighter malformations are caused by physical or mechanical influences acting on a single individual, or by some pathological lesion. Panum, Dareste, and others, by experiments on this subject, have shown that different degrees of heat and oxygenation, and mechanical shocks, always lead to some malformation, but the same agency rarely produces the same malformation. Lesions of the amnion and placenta, and twisting of the funis around the fœtus, are fertile causes of deformity. On dissection, a large number of deviations are found to be dependent on inflammatory processes, causing morbid adhesions and serous effusions. These interfere with nutrition, and so lead to an arrest of development. Again, as in after-life, so in the embryo, a primary lesion may induce a secondary one, as when club-feet are caused by a defect in the nervous centres. In the production of malformations, causes of a general nature affecting the parents must not be left out of consideration; for syphilis, chronic alcoholism, and hereditary influences are undoubtedly very potent factors. The writer attaches but very little importance to Demeaux's suggestion—unsupported as it is by any valid evidence—that copulation in a state of drunkenness may engender malformations; but he is inclined to give more credit to maternal impressions during pregnancy as an agent in some of these cases. Many examples which are ascribed to such influences are undoubtedly due to other causes; but the numerous well-attested instances in physiological treatises, which prove the effects of both prolonged and sudden, if intense, emotion on the process of secretion, must make one pause before dogmatically asserting that the nutrition and development of the embryo cannot be interfered with in some similar manner.

4. **Transpositions.**—Transposition may affect the entire organism in some of the lower classes of animals, as in certain fishes and molluscs; but in man it is limited to the thoracic and abdominal viscera. The organs normally situated on the right side are placed on the left, and *vice versâ*; whilst those which occupy the median plane are so rotated that the parts which should be found on one side of the mesial line are displaced to the other. Such transposition varies in degree in different cases, sometimes affecting all the viscera, at other times merely one or two organs. The more general cases are stated by Dareste to be due to the embryo heart taking a turn in its early development to the left instead of to the right, which is its normal change. He has artificially produced similar deformities by incubating eggs placed obliquely, so as to subject their extremities to unequal degrees of heat, and cause an excess of development on one side. Bischoff, however, attributes them to an alteration in the normal position of the umbilical vesicle

and allantois, so that the former turns to the left and the latter to the right, and suggests that this might possibly influence the site of the internal organs.

5. **Imperfect Union or Closure.**—A numerous variety of malformations result from an imperfect union of embryonal parts, originally separate—such as hare-lip, cleft palate, spina bifida, &c.; or from imperfect closures of fœtal passages, such as the cervical, thoracic, and abdominal clefts, and in many of the latter cases the viscera are also profoundly modified.

There is no unimpeachable case recorded of true hermaphroditism, that is, where the presence of true sexual glands of both sexes has been satisfactorily established.

Treatment.—Many malformations, especially such as belong to the class of acquired deformities, and others due to minor degrees of imperfect union or imperfect fission, admit of benefit by treatment; but as such treatment is of a purely surgical kind, it does not require to be discussed in the present work.

John Curnow.

MALIGNANT CHOLERA.—A synonym for Asiatic cholera. *See* Cholera, Asiatic; and Micro-Organisms.

MALIGNANT DISEASES. — This term is applied to certain diseases or types of a disease which tend towards a destructive or fatal issue. First, it is applied to such diseases as cancer, which, in our present state of knowledge, inevitably lead to the destruction of life; and, secondly, to certain varieties of fevers and other acute affections, such as typhoid fever, scarlet fever, small-pox, and cholera, which present peculiarly grave and aggravated symptoms, and frequently end in death. *See* Cancer; Heart, Inflammation of: 2. Ulcerative Endocarditis; and Small-pox.

MALIGNANT PUSTULE. — *See* Pustule, Malignant.

MALINGERING.—Malingering, in the sense of an elaborate and carefully planned attempt to deceive the medical man, is not very frequently met with in private practice; and although the simulation of various morbid conditions is a common complication of hysteria, the consideration of this branch of the subject will find its more natural place under the heading of Feigned Diseases. The army or prison surgeon, however, must be on his guard against imposture, and must exercise all his diagnostic skill. For his guidance many elaborate works have been written, and much information collected regarding the nefarious way in which soldiers have often outwitted their medical attendants. In our own country, under the conditions of voluntary and short service, the men seldom attempt to do more than plead the excuse of some slight and temporary ailment to obtain remission from guards or drills. Headaches, rheumatism, colic, diarrhœa, and other affections of a more or less 'subjective' order, are naturally difficult of detection; but the surgeon learns gradually by experience, and seldom fails to acquire a pretty shrewd knowledge of the habitual schemer's somewhat narrow range of imposture; and hence it is that, with all its faults, the regimental system of military practice has always worked well, and enabled a sharp look-out to be kept on the troublesome malingerer, whose ingenuity is so unprofitably expended on attempts to shirk his own duties at the expense of his more industrious comrades. Occasionally, however, when the soldier urgently wishes his discharge, he is induced to lay his plans with greater decision, and to resort either to mutilation or to the imitation of chronic disease, and in Continental armies instances of this sort are comparatively common. To avoid the grievous burden of conscription, an infinite variety of artifices have been employed with greater or less success, and the ample literature of the subject bears amusing record to the ingenuity with which these inventions have been carried out. In dealing, however, with the minor degrees of malingering met with at home, we must be very careful not to be over-suspicious, and not to do injustice to a real sufferer whose symptoms seem somewhat vague and incomprehensible. Numerous cases are on record in which the mystery surrounding a fixed and obstinate pain in the back has been cleared up by the rupture of an abdominal aneurysm; and Dr. Spry records, in the nineteenth volume of the *Pathological Society's Transactions*, a most instructive case in point. A typically healthy trooper of the Second Life Guards presented himself at hospital, complaining of very uncomfortable sensations in the œsophagus and stomach, following the swallowing of a bone. Some suspicion of malingering was entertained at the time; but Dr. Spry, impressed by a certain anxiety of aspect, retained the man under treatment, and three days later death suddenly ensued, and the *post-mortem* examination revealed perforation of the aorta, caused by a small spiculum of beef-bone. Facts like this are abundantly suggestive of caution, and of the happy medium between excessive sharpness and undue credulity, which a wide and intelligently used experience can alone confer. Far better is it for us to be deceived twenty times than for unjust suspicion to be directed to the victim of some painful and depressing disease, whose only fault may consist in his inability to supply a sufficiently clear and convincing scheme of sufferings which may be only too real.

Robert Farquharson.

MALPOSITION OF ORGANS.—*See* Organs, Displacement of.

MALTA.—A warm, rather moist, and very variable winter climate. *See* CLIMATE, Treatment of Disease by.

MALTA FEVER.—SYNON.: Mediterranean Fever; Gastric Remittent, and Bilious Remittent Fever; Rock Fever (Gibraltar); Neapolitan Fever; &c.

DEFINITION.—An endemic disease of long duration, characterised by fever, enlarged spleen, profuse perspiration, constipation; by almost invariable relapses; accompanied by pains of a rheumatic or neuralgic character, and sometimes swelling of joints or orchitis; and characterised in fatal cases by enlargement and softening of the spleen, no swelling or ulceration of Peyer's glands, and the constant occurrence in various organs of a species of micrococcus.

GEOGRAPHICAL DISTRIBUTION.—As far as is known at present this fever is only met with on the shores and islands of the Mediterranean, where it is widely distributed.

ÆTIOLOGY.—Malta fever is probably due to the introduction into the system of a specific micro-organism. This assertion is based upon the following facts: (1) A well-defined species of micrococcus is found in the organs of every fatal case. (2) This micrococcus can be readily cultivated outside the body. (3) Inoculation of a pure cultivation into a monkey caused fever and death after twenty-one days. (4) From the organs of this monkey the identical micrococcus was abundantly obtained. As to how this micrococcus gains entrance to the organism nothing definite is known. There is no evidence that Malta fever is communicated directly from individual to individual. One attack of Malta fever probably confers immunity against a second. *See* MICRO-ORGANISMS.

Age and Sex.—This disease chiefly affects young persons between the ages of ten and thirty; less frequently under ten, and from thirty to fifty; and very rarely above fifty. It does not seem to occur among infants, or if it does it is not recognised. Sex has little influence, but the complaint is more common among men than women.

Station in life.—Malta fever attacks the well-to-do classes, living in large well-ventilated houses, probably in as large a proportion as it does the poor in their more crowded dwellings.

Months and Seasons.—The summer is the season of the greatest prevalence of the disease, and most cases occur in the month of July. A marked diminution takes place in autumn, and it is rare in the winter and spring months.

INCUBATION.—It is impossible to say definitely how long the period of incubation is, but the writer would put it approximately at ten days.

CLINICAL DESCRIPTION.—*Early Symptoms.* For the first week or ten days sleeplessness and headache are complained of, which may be mild or severe; the appetite is absent; there is nausea, sometimes vomiting, and a feeling of weight and tenderness in the epigastric region; constipation is the rule, diarrhœa the exception. The spleen and liver are enlarged, and both may be tender on pressure. Tympanites is uncommon, but may occur, as also may gurgling in the iliac fossa. During this time almost invariably a slight cough with scanty expectoration is developed, and on examination the breathing at the bases is found to be unsatisfactory, harsh and creaking in character, with now and then a moist crepitation. There is no eruption, but the patient suffers from a most profuse perspiration, and a more or less abundant crop of sudamina is developed. There may be a little delirium at night during this time, but this is rare, and is so slight as scarcely to call for remark. Unless there be headache or severe pain in the lumbar region, the patient for the first week or two usually professes that he suffers very little; at the end of this period the headache and acute symptoms usually disappear, and the long and monotonous period of the fever begins, a period which seems interminable alike to medical attendant and patient. The patient's aspect is natural but listless; his tongue is clean; he has a wish for solid food, which must often be denied; and his bowels require the stimulus of an aperient or enema for evacuation.

Later Symptoms.—The profuse perspiration still continues, and day after day the patient becomes weaker and loses weight, until he has scarcely power to stagger a few yards. During this period the temperature often ranges high. The patient sleeps moderately well, has no delirium or restlessness, is uncomplaining, and takes without any ill effect a large supply of fluid food and stimulants. The only 'variation' in his condition is afforded by a rheumatic affection of the joints; one day the knee is found red, swollen, and intensely painful on being touched, a few days afterwards a wrist or ankle may be attacked. Sometimes almost all the large joints in the body are affected in this way, or there may be intercostal neuralgia, sciatica, or an inflamed and swollen testicle. Thus many weeks may pass, but at last the temperature fairly comes down to the normal, and the patient enters on a long and tedious convalescence.

Temperature.—The chief characteristic in regard to the temperature curve in this fever is its irregularity. The type varies from the continued to the intermittent: one case is almost continuous throughout, another almost intermittent; some cases begin with a markedly intermittent type, and pass into the continued, whilst others begin as continued and pass into the intermittent. Some severe cases show a long irregular elevation of temperature, only reaching normal limits about the ninetieth day. The temperature curve, as a rule, runs high, reaching 104°, 105°, and even 106° F.

Duration. — Patients with Malta fever show an average stay in hospital of nearly ninety days. The length of the fever may vary from fifteen days to as many weeks or more.

Diagnosis.—A severe, rapidly fatal case of Malta fever cannot be distinguished from a similar case of typhoid except by *post mortem* examination, when the absence or presence of a specific anatomical lesion in the small intestine at once separates the two kinds. If, as many hold, these fevers are caused by the entrance into the body of specific micro-organisms, then it is evident that the most rational and scientific method of classifying them would be by the identification of the parasite peculiar to each. In all cases of Malta fever there is found a minute round or oval bacterium — the specific micrococcus; whereas in typhoid there is found a much larger rod-shaped micro-organism—the typhoid bacillus. Ordinary cases of Malta fever can be distinguished from typhoid by their long duration, the tendency to constipation, the absence of a specific eruption, and the much smaller rate of mortality, which does not exceed 2 per cent.

Treatment.—This is a specific fever, and no drug at present known has any power of modifying its course. The sulphate and salicylate of quinine, Warburg's tincture, eucalyptus, calomel, salicylic acid or the salicylates, carbolic acid, and other drugs have been tried again and again for this purpose, but without any good result. Medicinal treatment must therefore be directed to mitigate severe symptoms. At the beginning of the fever phenazone is often found useful to combat severe headache and sleeplessness. For the constipation a mild aperient or simple enema will very often prove necessary. For the neuralgic and articular pains, hypodermic injection of morphine, and the liniments of aconite, opium, and belladonna will be prescribed. Treatment must therefore be principally directed to keeping up the patient's strength by judicious dieting, and, when required, by stimulants, and by attention to ordinary hygienic principles. Removal of the patient from the affected area does not cut short the course of the fever; but, as in many other diseases, complete restoration to health will certainly be hastened by change of climate. David Bruce.

MAMMARY GLAND, Diseases of. *See* Breast, Diseases of.

MANIA (*μανία*, fury, madness).—Synon.: Fr. *Manie Suraiguë*; *Délire Aiguë*; *Fureur*; Ger. *Tobsucht*; *Wuth.*

Under the term 'mania' very distinct disorders or degrees of disorder have been described, which we shall speak of as *Acute Delirious Mania*; *Acute Mania*; and *Mania.*

I. **Acute Delirious Mania.**—Acute delirious mania, or maniacal delirium—whichever we prefer to call it—is something quite distinct from that ordinarily known as acute mania. The symptoms are much graver, the course is briefer and more defined, and the treatment of the one would be quite inappropriate to the other. An outburst of delirious mania may take place after very few and very short premonitory symptoms. Quite suddenly, after a few days or even hours, the patient will display the most violent excitement, which may as suddenly subside, or run a well-marked course of a few weeks; and if it does not terminate fatally, will gradually decline, recovery usually taking place. Such an attack may have its origin in some sudden mental shock, as the death of a friend, a violent quarrel, a disappointment or suddenly announced misfortune; or it may arise in the course or decline of an acute disease, as pneumonia or measles. It may also come on during rheumatism, or after great fatigue, an epileptic seizure, or child-birth.

We cannot tell at first whether the attack will be transient or prolonged. We may try to cut it short by a brisk purgative, and by such medicines as chloral and bromide of potassium, a subcutaneous injection of hydrobromate of hyoscine, or a full dose of sulphonal, and these not infrequently answer the purpose. Sleep is procured, and perfect recovery may take place in a few days. There are patients whose organisation is so unstable that it is thrown off its balance by a cause perhaps trifling, but which produces a tremendous nerve-discharge and complete disturbance of the whole mental functions. But so transient may this be, that one sleep restores the normal equilibrium, and the patient is cured. This condition in females is often called hysterical—*hysterical mania.* There is no special connexion between it and the uterine functions, and it is better to retain the name 'hysterical mania' for a variety to which it may be more appropriately given.

The delirium, however, does not always terminate quickly. If sleep becomes less and less, the mind more and more confused, and quiet and lucid intervals rarer, we may be sure that the attack will be serious and prolonged, and that careful and efficient nursing for some time will be necessary. Where a quiet and airy room can be provided, and a patient's means are sufficient to allow him an adequate staff of attendants, an asylum is not indispensable. He will not require to take exercise in a garden; he will not be dangerous, as some are, to himself or others, though he may be violent and excited. He may be noisy, however, and so not able to remain unless the house is detached. The room should be lofty and cool, the windows protected and darkened; all furniture must be removed, and the bed made on mattresses placed on the floor, for he will not lie on a bedstead, and attempts to keep him there will end in bruises or more serious injury. Clothes will be torn off; but if the weather is very hot, as is so often the case during these attacks, this will be of little consequence. If it is cold, a strong suit laced up the back may be put on, and underneath it the requisite body-clothes; or a blanket may be placed round the patient, and fastened up the back.

These patients are in incessant motion, singing, shouting, and talking in a string of incoherent utterances, often repeating the same sentence again and again, or a snatch of a song or text, or a rhyme of their own composition. As a rule they are not violent, and do not attack those about them, though they may resist that which is done for them. They may be hilarious and full of glee and mischief, which is a good sign; or terror-stricken, with visions of horrible objects, which is unfavourable. They are wet and dirty; and the urine will be high-coloured, and often retained for a long period. We shall derive valuable information if we are able to take the temperature; but often that is a difficult task. A high temperature is a bad sign; and so is a rapid pulse, if it continues persistently when the patient has not been using violent exertion for some time. The tongue will often become thickly coated, dry, and brown. If it does not, but remains moist and comparatively clean, this is of good omen.

Prognosis.—The prognosis in these cases is upon the whole favourable. The terminations are almost always either recovery or death. The patients are mostly young persons, who recover unless weakened by previous attacks, other disease, or child-birth. Many of the fatal cases, in the writer's experience, have been complicated by tuberculosis.

Treatment. — Sleep in the attacks now under consideration is generally absent, sometimes for many days. Women can last longer without sleep than men, and die much less frequently in acute delirium. If sleep does not come the patient dies, and our great effort must be to promote sleep by various methods. The first question will be whether we are to give drugs to accomplish this; and, if so, what drugs? Opium must not be given; it will not procure sleep, whether given by the mouth or subcutaneously. It may produce a slight narcotism for half-an-hour or so, and, if we increase the dose, will cause narcotic poisoning and death; but in the height of the attack it will not procure sleep. Chloral we may try in combination with bromide of potassium, giving half-drachm doses of each, and watching the effect. In most cases, sleep of longer or shorter duration will be caused by these drugs; and although it may be short, it may be sufficient to save the patient's life, and enable him to battle successfully with the disorder. In the writer's experience, many more of these acutely delirious patients died before the introduction of chloral than since. Yet it must not be given in enormous or repeated doses, and a considerable interval should elapse between them. It may be administered easily in stout or ale, and often in wine. We may also give sulphonal, or that powerful but somewhat dangerous drug, hyoscine. Such drugs as these are not to be administered frequently, or at regular intervals. We wish to procure sleep enough to prevent the patient from dying by exhaustion; but in this very acute form no medicine is likely to produce more than a short sleep, and is more likely to do this if not given too frequently, and less likely to produce bad effects.

Next to sleep, the most important matter is food. To enable the sufferer to withstand the exhaustion, which is the cause of death when a case ends fatally, he must be fed frequently and liberally. These patients rarely refuse food, but require careful coaxing and feeding; and a skilful attendant will give something every two or three hours — minced meat and vegetables, or bread and milk, beef-tea, eggs, and the like. Brandy often produces great excitement at the onset and height of an attack, and stout or ale is more suitable, and more likely to bring about sleep. We may give also plenty of lemonade, barley-water, and such drinks, if there be great heat and thirst.

Although this unconscious or semi-conscious delirium may continue for many days, yet in almost every case the violence and excitement are paroxysmal, with intervals of comparative calm, even if there be no sleep. Judicious attendants will avail themselves of these quiet intervals to administer food, and keep the patient in the recumbent posture, thus ensuring rest, instead of letting him be continually on his legs wandering about the room, and so exhausting his strength. And when held down quietly, with cold cloths applied to the head, or his face fanned by the nurse, he is not unlikely to drop off to sleep.

Can sleep be procured by other means? The French have advocated prolonged hot baths, but they are attended with considerable danger. We may try a bath of half-an-hour at 90° or 92°, allowing it to become cooler, but it is of no use attempting this unless the patient submits to it without a desperate struggle. Cold to the head may be applied, because it is soothing and grateful to the sufferer, though it is a question whether the circulation in the brain is much affected thereby.

The bowels may be kept open by a dose of calomel administered in the food, or half-a-grain of podophyllin. Active purgation is inadmissible except at the very outset, and enemata cannot easily be given in the violent stages. It used to be the fashion to apply blisters to the nape of the neck or calves. This is most unadvisable, for such parts may become very sore, owing to the restlessness of the patient, and thus deprive him of sleep. Neither is it necessary to cut all the hair off, which in the case of a lady may be a very grievous matter. If very long, it may be shortened without being cut close to the head.

II. **Acute Mania.**—Quite different from the unconscious raving of maniacal delirium is the conscious but violent excitement to which we give the name of *acute mania.* The former is a disorder dangerous to life, running a rapid course to death or amendment in a week or two. The latter may go on for weeks or months with little danger to life, but with excitement so troublesome that the sufferers require the restraint and discipline of an asylum. Though most insane, full of delusions and outrageous habits of every kind, they know what they are about, and are all the more mischievous in consequence. They can take every advantage of an opportunity, and know how to exasperate those about them. They generally eat well, and sleep indifferently, but sufficiently to support life; and their bodily health often remains wonderfully good considering what they go through. They will destroy clothes, windows, bedding, and deny or justify all they have done. The termination is not usually fatal, unless the health gives way through some other disease. The patients generally recover gradually, or sink into chronic mania or dementia.

Prognosis.—The prognosis in cases of acute mania will depend upon circumstances. (1) The number and duration of the attacks are important. In a first attack the prognosis is favourable. If recent, we may have hopes, even if there have been preceding attacks of a like character. (2) If the patient is not of advanced age or of broken health, the prognosis is favourable. (3) If the mania consists of violent, turbulent conduct, rather than of fixed delusions, as is frequently the case, there is more hope. If the patient hears voices, the prognosis is bad. If there are delusions which impel him to refuse food, and he does so persistently and violently, it may be difficult to give sufficient nourishment, and he may sink from exhaustion, or become a chronic maniac.

Treatment.—Patients suffering from this form of mania do not require, like the last, to be kept in one room; on the contrary, they should take plenty of exercise in the open air. This will promote sleep more than drugs, though we may give an occasional dose of chloral hydrate, or bromide of potassium, or the latter with chloral hydrate or with Indian hemp. Such medicines, however, should be given only to procure sleep, not to allay excitement; we may also try sulphonal or hyoscine. In many cases, however, sleep procured by drugs appears to prolong the attack, and, where there is no danger to life, it is better to omit them, and to let natural sleep come after the fatigue of exercise. Plenty of food is required, for the waste is great.

Patients of this kind are not to be cured or even kept without discipline and moral treatment; and great tact, firmness, and patience are required for their management. They may be very dangerous and spiteful, will know how to provoke attendants, and how to take them unawares if off their guard. Moral treatment will be far more efficacious than drugs, but it can only be carried out in an asylum. Patients in this condition, if kept in private houses, must be rendered quiet by drugs; but there is great fear lest by this method the disease, instead of being cured, may be converted into a chronic and incurable mania.

III. **Mania.**—A great variety of cases are grouped under this name, arising from various causes, but alike in the fact that they are marked by excitement rather than depression, by exaltation or wrath, but not by gloom. Excitement and noisy and irrational conduct characterise some, but most patients present delusions coinciding with their temper and bodily condition when in health. Almost always this form of insanity is marked by delusions, if it lasts long enough; but sometimes a short burst of excitement—a transitory mania—may pass away without the stage of delusion being reached.

The diagnosis of an ordinary case of mania is not difficult. The prognosis must depend on the cause; the age of the patient; the character of the delusions, if there be any; the occurrence or non-occurrence of previous attacks, and their history. Attacks of mania are frequently recurrent, and may be repeated again and again through a long life; recovery may take place on each occasion, or the disorder may at last turn into chronic mania or dementia. The period of excitement in many cases is followed by one of depression, and these may alternate with great regularity for twenty or thirty years; and even when the patient is sunk into hopeless dementia the period of excitement may occur as regularly as before the mental powers had given way.

Treatment.—Of the treatment of these cases a great deal cannot be said. The majority will require the care and vigilance to be found in an asylum, at any rate during the excited stage. The intervening or rational period will often be prolonged advantageously by removal from the asylum; and when this is the case there will be frequently found less reluctance to return to it when the necessity arises, and instances are not uncommon of patients even themselves seeking its shelter.

G. F. Blandford.

MANIPULATION (*manus*, the hand). A mode of investigating and also of treating diseases by the use of the hands. *See* Physical Examination; Friction; Massage; and Shampooing.

MANITOU SPRINGS, in Colorado, is famous for its mineral springs and as a high-altitude station, being situate 6,370 feet above sea-level, in a sheltered valley of the Rocky Mountains at the foot of Pike's Peak. The climate is that of Colorado Springs, six miles distant (*see* Colorado Springs), and the mineral springs consist of: (1) alkaline and saline, useful in kidney and liver affections; and (2) chalybeate alkali (the iron ute), of repute in uterine disease. The climate has been found valuable in the treatment of chronic phthisis. The neighbourhood of the great tracts of Manitou and Estes Parks, 1,000 to 1,200 feet higher than Manitou Springs, being available for camping-out, is an additional attraction.

MARASMUS (μαραίνω, I grow lean).—A synonym for general wasting. *See* Atrophy, General.

MARIENBAD, in Bohemia.—Alkaline sulphated waters and mud baths. *See* Mineral Waters.

MARSH FEVER.—A synonym for intermittent fever. *See* Intermittent Fever.

MASKED.—A synonym for larvated. *See* Larvated.

MASSAGE.—Synon.: Medical Rubbing; Mechanotherapy; Fr. *Massage*; Ger. *Massiren.*

Definition.—A series of mechanical movements, best executed by the hands of the operator, affecting not only the skin, but also the deeper structures of the body.

Modes of Action.—Massage acts in the following ways: (*a*) it quickens the flow of the fluids (blood, lymph, chyle, and others); (*b*) it increases secretion and excretion; (*c*) it excites muscular action.

Methods.—The movements in massage are of several kinds: (1) Stroking, or *effleurage*; (2) Pressure, or *pétrissage*; (3) Percussion, or *tapotement*; (4) Vibrations; (5) Passive movements; (6) Active or Swedish movements; (7) Medical gymnastics.

Stroking is performed by lightly drawing the hand in one direction over the surface of the part: on the head from the vertex, and on the spine from the neck, downwards; on the limbs, from the extremities towards the trunk. When *friction* is employed, greater pressure is made, and the hand is moved to and fro.

Pressure (squeezing, kneading, rolling, &c.). The pressure and relaxation should be alternate and rhythmical, simulating natural muscular action. During the pressure the veins, capillaries, lymphatic ducts, and lymph spaces are emptied; and the valves in the vessels preventing the return of the expelled fluids, room is made for a fresh supply.

Percussion (tapping, beating, pounding, and others) causes muscular contraction.

Vibrations act in a similar manner.

Passive movements.—All the normal movements of the joints are fully executed by the operator, the will of the patient being in abeyance. The synovia is increased, if scanty—absorbed, if in excess; deposits around the joints are removed, and nutrition is promoted.

Active or *Swedish movements* are performed with the combined help of the patient and operator. The will of the patient is concentrated on the muscles under treatment. The patient is directed to cause a muscle to act, and the operator resists the movement, employing slightly less force. When the muscle has fully contracted, the operator employs more force, whilst the patient, diminishing but not ceasing his resistance, allows the part to be brought back to its original position. This is repeated a suitable number of times, but never so as to cause muscular exhaustion.

Medical gymnastics have for their object the bringing into action those muscles which are seldom employed, or which, for some special reason, require strengthening.

Uses.—The maladies, both medical and surgical, for which these therapeutic agents have been employed with success are very numerous. It must suffice to mention the following: Muscular weakness and wasting; infantile paralysis; Bell's palsy; lead palsy; neurasthenia; neuralgias; sciatica; peripheral neuritis; anæsthesia; hyperæsthesia; chorea; hysteria; occupation palsies; some forms of arthritic disease, as rheumatoid arthritis and chronic rheumatism; and the morphine habit.

John Fletcher Little.

MASTALGIA
MASTODYNIA } (μαστός, the breast; and ἄλγος, or ὀδύνη, pain).—Pain in the mammary gland. *See* Breast, Diseases of.

MASTICATION, Disorders of.—In the mouth the food is submitted to the action of the jaws, carrying the teeth; is moved about by the tongue; and is kept between the teeth by the lips, cheeks, and tongue. The muscles which perform the complicated and nicely adjusted movements of mastication are supplied by the third division of the trifacial, the facial, and the hypoglossal nerves. These movements are essentially voluntary, the stimuli which determine them being central in origin, and passing to the muscles by the above-mentioned nerves; but, at the same time, the mere contact of the buccal mucous membrane with food aids in determining the movements, afferent impressions travelling to the brain by the fifth pair of nerves.

Mastication is liable to be disordered from various causes.

1. *Muscular Paralysis.*—Imperfect performance of mastication is frequently the result of cerebral lesions, such as hæmorrhage or tumours. Dependent on the seat and extent of these will be the extent of the paralysis, which may vary from an impaired movement of one cheek, thus permitting the food to collect between it and the gum, to almost an absolute inability to move the lower jaw from side to side, or to close the mouth.

There are several special forms of paralysis in which the movements of mastication are affected, either alone or in common with other muscles of the body.

(*a*) *Labio-glosso-laryngeal paralysis* is especially characterised by the impairment of mastication and deglutition, which progresses from a mere escape of saliva, due to paralysis of the orbicularis oris, to complete inability to perform either act. Of the masticatory muscles, it is those of the tongue and lips which are mainly affected. As the disease progresses to its invariably fatal end, the palsy increases in completeness.

(*b*) The loss of power in the muscles of mastication associated with *diphtheria*, is far less frequent than paralysis of deglutition, and is usually limited to some weakness of the tongue, and less often of the lips and cheeks.

2. *Muscular Spasm.*—Trismus, or tonic spasm of the muscles of mastication supplied by the motor branch of the fifth nerve, is rarely unilateral. The jaws are usually completely locked, and incapable of separation, thus rendering mastication impossible. The trismus may be a part of a general condition of tetanus, or may be the sole indication of spasm; and in the latter case is usually reflex in origin, being determined by such causes as dental irritation, or facial neuralgia, or, more rarely, by distant wounds or intestinal worms.

Irregular clonic spasms of the muscles of the jaws, such as are frequently seen in epilepsy and hysteria, and are evidenced by chattering and grinding of the teeth, will offer some difficulty to the proper performance of mastication.

Spasm, whether tonic or clonic, when limited to the facial muscles supplied by the seventh pair, will interfere but slightly with mastication. By preventing the action of the lips and cheeks, the food will not be so easily kept between the teeth, and the saliva will dribble from the unclosed mouth. Nor are the impulsive spasmodic movements of the tongue, as seen in chorea, important as impairing the proper mastication of the food.

3. *Affections of the Temporo-maxillary Articulation.*—Chronic arthritis may lead to such serious disorganisation of the joint as to impair its movements, ankylosis occasionally occurring.

4. *Morbid Conditions of the Mouth.*—Inflammation of the mouth or tongue, and disorders of the teeth, render mastication difficult. Enlargements of the salivary or lymphatic glands, tumours of the thyroid body, epulis, and new-growths of the tongue, as well as abnormal apertures in the palate, floor of the mouth, or cheeks, caused by ulceration or noma, may interfere with mastication.

Effects.—Portions of food imperfectly masticated may produce suffocation, by blocking up the entrance of the glottis, or lodging in the gullet. Imperfectly masticated food, when swallowed, is a well-recognised cause of dyspepsia.

Treatment.—The treatment of disorders of mastication naturally consists in the removal of their cause, when possible. The reader is referred to the articles in which the several conditions are fully discussed.

W. H. Allchin.

MASTURBATION (*manus*, the hand; and *stupro*, I ravish).—Synon.: Fr. *Masturbation*; Ger. *Selbstbefleckung*.

Definition.—The excitement of the sexual organs by unnatural means.

Ætiology.—Masturbation is practised under a variety of circumstances. First, in infants and young children, local irritation situated beneath the prepuce in males, or within the vulva in females, leads to manipulation of the parts, and to consequent pleasurable excitement, which is constantly renewed, with an entire unconsciousness of the meaning of the practice. As an instance, the writer was consulted by a mother about the extreme delicacy of her boy, then little over four years of age. No tangible disease being evident, the little fellow was stripped, with the view to a more complete examination. Whilst this was being made, the child was seen to rub his penis with the hand in the most careless manner, causing thereby an erection—an observation which explained the cause of the ill-health.

The second class includes individuals who have reached or are near the age of puberty, and have either accidentally learned, or been taught, this pernicious habit. *Balanitis* is a frequent exciting cause. *Pruritus vulvæ*, due to diabetes or other causes, may lead to it in the female.

A third class of cases may be mentioned, in which the practice has a central origin, in certain forms of brain-disease or cerebral deficiency, as is seen in some forms of insanity and in idiocy.

Effects and Symptoms.—There is no doubt that the excitement incident to the habitual and frequent indulgence in the unnatural practice of masturbation leads to the most serious constitutional effects. These effects are more especially manifested in the nervous system, the functions of which are perverted. The mental faculties become more or less affected; and often great despondency, loss of memory, irritability, prostration of strength, headache, and neuralgic pains ensue. Facial acne is a common symptom. Anæmia, accompanied by the habit of blushing, occurs; and the functions of the heart are disturbed. Digestion is disordered. There is general loss of health and strength; and chronic hypochondriacal invalidism, if not worse, is set up. In certain cases the urinary organs are affected; and the writer has observed in several instances the presence of albumen in the urine, which would seem to be the result of some reflex action on the nerves and vessels of the kidney. The effects on the male genital organs themselves are marked. There is extreme irritability of the neck of the bladder and adjoining parts, accompanied by discharge of mucus and of prostatic secretion, often mistaken for semen. At the same time seminal emissions are prone to occur on the least sexual excitement, either by day or during sleep; and in extreme cases there is impotence. In the female the natural feelings are often lost.

Diagnosis.—In many cases of masturbation in young men the diagnosis is sufficiently easy; for such persons, alarmed by reading the advertisements and books written specially to excite feelings of shame and fear, and to bring the subjects of them within the nets spread abroad by quacks, are sufficiently ready to declare the cause of their distress. In other cases, in which the practice is concealed from fear of the consequences, or from innocent unconsciousness of its nature—and this is more especially the case in females—the diagnosis is often very difficult. When, however, the symptoms just described are present, in the absence of any cause to account for them the practitioner may entertain a reasonable suspicion of the existence of this habit, although it may be difficult in many cases to carry his impression beyond the suspicion.

Treatment.—In the first class of cases above mentioned—that is, in very young persons, in whom some local irritation exists—the source of this irritation must be found and removed. Sometimes it may be an elongated prepuce, with irritating matter beneath it; in such cases circumcision may be required. In females cleanliness and simple lotions may suffice; or irritation, caused by the wandering of thread-worms, or in other ways, may require to be treated. In these cases attention to the general health, to the state of the digestion, to the urinary secretion, and to the bowels, should not be neglected. Diabetes must be treated if present. Extreme watchfulness by the nurse is necessary, and at night it may be even necessary to secure the hands by muffling or tying them behind the back.

In young adults the moral sense must be acted upon. It has been suggested, by way of prevention, that judicious and kind advice may with advantage be given before even a knowledge of the habit is acquired; whilst too much vigilance cannot be exercised by those who direct and assist in the management of schools.

In the actual treatment of the effects established by masturbation, it is of the highest importance to improve the health, both mentally and bodily. Early rising, healthful exercise, careful diet, and travel if practicable, should be recommended. Remedies directed to the treatment of symptoms connected with the nervous, circulatory, and digestive systems will be required. Of course the habit must be entirely stopped, and all thoughts of a loose or libidinous character must be avoided. The bromides, especially the bromides of potassium and ammonium, are very useful for lessening sexual excitability; and, in the case of females, these may be more especially needed at the close of, or just after, the catamenial periods. In certain cases where these remedies, together with steel, and other appropriate drugs, have failed to diminish the frequency of the seminal emissions which are common in males, caustics may be applied to the neck of the bladder. *See* Spermatorrhœa.

MATLOCK, in Derbyshire.—Thermal waters. *See* Mineral Waters.

MAW-WORMS.—A synonym for thread-worms. *See* Entozoa.

MEASLES.—Synon.: *Morbilli*; *Rubeola*; Fr. *Rougeole*; Ger. *Masern*.

Definition.—An infectious specific fever, with an eruption, on the fourth day after catarrhal symptoms, of a deep-red spotted rash; this is at first slightly raised, and is distributed in crescentic groups, which soon extend over all parts of the surface; it persists as a general mottling after the subsidence of the fever, and where intense may cause a fine desquamation. The disease prevails as an epidemic, and spreads by direct infection. It very rarely attacks the same person more than once.

Ætiology.—Contagion is the cause of measles wherever it is now met with. In large towns, where sources of infection always exist, epidemics recur about every four years, chiefly among children, as fresh series of the susceptible become exposed. Few adults suffer; most of them having been attacked in childhood. Among scattered populations long periods may elapse without infection reaching them; when it does, neither age nor sex influences directly either the liability to attacks, or their severity.

The contagium of measles, except in the catarrhal stage, is not far diffusible in the air, but clings to surfaces, and may so be carried from place to place. Children with full eruption have been brought into a house among others, and nursed in a room apart, without any extension of the disease even to the most susceptible. When young infants are said to escape infection, it is where the family is small, and they are less exposed.

Measles in a school or family is sure to spread; the catarrhal stage, infectious throughout, is mistaken for a common cold, and no timely separation is attempted. The cough is an important means of conveying infection at this time.

The period of incubation is ten to twelve days, rarely a day or two more. During the latent stage of this long incubation, those who have been exposed to infection are thought to have escaped, and are sent to begin the same round elsewhere. The disease may be conveyed by *fomites.* Infection begins before the rash appears, and the contagium may be given off by the third day, most probably during the greater part of the period of incubation.

Contagium. — The contagium principle, developed only in the bodies of the sick, is found during the height of the disease in the tissues, the secretions, the blood, and the breath. Inoculation at this stage either with the blood or serum, by Home, Cullen, and others, reproduced measles without modification; the primary fever then appearing on the seventh day, and the eruption on the ninth and tenth. Mayr, of Leipzig, twice conveyed the disease by means of nasal mucus. Catarrh began on the eighth and ninth days; rash on the tenth and eleventh. A big dog after licking the hands and face of a child ill with measles had coryza a week after, and died in the following week with fever and bronchitis; spots of measles-like congestion were found in the pharynx and trachea, with engorgement of the lymphatic glands. After an attack of measles personal infection is mostly over in a month; it may persist longer, or be conveyed somehow by convalescents for another month. Infection may linger long in closed rooms, or cling to bedding and articles of clothing unless stoved; such disinfection lessens the fatality among further cases of measles, as well as the spread of the disease. After two years of age the mortality is not greater for children in proportion to the numbers attacked than at other periods of life; and there is some advantage in contracting this disease at a time when careful nursing and individual attention can be secured. Those who escape measles during childhood are very likely to be seized on taking their place in mixed communities.

Anatomical Characters. — The mucous membrane of the larynx and trachea is always red in measles, often with punctiform congeries of vessels; and not infrequently thin films of lymph are found loosely adherent. In fatal cases the bronchi are congested, sometimes with exudation on the lining membrane, more frequently covered with muco-pus, or plugged with catarrhal mucus; capillary bronchitis with broncho-pneumonia is frequent. Lobar pneumonia, if extending to the surface, is accompanied by pleurisy, often limited to the part of the lung affected. Fluid may be found effused into the pleura and pericardium. Petechiæ are often found on the pleural surfaces. Any inflammatory signs in the serous membranes, cardiac or articular, are rare. All the internal organs are congested, and show hæmorrhagic spots. The cranial sinuses are full; there is hyperæmia of the meninges and brain-substance, and increased fluid in the ventricles and subarachnoid space; more rarely recent lymph is seen on the surface of the hemispheres; deposits at the base belong to later consequences of the disease. Congestion of the digestive tract is most marked near the ileum and colon: externally the distended veins of the submucous coat are seen; internally there is deep redness of the surface, the solitary glands are distended and elevated, the agminated to a less degree, but there is little or no enlargement of the mesenteric glands. The follicles of Lieberkühn and the tubular glands of the large intestine are more distinct than usual. A chronic ileo-colitis may result. The liver is mottled; both the portal and hepatic veins are full; and the lobules are ill-defined and granular in appearance, with fatty particles interspersed. The bronchial glands are often enlarged, and sometimes softened; suppuration from them extended up behind the œsophagus in one instance. The lymphatic glands of the neck are always congested and enlarged, and often those elsewhere, as in the axilla or groin. The spleen is swollen and friable; or very little altered. The kidneys show no distinctive changes; they are hyperæmic in the earlier stages of the disease, and the tubules may then be full of epithelium and cell *débris.* The degree of after-congestion depends much on the degree of pulmonary obstruction, or on early exposure to cold or fatigue; no albumen or casts of renal tubes are found in the urine, unless a secondary nephritis have been thus occasioned.

Symptoms. — The symptoms of measles seldom occur until eight days after exposure to infection. They may begin suddenly, with high fever, aching pains, and vomiting, the initial fever subsiding next day, but not completely, when there may be little feeling of illness, but some signs of coryza, cough and sneezing, with enlargement of the lymphatic glands in the neck. On the third day the coryza is more marked, the cough often very troublesome, and the fever increased.

Some few spots of eruption are now visible on the forehead and sides of the face. The conjunctivæ are injected, the tonsils full and smooth, the soft palate mottled, the tongue furred, the pulse quickened. On the fourth day the eruption appears more fully, with rapid pulse and sudden elevation of temperature, often to 104° by night, with delirium. On the fifth day, with full rash, there is marked alleviation of all the symptoms: the cough is quiet, unless lung-mischief mark the crisis; the pulse is less full and frequent; the tongue cleans; and the temperature, already fallen by 3° or even 4°, often reaches the normal by the sixth day, leaving the skin still deeply stained by the fading rash, and the patient weak. During the next week or ten days there is a tendency, not only to depression, but to sudden rises of temperature, with various complications that retard or endanger convalescence. We notice three stages—the *ingress*; the *eruption*; and the *decline*.

The Ingress.—The ingress of measles is not always with marked initial fever. Coryza and spots of the rash may be observed before illness is complained of, though some elevation of temperature can be traced for three days before the full eruption. This febrile movement has been preceded in some cases, where thermometric observations were made throughout the period of incubation, by a well-marked depression before the initial fever, and then vomiting or headache, vertigo, chorea, eclampsia, and other irregular symptoms may occur. Often some slight disturbances of health, and even cough, have been observed all through the incubation-period; sometimes an intercurrent disease has delayed the regular march of the invasion to seven or eight days, or the latent stage has been prolonged to ten or twelve days, or these days may be febrile from a concurrent influenza or herpetic catarrh. The infection of influenza, received after that of measles, in one case delayed the invasion by ten days. The eruptive fever always occupies four days. As this approaches the crisis, many symptoms are aggravated. Incessant cough occurs, often in children with croup of the catarrhal kind; bronchial irritation with *râles* and rhonchal fremitus, or possibly submucous rhonchus, may be heard at the pulmonary bases; the respirations, hurried and shallow, are 30 to 40 in the minute; the pulse is quickened to 130 or 140. Both the respiration and the pulse, especially the former, are more accelerated in young children; and with them convulsions may at this period retard the eruption or prove fatal. Death before the rash is thrown out, though rare, has also happened in adults. The urine is scanty, yellow or dark-coloured, and deposits lithates; at the crisis it has been suppressed for forty-eight hours. Abdominal pain or diarrhœa often occurs at this time, and the latter may become a serious symptom. Thirst is great; the lips are dry; the tongue is moist, with red papillæ showing through a thick white fur. The palate and fauces are red, from many punctiform congeries of vessels. The deep injection and swelling of the pharynx may extend to the Eustachian orifices, and cause deafness. Deglutition is painful, and sometimes difficult, from the imperfect closing of the turgid epiglottis, as well as from fulness of the tonsils. With these throat-symptoms, the gland at the angle of the jaw is somewhat enlarged and tender; but there is not much swelling or œdema of the overlying integument. The lymphatic glands of the neck are palpably enlarged before there is much or any rash on the skin, those of the axilla and groin afterwards. Epistaxis is not rare. The eyelids are swollen, the conjunctiva being inflamed and purulent; intolerance of light is complained of; and there is risk of the eye being permanently injured. The nocturnal delirium and most of the urgent symptoms abate when the eruption of measles is completely out.

The Rash.—The rash of measles first shows itself on the face or shoulders, in distinct red spots, in circular groups or much scattered; fresh spots soon show in the clear skin. They begin as red points, which are raised, and feel rough or 'shotty,' especially on the face, and early in the eruption; they then form crescentic groups, which coalesce into patches of irregular outline on the body. The face, soon disfigured by the swelling, is first covered; then the neck and chest. The rash is also well-marked in the scapular region, extending to the rest of the trunk and to the extremities on the second day, becoming more sparse as it descends. A peculiar and offensive odour from the sick is recognisable during the whole eruptive period. The rash declines in the order of its invasion. Within twenty-four hours the swelling of the face subsides; the red spots, no longer raised, become pale under pressure, and leave a yellowish discoloration, or on the shoulders marks of a dusky red. Considerable irritation attends the rash, continuing with it to the third day or longer. At this time fine desquamation is noticed on the face; small scales of cuticle are detached from the top of the enlarged papillæ, so that most of the surface is furfuraceous; this disappears with the irritation by the second week, or may persist a week longer; it does not occur when the eruption has been slight, hardly ever on the fingers and feet, and never in large shreds. A coppery, mottled discoloration remains on the more vascular parts of the skin, or where the rash has been most marked, for eight or ten days, and sometimes continues visible three weeks from the commencement of the illness. The eruption may begin on other parts of the body than the face, as at the seat of any injury to the skin. The disease may run its course safely with very little, possibly without any, eruption. An imperfectly developed dusky or livid rash is met with in severe cases; a full rash may recede on serious lung-complication. Petechial specks may accompany a moderate eruption, or hæmorrhagic spots complicate the irregular forms. Some of the earlier spots may not only be raised and acuminate, but minutely vesicular at their apices. In the dark races the eruption is yellowish, raised above, but somewhat lighter in colour than the surrounding integument; in the mulatto it varies from a yellowish to a dusky brown; but all other signs of the eruptive period are well marked.

The Decline. Complications and Sequelæ. The pulmonary lesions of the febrile stage, capillary bronchitis or broncho-pneumonia, may delay defervescence, or rapidly prove fatal. With moderate lung-mischief the fall of temperature following the rash is often very marked; and, with extreme depression, further congestion of the lung may occur. The liability to depression of temperature which follows many acute fevers is specially marked in this one, and requires to be guarded against. A tendency to sudden elevations of temperature is also noticeable for ten or twelve days after the eruptive fever subsides; rarely this has been accompanied by a recrudescence and reappearance of the rash: a true relapse is hardly known. The common accidents of this period are—first, a return of cough in children; this may be croupy, beginning the very day of the first decline of temperature. The temperature again rises suddenly, perhaps to 103°, with greatly excited pulse and respiration. Next day there is tracheal rhonchus, but no increased size of the cervical glands. The cough then becomes looser, and thin shreds of false membrane are expelled. This form of membranous croup is as common from three to six days after the rash, as catarrhal croup is the day before the rash. It rarely attacks more than one child in a family; this is sometimes the same child who had laryngeal symptoms in the catarrhal period. In some epidemics laryngitis and subsequent hoarseness have often followed. More frequently a return of cough, or of short hurried breathing, indicates the commencement of bronchitis or of broncho-pneumonia. The air-passages are left in a specially irritable state after measles, so that the chest must always be looked to. The eyelids also need care. Otitis may cause a high temperature of short duration. Three or four febrile interruptions may happen in a single convalescence. Serious complications, not attended with much temperature-disturbance, are found in diarrhœa, dysentery, and passive hæmorrhages. Enteritis, with diarrhœa and dysentery, is as fatal and frequent a complication of this disease in hot climates as are pulmonary affections with us. In convalescence, after a critical increase of urine, the kidneys act more freely; if during pulmonary obstruction the chlorides were diminished, they now reappear, the excretion of urea is increased, and uric acid may be eliminated in excess. Albuminuria, unless determined by extreme neglect and exposure, is not often a consequence of measles.

Impairment of health results as often from this as from any other specific fever. Nerve-waste may lead to imbecility and dementia. Acute tuberculosis is started, or tubercular deposits begin after measles. The strumous diathesis is evoked, and may set up a troublesome ophthalmia, with danger to the cornea; or a fatal ulcerative stomatitis. Abrasions of the nares or lips may persist or extend, eczema or ecthyma appear, and glandular enlargements increase or become chronic. Even in the robust acute pulmonary disease is readily induced by exposure or want of care during convalescence; a liability to this, to pustular eruptions, and for three weeks to irregular febrile disturbance, may be noted. It has happened that some nervous disorders, such as chorea, epilepsy, or mania, have been arrested during an attack of measles, and with permanent benefit. Measles not infrequently co-exists with mumps and with whooping-cough, more rarely with varicella and vaccinia. Either of these, taken with measles, is delayed or interrupted, resuming its course when the eruption of measles is over. Whooping-cough, established beforehand, is temporarily interrupted by an attack of measles. Scarlet fever may complicate measles; also erysipelas; or measles may be contracted in the course of typhoid fever. Diphtheria is not so frequent a complication of measles as it is of scarlet fever. After any of these diseases the liability to suffer infection from the others seems to be increased. The exemption from a second attack of measles is not universal, but the exceptions to the rule are so few as to be rarely observed. Some persons protected by a previous attack have had catarrh, with transient rash, while in attendance upon children with measles. In two instances observed by the writer, at intervals of fifteen and twenty-five years respectively from the primary attack, the rash was preceded by the usual catarrhal fever, and was but slightly, if at all, modified. Out of numberless mistaken cases, no others have come under his notice. An allied form of rubeola (*sine catarrho*), essentially distinct, is commonly mistaken for measles; hence the belief in second measles.

Mortality.—The fatality of measles is increased by extremes of heat in hot countries and seasons, and by extremes of cold in cold climates; by malarial soil, vitiated air, or crowded dwellings; by defective diet; and by scurvy.

The annual mortality from measles in London is nearly five per ten thousand. The deaths from measles are about one per cent. of all deaths in England and Wales, and nearly two per cent. in large towns; this is higher during epidemics, but has not reached much beyond 2·7 in London. The proportion of deaths to attacks varies from twenty to thirty per cent. in crowded wards, to one or two per cent. in healthy houses; the mortality of ten or twelve per cent. is a common estimate. Among young children the deaths are in equal proportion for the two sexes; more than half of the whole number of deaths from measles are of children under two years of age; the proportion thence progressively diminishes. This differs from what is observed in scarlet fever and diphtheria; moreover, the proportionate fatality of these latter diseases in the two sexes is greater for girls.

Pathology.—Measles is the type of a zymotic disease. A bacillus, recognised by Drs. Canon and Pielicke as specially concerned, is described in the *Berliner Klin. Wochenschrift* of April 18, 1892. It was found in the blood, mostly on the sixth day of the disease and for a day or two after the crisis; also in the nasal, conjunctival, and bronchial secretions. Ten years ago Dr. A. Ransome obtained some such particles from the breath of two persons suffering from measles. Drs. Braidwood and Vacher subsequently confirmed this observation. Glycerine, on which children with measles respired during any of the eruptive days, exhibited numerous highly refractile bodies, larger than those seen in vaccine-lymph; others were elongated. They were most abundant in the two days of greatest eruption; they were not found in the breath during health, nor in the course of scarlet fever and typhus. After death from measles, on the eighth day, they were found in the true skin in groups below the rete mucosum, by the lymph-spaces and sweat-ducts, but not deeper than the level of these glands; sparkling, spindle-shaped, rod-like, or canoe-shaped bodies were also seen, which did not take the carmine stain. These bodies were not seen in the lymph-spaces, in the sweat-ducts and glands, nor in the hair-follicles. In the lung both forms were found in some exudation filling the alveoli. The spherical forms had a dark, smooth outline, and did not readily take the carmine stain. Near these were rod-like, fusiform, or ovate bodies, slightly stained by carmine. These are quite distinguishable from the particles seen in other forms of pneumonia. With a high power, similar sparkling, staff-shaped bodies were seen scattered round the bile-ducts. None were found in the kidneys, spleen, or mesenteric glands.

In the blood some increase of white and a great decrease of red corpuscles occurs during the fever of measles. Numerous moving microzymes have been seen during the eruption, decreasing rapidly, and disappearing in three weeks; but temporarily reappearing with any febrile disturbance.

Diagnosis.—The first spots of measles, if scattered, raised, and hard, may be mistaken for those of small-pox; or the small-pox eruption may begin with some measles-like roseola. The temperature curve for the two diseases is similar. In the small-pox curve a sudden rise begins only two days before the eruption, whilst in measles there is a gradual rise for three or four days; this in small-pox is evidenced by a history of sudden and severe illness only on the day but one before the eruption, whilst in measles there is no such symptom on that day, the illness dating from a day or two earlier, usually with distinctive catarrhal symptoms.

The declining rash of measles leaves a mottling of the skin, not unlike the mulberry eruption of typhus; the latter seldom appears before the fifth day of the disease, the fever continuing high for several days after. In measles, at this stage of the rash, the fever has already begun to decline, the temperature falling suddenly, often to below the normal. The rash of *rubeola sine catarrho*, *rubella*, or *Rötheln*, closely resembles the eruption of measles; the spots, brighter in colour and even more discrete, are preceded by only one day of headache or slight sore-throat. The incubation-period generally is longer than in measles. In scarlet fever the ingress is sudden; there is the characteristic sore-throat; and there is the early appearance on many parts of the body of the finely diffused, comparatively smooth, bright scarlet redness of the rash. The incubation-period has been short. In erysipelas the redness appears at one part only, and extends from that, whether it be the face or other parts of the body. Roseola from irritating articles of food has very little fever, and no enlargement of the cervical glands, otherwise it might look like measles; of the rashes from drugs that of phenazone may resemble the early papules, that from cubebs the later mottling. Urticaria and erythema, with differing aspect, cause but slight thermometric disturbance.

Prognosis.—This is mostly favourable in measles: the tendency of the febrile action is to recovery. Favourable progress may be endangered by—(1) the bad health of the sufferer; (2) want of care; (3) unsanitary surroundings. Under either of these conditions the simplest kind of measles may give rise to the worst forms of the disease. Morbilli *mitiores* and *graviores* are not essentially distinct. High fever with the eruption is not in itself unfavourable. At this time a temperature of 105° in children, and 104° in adults, or half a degree beyond, is safely reached; with precautions at its sudden decline, the progress afterwards is mostly satisfactory. High temperature during the after-course is a sign of greater import; it guides to various complications, and subsides as they are relieved. Occurring irregularly it is a cause for anxiety; if steadily maintained, or recurring regularly at short intervals, with wasting as a result, there is little hope of recovery, and none if acute tuberculosis of lung or of brain is evidenced. The latter danger makes convulsions of worse augury in the decline than during the ingress of measles in young children; convulsions, taking the place of delirium in older persons, cease after the eruption. Recession of the rash is not alarming when the attack is slight, or the temperature is low at the crisis; when there is pulmonary or other local congestion, and at the same time sudden depression, it becomes an additional sign of danger. A dark rash, interspersed with fine red specks, may occur early in cases of moderate severity; a dusky or livid colour subsequently marks cases of considerable intensity; petechial or hæmorrhagic blotches at this time are of grave import, as indicative of scorbutus, which state ranks next to impaired nutrition in infants as the most unfavourable concomitant of measles. Black or hæmorrhagic measles, without scorbutus, is more rare than is hæmorrhagic or black small-pox. Some dangerous hæmorrhages may follow measles where no scorbutic condition exists. Among unsanitary conditions, though the presence of sewer-gas has in isolated instances determined a fatal result, the most disastrous is overcrowding. The great mortality from measles is due to lung-disease, not at the height of the fever, but in the second week; the frequency and severity of pulmonary complications being less a direct effect of low temperature than of tainted air in which the poor are pent up for the sake of warmth. During the ingress of measles exposure to cold may occasion a highly dangerous suffocative catarrh, with capillary bronchitis; after or during the rash a chill is as likely to conduce to serious diarrhœa as to pulmonary congestion, especially in hot weather. Equally depressing in their effects, these are direct results of the disease independently of weather or season. Measles contracted during acute or prolonged illness is a grave additional danger. In the puerperal state infinitely less mischief is produced by this disease than by scarlet fever. Delivery has been hastened without mischance; or abortion has resulted, not without risk of fatal results. There are times when young married women who have not had measles should keep from risk of infection. It would seem that the child can go through the disease *in utero*, with after-immunity. There is an instance on record of a mother with measles giving birth to a child 'full of measles,' both doing well; others of infants having the rash three, five, and eight days after birth, when the mother was herself ill. Infants escape measles while suckling, insomuch as they are less exposed to infection; they may suffer no less severely than others. In adolescence a body-heat of 107° has been safely passed, during the decline of measles, with no marked complication. In children of all ages a warning is given of some danger closely following the eruption when the normal fall of temperature at the crisis is delayed or prevented. In advanced convalescence sudden rise of temperature, with delirium, often marks an attack of pneumonia; this, if of limited extent, may be hoped to end favourably in a week by resolution, without much cough, but with steady high temperature till near the end.

Treatment. — Rest, pure air, equable warmth, diluents, and nourishment, are the chief requisites in the treatment of measles.

All risks from exposure or fatigue should be avoided while the disease may be only latent. The first catarrhal signs demand confinement to the room; the initial fever, rest in bed. The usual meals, moderate in quantity, may be taken; if not, milk, broth, or meat-jelly will be required. Extra liquids, such as barley-water, lemonade with gum or glycerine, cold water, and small pieces of ice, are pleasant and necessary. Simple salines, as potash in the lemonade, or citrate of ammonium, are useful. Dilute acetate of ammonium, coloured with syrup of saffron, is an old and good form; to this a few drops of ipecacuanha wine may be added, but neither expectorants nor diaphoretics have any influence on the cough until after the eruption. Antimonials and aconite should be avoided. The bowels must be gently regulated; a furred tongue is not a reason for giving purgative medicine. No diminution of the expected critical fever, if this were desirable, will be brought about by the action of emetics and aperients; where either of such evacuations have troubled the ingress, the eruption is delayed with no after-benefit. Hot applications relieve pain and cough. The free use of cold, so speedy and potent an antipyretic in scarlet and other fevers, is not required in the early stages of measles, and would be injurious until after the eruption is out; where this is interrupted, as by debility or chill, sometimes by convulsions in infants, the warm bath is to be used, with or without the addition of mustard. At this stage of the disease wine is rarely necessary; it may be required after epistaxis or for sudden depression, where food has not been taken. The room should be kept quiet, and at times dark, so that sleep may be favoured. Tepid sponging of the surface, part at a time, relieves the feeling of heat and tension; irritation is soothed by applying cold cream to the face, and carbolated oil to the body, or by rubbing with suet in some places. The bed-clothes should not be too heavy. An attendant may be required during the night. Good ventilation admits fresh air without draught or chill to the patient. A spray of ozonised water or aromatic vinegar freshens the air of the room, and is preferable to steam. In this way, with previous good health, the danger of pulmonary complications is lessened. When several cases have to be treated in a ward, each patient should have a space screened off from draughts, and kept sweet. Directly the rash is out, the fever falls, the tongue cleans, the appetite returns, and the patient seems cheerful and well; ordinary food can soon be taken, sleep returns, and no alcoholic stimulant is required. On the other hand, with dislike of food, languor, or restlessness at nights, stimulants should be given, before the dry tongue, small and rapid pulse, receding rash, or signs of pulmonary congestion render free and frequent stimulation indispensable. There is, perhaps, no condition where wine and spirits produce such marked and immediate benefit as in the pulmonary congestion at the crisis of measles; they are sometimes a means of saving life in the after-depression till such nourishment can be taken as will soon supply the needed support. Sedatives are not often required; a small dose of Dover's powder moderates any tendency to diarrhœa; this is always to be guarded against and never provoked. Where, without complication, the febrile crisis is delayed, a dose of quinine with Dover's powder at night has been useful. After the crisis tepid bathing, with great precaution, aids sleep, and gives tone to the cutaneous, bronchial, and pulmonary circulations; cold affusions may be necessary for hyperpyrexia at a later stage, when, if head-symptoms threaten, ice should be applied to the head. Croupy symptoms and bronchial catarrh are better treated without steam cots or kettles. Diarrhœa at the close of measles may take the place of pneumonic symptoms, and need not be suddenly checked; rest in bed, carefully regulated diet, and stimulants, with opiate epithems, or an opiate enema, will relieve this. The mineral acids, with or without a bitter, aid digestion, and can either be given very dilute as a drink at any time, or in a definite dose with food. For the irregular febrile disturbance noticed in the weakly, they are useful adjuncts to the quinine or cod-liver oil that are then essential. Some local troubles must be treated. Earache needs a dose of butyl-chloral hydrate, or a warm poultice with a little opium in the ear gives relief; otorrhœa requires tepid syringing. For ophthalmia, lead lotion, and the topical use of belladonna or atropine if there be photophobia, are necessary; the swollen eyelids should be raised to see that no injury to the eye occurs, while other severe symptoms may be attracting most attention. Ulcers in the mouth or elsewhere may have to be touched with diluted borax or boric acid, where astringent washes are ineffective. After-treatment is always important and necessary. For the anæmia which attends convalescence some form of iron is to be taken with meals two or three times a day. Cod-liver oil should be given an hour after meals, at least twice a day, to the strumous or delicate. Often the mineral acids with a bitter are of service, especially when the rash has been livid or petechial. The clothing should be warm, with flannel next the skin. Cold bathing rapidly performed, or with salt-water, is to be recommended; and when the weather is fine, the patient should go out of doors once or twice a day, avoiding chill or fatigue. Children are the better for an afternoon sleep; adults should avoid full work, or exposure at night, for one or two months after measles. Convalescents should have a change of room in the second week of the illness. Means should then be taken to purify and disinfect the sick chamber, as by burning sulphur or the bisulphide of carbon in it before the cleaning; this does not interfere with other rooms in the house to which convalescents are removed. All clothes and the bedding used during the illness should be afterwards stoved. Change of air or place is not so necessary as is often supposed. Home is the best place for cure, not only until all danger of infection is passed, but that the dangers of convalescence and the possible development of any constitutional defect may be watched, and receive the earliest and best attention.

William Squire.

MEASUREMENT.—A method of physical examination, in which tape-measures and other instruments are used to ascertain accurately the shape, dimensions, and movements of different parts of the body. *See* Physical Examination.

MEDIASTINUM, Diseases of.—Synon.: Fr. *Maladies du Médiastin*; Ger. *Krankheiten des Mediastinum.*—The principal morbid conditions which occur in connexion with that region of the chest which is known as the mediastinum, are (1) aneurysm of the thoracic aorta; (2) inflammation of the tissues or textures within the cavity; and (3) new-growths involving the same space. Of these conditions, aortic aneurysm is by far the most common; but it possesses so many special features that it is described separately in this work (*see* Aorta, Diseases of; and Thoracic Aneurysm). The remaining pathological conditions involving the mediastinum are discussed in this article.

1. Mediastinum, Inflammation of.—Synon.: Mediastinitis; Fr. *Médiastinite*; Ger. *Mediastinitis.*

Definition.—This term has been employed to denote inflammation of the serous surface of the duplicature of the pleura separating the pleural from the mediastinal cavity, and also inflammation originating in the cellular tissue or other textures of the mediastinal space. In the former sense mediastinitis is but a variety of pleurisy, which, though it may be characterised by special symptoms, must be very difficult, if not impossible, to diagnose during life. We confine our attention here to inflammation and its results in the mediastinal cavity.

Ætiology and Anatomical Characters.—There are very few trustworthy observations on record of simple acute inflammation of the mediastinum, terminating either in resolution or in effusion of plastic lymph. An example of the latter detailed by Wildemann is probably unique. In this instance the anterior mediastinum was filled with layers of solid exudation; the pericardium inflamed; and its cavity distended by six ounces of pus. The mediastinal effusion appeared to have been occasioned by long-continued pressure on the sternal region. On the other hand, we have numerous examples recorded, in which mediastinal abscesses have resulted both from primary or idiopathic, and from secondary or symptomatic, inflammation. Primary abscess, though rare, is occasionally met with, produced either by local injury or simply cold. Gunther (in *Oesterreich. Zeitschr. f. prakt. Heilk.* 1859) and others have recorded cases of mediastinal abscess originating simply in cold. It may, however, be suspected that some forgotten physical injury had in certain of these cases been received, as in the only case of the kind that has fallen under the writer's notice. Dr. Goodhart, in the *Pathological Transactions*, vol. xxviii., records a case of acute mediastinal abscess, resulting apparently from injury produced by the sticking of a piece of meat in the œsophagus. But by far the most frequent cause is suppuration of the lymphatic glands in scrofulous subjects, as in a remarkable instance recorded by Dr. Bristowe, in the *Pathological Transactions*, vol. ix. p. 46. Secondary or symptomatic abscesses, in the form of purulent *dépôts*, are not infrequently met with in the anterior mediastinum, either in connexion with operations, such as tracheotomy, or as the result of general pyæmia. Syphilitic gummata are also sometimes found in this region.

Symptoms.—The only instance of primary abscess of the anterior mediastinum that has fallen under the writer's observation presented the following symptoms: A middle-aged lady, previously in good health, fell on going upstairs and struck the sternum against the stone edge of the stairs. A few weeks afterwards she complained of uneasiness about the chest, and of pains in the left shoulder and about the scapula and neck. They were not severe, and had more the character of neuralgia or rheumatism than of anything more serious. After a time there was some general derangement of the health, attended by dyspeptic symptoms, a certain degree of febrile disturbance, some dyspnœa, and inability to lie down except in certain positions. Two months after the accident, which had been forgotten, there was a distinct prominence over the upper part of the sternum of an oval shape, and rather less in circumference than the palm of the hand, not red, but tender on pressure, and to which was referred a sense of uneasiness and oppression. The aspect of the patient was indicative of some anxiety, but not distress. The breathing was quiet; the pulse was quickened; but there was little or no febrile heat. There was some cough, attended by mucous expectoration sometimes streaked with blood. The patient complained of soreness and irritation of the larynx and fauces. The action and situation of the heart were normal. There was dulness on percussion over the whole of the prominence of the sternum, and nowhere else throughout the chest, but neither pulsation nor fluctuation could be detected in the swelling. There was no physical evidence of pressure either on the trachea or bronchi, although the patient admitted a feeling of weight or pressure, as well as of dull uneasiness; but there had been no sense of throbbing. There was no enlargement of the jugulars or superficial veins, nor any tumefaction of the base of the neck. Careful physical examination of the whole chest revealed nothing beyond a few loose mucous *râles*. Local sedative applications and the use of bromide of potassium gave some relief to the pain and local tenderness, but the cough and laryngeal irritation continued. After a few days about a teaspoonful of bright fluid blood was coughed up, and the day following a little more without effort. The next day there was suddenly brought up from two to three ounces of purulent matter, followed by a sense of great relief. A microscopical examination of this matter revealed nothing more than pus and mucus mixed with an unusually large number of squamous epithelial cells, but not a trace of elastic tissue, or anything to indicate disorganising changes in the lung. The purulent expectoration continued, but in steadily decreasing amount, for about five weeks, the sternal swelling subsiding *pari passu*. Ultimately the sternal region was of normal aspect, and the general health was completely restored, though for some time there was occasional slight oppression of the breathing.

The above example has been recited because the symptoms correspond very closely with those which have generally characterised such cases. In some instances, however, there has been more distinct evidence of phlegmon, and a greater amount of febrile disturbance and distress. Unless the abscess be large, or associated with glandular or other organic disease, symptoms of compression, either of the bronchi or large vessels, are not usually observed. But in the latter case there may be not only symptoms of venous and bronchial obstruction, but even serious laryngeal symptoms and paroxysms of severe dyspnœa. The abscess may open into either the trachea, bronchi, or pleural cavity, if no external outlet is obtained. Spontaneous external opening is said to occur most frequently on a level with the second rib, to the left of the sternum.

Prognosis.—The prognosis of mediastinal inflammation should, in view of its possible modes of termination, be guarded.

Treatment.—Unless the acute symptoms of phlegmonous inflammation should be well marked, but little can be done in the way of treatment, beyond allaying pain, and the use of local soothing applications. Strict rest should be enjoined, and an external opening should be made for the outlet of matter as soon as distinct indications are presented of its presence. It should also be borne in mind that the inflammatory action is liable to spread, and to involve either the lungs or the pericardium.

2. **Mediastinum, Morbid Growths connected with.**—By far the larger proportion of intra-thoracic growths originate in the mediastinum, and for the most part in the lymphatic glands. Others, which may commence in the lungs or pleura, involve, sooner or later, the mediastinal spaces. In treating, therefore, of mediastinal tumours, from a clinical point of view, it is of less importance to determine their precise origin than to ascertain the general character of the growth, its modes of development, and the effects likely to be produced on the surrounding textures. It is manifest, however, that the particular site of the growth must exercise an important influence, both on the early symptoms and the subsequent features of the case. It is important, therefore, to remember, when forming a diagnosis in cases necessarily very obscure in their early stages, how very various are the situations and relations of the growths. Thus either functional derangements of the heart, neuralgic pains of the muscles, dysphagia, spasmodic affections of the larynx, bronchial irritation, or limited pleuritic symptoms, may be the earliest indications.

Varieties and Symptoms.—Almost every form of morbid growth has been met with in the mediastina: cancer in all its varieties; sarcomatous, osteosarcomatous, enchondromatous, and fibrous tumours; lymphadenoma; lardaceous, steatomatous, and tubercular masses; and syphilitic gummata. The progress and duration of the case will differ materially, according to the natural history of these several formations. The growth of some is much more rapid than that of others. By some the adjacent textures are much more readily invaded than by others. Constitutional symptoms and impairment of the general health are much more pronounced in some than in others. Apart, therefore, from the special features given to each case by the particular locality of the disease, there will be very great differences in its general aspect and progress. And were it only in reference to prognosis, irrespective of treatment, it would be very desirable to determine the nature as well as the existence of the growth. This, unfortunately, in many instances, cannot be done; but in others we may form an opinion with considerable confidence. The development of the malignant growths is generally much more rapid than that of the more innocent, and the duration much shorter. It is seldom that the duration of intra-thoracic growths of a malignant character extends beyond a year. Those having the character of lymphadenoma or lymphosarcoma are sometimes of much longer duration. These in a large proportion of cases commence in the lymphatic glands of the posterior mediastinum, or in the anterior mediastinum, from, as some believe, remains of the thymus gland. They sometimes attain to an enormous size, and may ultimately involve all the structures within the thorax, including the heart and pericardium. In other instances, commencing probably in the connective tissue, the disease spreads along the roots of the lungs and sides of the bronchi, extensively involving the adjacent tissues and the lungs themselves, without, for a long time, giving rise to any considerable tumour. In other cases several distinct tumours are developed at some distance apart. The period at which pleuritic effusion or œdema of the external parts occurs also varies greatly. Thus, too, it happens that alterations in the external form of the chest are early manifest in some cases, and not till later in others. In some instances these alterations of form are limited, in others they implicate the whole of one side, or even the whole contour of the thorax. In not a few instances, whilst the growth is still of limited extent, and confined to the posterior mediastinum, the symptoms so closely resemble those of aneurysm as to make the diagnosis extremely difficult and uncertain. The more prominent symptoms are indeed in some instances, and for a long time, mainly cardiac. This it is important to bear in mind, inasmuch as pericardial effusion and consequent sternal prominence has been mistaken for a mediastinal growth. In the most malignant types of disease, and where, as in far the greater number of instances is the case, the lymphatic glands of the thorax have become implicated by extension of disease from other organs, the local thoracic symptoms are from the first associated with those general symptoms which are characteristic of malignant disease, and pass under the term of cancerous cachexia. Sarcomatous tumours, on the other hand, may attain a considerable size without constitutional symptoms of any special character. As a rule it may be said that all intra-thoracic growths tend to develop inwards rather than outwards; and thus often overlap the lungs and heart, pass along the great vessels and nerves, and press on those parts which offer least resistance. It is only in very rare instances that the chest-walls become eroded by the outward pressure of the tumour, as happens in so many cases of aneurysm. This is the more remarkable because in many instances the presence of the growth is distinctly indicated by external tumour, arising from outward pressure of portions of the chest-walls. This is of course especially the case when the growth is in immediate proximity to the walls of the chest. In the case of large tumours the external form of the chest may be rendered unsymmetrical by displacement of the heart, and downward pressure on the diaphragm and liver. There is, however, another and very distinct mode by which the symmetry of the chest is affected, and that is by collapse of the lung and sinking of the chest-wall, in consequence of the pressure exercised on the root of the lung by the progressive advance of the tumour. The effect of this is sometimes rendered still more apparent by the corresponding expansion of the opposite lung, either from congestion or induced emphysema. The deformity of the chest attains its maximum in many cases by the outgrowth of tumours above the clavicle and along the neck. It may be well, however, at the risk of some repetition, to classify, under different heads, the most characteristic of the multifarious phenomena that have been observed in connexion with the different varieties of mediastinal growths.

Derangements of the circulation.—Derangements of the circulation, which are necessarily induced, in all cases, to a greater or less degree, give rise to phenomena which are of special diagnostic importance in mediastinal tumours. The return of blood through the vena cava superior and its affluents is early impeded, more or less, in the majority of cases, and sometimes to such an extent as to give a special aspect to the case. It is not, however, simply by pressure on the venous trunks that the indications of pulmonary congestion, œdema, and cyanosis are induced. In many cases the veins themselves, although seldom the arteries, are involved in the cancerous disease; and when this is not the case, there is often a special tendency to thrombosis and obliteration both of the large veins and of their radicles. Cancerous deposit has, in some cases, been traced into the jugular and subclavian veins, entirely occluding them; in other cases these vessels have been enormously distended. Thus we have in many instances great tumefaction of the face, neck, and upper extremities, from œdema and general serous infiltration. In like manner, obstruction to the circulation through certain portions of the lungs may give rise either to hæmorrhage in the form of hæmoptysis, to sanguineous effusion into the pleura, or to large apoplectic clots, that is, infarcts. In this latter way the physical signs of consolidation are sometimes suddenly induced, or increased; and after death the pleural cavity has been found occupied by large protuberances from the pleura, consisting simply of blood-tumours, due to extravasation into the pulmonary tissues. Although the arteries are much less liable to become implicated in cancerous disease than the veins, they are subject, like all the other contents of the thorax, to pressure. The force of the current of blood through them may thus be diminished, and there may be a marked difference in the radial and carotid arteries of the two sides, just as there is in aneurysm of the aorta. It is needless to say that the symptoms arising from mechanical influences acting on the heart must be very various. This organ may either be dragged from its natural situation, or surrounded, more or less completely, by the advancing disease, and its situation and action concealed from all observation; or its very substance may become involved in the spread of the disease, and the pericardium may be largely distended by serous and bloody effusion. Apart from those disturbances of the heart's action arising from interrupted circulation through the lungs, its innervation may be seriously affected, as will be subsequently noted. And it is evident that the sounds, rhythm, and impulse will be affected in more ways than one; even when neither the valvular apparatus nor any other structure is the actual seat of disease. In the malignant forms of disease the muscular power of the heart is generally impaired, and there is a consequent tendency to palpitation and faintness, often associated with nausea and vomiting. Such symptoms have been observed in rare cases, where the heart has become implicated by disease extending from the mamma through the thoracic walls.

Febrile symptoms.—Mediastinal tumours are not as a rule characterised by febrile disturbance, at any period of their course. Several examples of tumours having the character of lymphadenoma have, however, exhibited striking exceptions to this rule. The writer has recorded a remarkable instance, and others have been recorded by the late Dr. Murchison and Dr. Church, in which there was persistent elevation of temperature, and rapidity of pulse and respiration, but with daily alternations of rise and fall. And in these instances it is remarkable that the pyrexia declined with the advance of the disease to its fatal termination. Intercurrent inflammatory affections, whether of the pulmonary tissue or of the pleura, may in any case occasion corresponding symptoms of fever. These, however, are seldom very pronounced.

Disturbances of innervation.—Disturbances of innervation occur at all stages, and in connexion with every variety of growth. They vary, however, greatly in their character and severity. Although pain may be said to be present in most instances, it is often, all through the case, by no means a prominent symptom. The patient's distress, often very great, is more frequently due to dyspnœa and interrupted circulation than to direct implication of the nerves. Nevertheless neuralgic pains are among the most frequent of the early subjective symptoms, and are sometimes severe in the later stages. When from the situation of the growth the recurrent laryngeal nerve is early implicated, we sometimes get paralysis of the vocal cords, and aphonia, at other times spasmodic paroxysms of dyspnœa and urgent laryngeal symptoms. In rare cases cancerous disease of the posterior mediastinum has invaded the spine, and given rise to paralysis of the limbs and trunk (*vide* Cases 11 and 12 in the writer's *Lumleian Lectures*). The cough, which is generally due to more or less bronchial irritation and secretion, sometimes arises from purely nervous reflex irritation, and may occur in paroxysms like those of whooping-cough. The innervation of the heart may be so disturbed as to occasion symptoms of angina, as well as various irregularities of action and tendency to fainting. The immediate cause of death is not infrequently to be attributed to sudden interruption of the heart's action.

Respiratory phenomena.—The respiratory phenomena, although presenting the utmost diversities, have nevertheless certain special characteristics. When the patient is at rest, there is often nothing to denote any impediment to the respiratory function—no quickened movement, no alteration of aspect, no expression of anxiety; but on the least exertion, dyspnœa is at once manifested. Mere change of position may induce a paroxysm of dyspnœa. With advancing disease implicating at length the contents of the thorax to a great extent, there may be no corresponding increase of dyspnœa, especially if the progress be slow. In other cases, with physical signs of a very questionable and limited character, there may be great distress in breathing. Absence of apparent dyspnœa is sometimes the more remarkable from the manifestly diminished movement of the chest-walls, or even complete immobility perhaps of one side. Nor in many cases does the dyspnœa correspond with the evidence of pressure, and the absence of respiratory sounds on auscultation. The want of correspondence between the physical signs and the functional symptoms is indeed often most striking. In one case there will be persistent difficulty of breathing, amounting to orthopnœa of the most urgent character, in another merely a little quickened respiration—lividity and turgescence of features in one case, in another an anæmic aspect.

Physical signs.—So long as a mediastinal tumour remains of but small size, it will, of course, not be recognisable by external physical signs, except such as are due to mechanical derangements of the circulation, generally denoted by enlargement of the external superficial veins. Comparatively small tumours will, however, sometimes manifest themselves by circumscribed alterations in the external aspect of the chest. This of course will depend much on the site of the tumour. Tumours of the anterior mediastinum may very early manifest themselves, by throwing forward the sternum and the sternal attachments of one or more of the ribs, and ultimately rendering the two sides of the chest asymmetrical. It is in these cases, when, with the growth of the tumour, the heart and aorta become overlapped and pressed on, that we have evidence of pulsation and vibration, simulating closely the signs of aneurysm, and sometimes attended by a cardiac bruit. In other cases the growth, extending upwards, shows itself by tumefaction and swelling above the sternum and clavicles, being then often attended by signs of pressure on the trachea or bronchi. When the posterior mediastinum is the chief seat of disease, this may attain to very considerable development before any very decided alteration is seen in the form of the chest, unless one or other pleura have become distended by fluid effusion. The diagnosis of these latter cases often presents the utmost difficulty, the physical signs being simply those of pleuritic effusion, and the symptoms such only as may be fairly referred to the mechanical effects of fluid pressure. When the tumour is of any considerable size, the motions of those parts of the chest-walls which are in immediate proximity to the growth are almost always impeded, and there is evidence of diminished expansion. This is also the case when the pleura is occupied by secondary growths, when there may be obliteration of the intercostal spaces, as in pleurisy. But as collapse of the lung sometimes takes place with little or no pleuritic effusion, there may be falling in of one side of the chest, appreciable by the eye, as well as by measurement. As, however, the tumour usually extends more to one side than the other, the measurements of the two sides will generally differ, from this cause alone. By percussion and palpation the ordinary signs of solidification will of course be detected, whenever the tumour approaches the chest-walls and attains to any size, or whenever any considerable portion of the lung has been rendered solid, either by invasion of the growth, by pneumonic consolidation, or by hæmoptyic engorgement. Signs of displacement are often manifest comparatively early, and later on may be of the most unmistakable character. The heart may be dragged away from its natural situation in various directions; the diaphragm thrust down; the lower ribs thrown out; and the deformity of the anterior part of the chest, and the physical signs on auscultation and percussion, may be greatly modified, by distension of the pericardium from effusion. It will at once, therefore, be seen that the cardiac signs will be of very variable and diverse character—so much so that any detailed description would be of little practical use. It should also always be remembered that the lung undergoes very various and opposite changes as the result simply of pressure on the bronchi, and interruption to the entrance and egress of air from the air-cells. Thus in the early stages there may be more or less of emphysema, and corresponding physical signs on the affected side; and in more advanced cases a certain amount of emphysema of the opposite side. As the bronchi become occluded, we have at first the stethoscopic signs of accumulation of secretion, soon to be followed by signs of consolidation and absence of respiration, when the lung is undergoing those destructive changes by which it becomes converted into a solid mass broken up by irregular abscesses or pockets of pus, produced in part by actual pulmonary disintegration, and partly by dilatation of the bronchi. In the latter condition there may be enlargement of the lung and distension of the side, rather than collapse. Hyper-resonance from emphysema, followed by signs of consolidation and absence of all respiratory phenomena, associated with or preceded by other indications of pressure, would be tolerably decisive of the existence of a mediastinal tumour, but whether aneurysmal or some form of malignant disease might still be a question.

Diagnosis.—From the preceding remarks it will be evident that there are no symptoms or physical signs, nor any precise order of phenomena, that can be said to be peculiar to, or diagnostic of, an intra-thoracic growth. No two cases will be found to be precisely alike. Nevertheless, the want of correspondence with the ordinary forms of thoracic disease; the very general presence of signs of pressure and mechanical derangement; and the varying aspects of these signs, are, in the majority of cases, when considered in conjunction with the history of the case, sufficient to lead, if not to a positive, at least to a highly probable, diagnosis. In the early stages of a mediastinal tumour, when the growth is still small, it will be easily seen, if we reflect on the anatomical relations of the mediastinum, that an accurate diagnosis must often be impossible. And even when formidable symptoms arise from the peculiar relations of a small growth, it must often be extremely difficult to avoid error. Both retro- and antero-sternal nodes will sometimes closely resemble both aneurysm on the one side, and mediastinal tumours on the other. For further observations the reader is referred to the articles Bronchial Glands, Diseases of; Lungs, Malignant Disease of; and Thoracic Aneurysm. *See* also 1. Mediastinum, Inflammation of.

Treatment.—There is but little that can be said as to the treatment of mediastinal tumours, except as regards the palliation of urgent symptoms, or the relief of some of the chief secondary effects of the original disease. All forms of intra-thoracic growth of a malignant character are steadily progressive to their fatal termination. Some of the less malignant in character—for example, lymphadenomatous tumours may last a long time, and appear for a while to be stationary, and unattended by any serious impairment of the general health. Even these, however, are exceptional cases. Bodily rest, freedom from causes of moral disturbance, maintenance of the general nutrition, change of air, and every available hygienic means, are essential in all cases. Chalybeates and other tonics may be of more or less service. Iodide of potassium has appeared to be of use in some cases, and mercury has been recommended. Special symptoms often admit of considerable relief; for instance, local pains by external soothing applications, or by counter-irritants, such as sinapisms and small blisters. The latter are often of signal benefit. Pain, sleeplessness, and harassing unrelieving cough may all be alleviated by opium and other narcotics or sedatives, such as chloral or bromide of potassium, and sometimes by minute doses of antimony. For the distressing paroxysmal attacks of dyspnœa and laryngeal spasm, opium and its preparations require to be given with caution; but chlorodyne, Hoffman's anodyne, and the inhalation of chloroform are often useful. The distress arising from dyspnœa and inability to lie down will often tax the resources of the physician to the utmost, depending as they do on a variety of complex causes. When they appear to be mainly referable to accumulation of fluid in the pleura, paracentesis must be resorted to, and will often be followed by great temporary relief. At one time the writer was averse to this procedure, but further experience has led him to believe that it is productive of little if any mischief, and that life may sometimes be much prolonged by even repeated evacuation of the pleural effusion. In proportion as symptoms of pleurisy, bronchitis, or pneumonia predominate, they must be met by the ordinary therapeutic resources. It remains to be seen whether our further knowledge of the natural history of lymphadenoma may advance our therapeutic resources. Certainly the slower progress of such cases affords more time for the trial of iodine, chalybeates, or other constitutional remedies.

It should ever be borne in mind that severe attacks of dyspnœa, with stridulous breathing and other indications of intra-thoracic pressure, may all be due to nerve-irritation alone, and often be greatly alleviated by small doses of morphine combined with antispasmodics. J. Risdon Bennett.

MEDIATE (*medius*, intervening).—A term applied to auscultation and percussion, when some medium is interposed between the surface of the body of the patient and the ear or finger of the physician, such as the stethoscope in the one case, or a pleximeter in the other. *See* Physical Examination.

MEDITERRANEAN, The.—A moderately dry, warm, and very sunny winter climate. *See* Algiers; Cannes; Hyères; Malaga; Mentone; Nice; San Remo, &c.; and Climate, Treatment of Disease by.

MEDULLA OBLONGATA, Lesions of.—Synon.: Fr. *Maladies de la Moelle Allongée*; Ger. *Krankheiten des verlängerten Marks.*

Introduction.—The pathology of the medulla oblongata is more than usually complex. Not merely is it liable to injuries, and diseases such as hæmorrhages, softenings—necrobiotic and inflammatory, tumours, &c., having their primary seat there, as in other nerve-centres; but also, and more frequently, the medulla is implicated in diseases of the pons and cerebellum, and affected indirectly by intracranial diseases in general. Being the connecting link between the brain and spinal cord, it is subject to ascending or descending degenerative processes, secondary to lesions in the spinal or cerebral sensory and motor tracts. Further, it is the seat of a special form of degeneration, characterised by a very definite group of symptoms, differentiated under the term 'bulbar or labio-glosso-laryngeal paralysis.'

With the indirect affections of the medulla oblongata, in connexion with the various forms of intracranial disease, degenerations of the motor or sensory tracts secondary to cerebral or spinal disease, or the pathology and symptomatology of bulbar paralysis, this article does not profess to deal, as these subjects will be found fully discussed under other headings. Attention will be directed mainly to the data which serve to establish, so far as this is possible, the regional diagnosis of medullary lesions.

Summary of Pathological Conditions.—*Traumatic lesions.*—Injuries of the medulla oblongata are not uncommon in consequence of fracture or dislocation of the atlas and axis, as in falls, hanging, twisting of the neck, or as the result of diseased vertebræ. In such cases death is instantaneous, owing to the sudden cessation of the circulation and respiration, from lesion of the centres of these vital functions, which are situated in the medulla (Flourens' *nœud vital*).

To commotion or contusion, with punctiform extravasations in the medullary centres (Duret, *Sur les Traumatismes Cérébraux*, 1878), is also to be attributed sudden death from blows on the head. Not infrequently lesions of the fourth ventricle, the result of cranial injuries, not proving fatal, give rise to diabetes mellitus or insipidus, along with other symptoms indicative of chronic lesion of the pons or medulla.

Effusions of blood into the fourth ventricle, whether arising from the medulla itself, the pons, or the cerebellum, or gaining access from the lateral ventricles by the aqueduct of Sylvius, are, as a rule, suddenly fatal from paralysis of the circulation and respiration. Death may occur with or without convulsions.

Tumours.—Tumours implicating the medulla oblongata may have their seat primarily in the medulla; but more commonly the tumours are situated at the base of the skull, in the cerebellum or pons, and invade the medulla in their growth. Apart from the general symptoms of cerebral tumour—headache, sickness, optic neuritis, &c., the special indications of implication of the medulla oblongata are one or more of the symptoms mentioned below. Here also, however, some remarkable cases have been put on record, in which, notwithstanding the existence of tumours actually in the substance of the medulla itself, the symptoms during life have presented nothing striking or characteristic. (*See* a case by Dr. Wilks, *Diseases of the Nervous System*, 1878.)

Hæmorrhage.—Hæmorrhage into the substance of the medulla oblongata, and limited to this, is comparatively rare. More commonly the pons and medulla are affected together. Hæmorrhages here of any extent are very rapidly fatal. In some cases death is instantaneous. In others a few hours may elapse, death occurring in profound coma with stertorous respiration and occasionally convulsions. Whether the hæmorrhage is primarily in the medulla or in the pons cannot be diagnosed with certainty. The other causes of sudden death, such as affections of the heart, must be excluded before hæmorrhage into the medulla can be diagnosed, and this is in many circumstances obviously impossible.

Hæmorrhage into the medulla oblongata is usually fatal, and rarely gives rise to chronic stationary lesions. These are commonly the result of thrombosis or embolism, or, more rarely, acute myelitis.

Thrombosis.—Thrombosis of the vertebral arteries is the most common origin of softening limited to the medulla oblongata. The onset is frequently sudden, as in hæmorrhage, but the course is more slow. The more chronic nature of the affection is an important diagnostic feature of softening. The symptoms of softening of the medulla thus arising are in many respects like those of progressive bulbar paralysis, but there are also important differences. They are sometimes generalised under the head of 'acute' or 'apoplectiform' bulbar paralysis, in contradistinction to the classic form of this affection described by Duchenne. *See* LABIO-GLOSSO-LARYNGEAL PARALYSIS.

LOCALISING PHENOMENA.—The symptoms met with in the affection just named are the most reliable clinical data on which to found a regional diagnosis of lesions of the medulla oblongata. The characteristic symptoms are a conjoint affection of the extremities and one or more of the bulbar cranial nerves, with impairment of speech and deglutition, and cardio-respiratory disturbances. Sometimes all four extremities are paretic or paralysed; sometimes the lower extremities alone; and occasionally the paralysis is of the hemiplegic order. If the paralysis affects only the extremities, without implication of the bulbar nerves, as sometimes occurs, a diagnosis of the medullary seat of the lesion cannot be made with certainty. Anæsthesia has not been recorded, but occasionally paræsthesiæ have been observed. Ataxic affections of the extremities have also been met with by Leyden and Prévost.

Of the cranial nerves the hypoglossal is most commonly involved. The symptoms are impaired mobility of the tongue, with more or less pronounced dysarthria (*see* APHASIA). This is not absolutely characteristic of bulbar disease, however, as a similar affection of the hypoglossal may occur in disease of the pons. The tongue and speech are rarely, if ever, so affected as in the classic or progressive bulbar paralysis. nor has the atrophy of the muscles of the tongue, with altered electrical reactions, been noted.

Of more importance as a diagnostic mark is dysphagia, or paralysis of deglutition. This, in the absence of general cerebral symptoms, points to affection of the medulla. Paralysis of the soft palate, on one or both sides, is also a frequent, if not constant, symptom. Occasionally also aphonia occurs, and, taken with the other symptoms, points conclusively to affection of the medulla oblongata.

Irregularity of the heart; acceleration or retardation of the pulse; and sighing and laboured respiration, often amounting to orthopnœa, in the absence of general cerebral symptoms, are also important indications of disease of the medulla oblongata. Among other symptoms have been noted coughing and vomiting, explicable by affection of the respiratory centres. Trismus has been mentioned by Joffroy as a characteristic symptom of acute bulbar paralysis, but Nothnagel, on good grounds, disputes the accuracy of this statement.

A case recorded by Glynn, *Liverpool Med. Chir. Journ.* 1887, where a tiny tumour (glioma) was found *post mortem* in the middle line of the medulla at the level of the calamus scriptorius, showed many of the above-mentioned symptoms, the most prominent being intense dyspnœa with paralysis of the diaphragm, vomiting, impaired movement of lips and tongue, dysphagia, loss of reflex action of palate, weakness in both arms and less in legs, and a trace of sugar in the urine.

Albuminuria and glycosuria have also been observed in connexion with bulbar lesions, the latter more particularly after injuries affecting the floor of the fourth ventricle; but the occurrence of these symptoms in connexion with acute bulbar paralysis requires further investigation, as they cannot as yet be regarded as constant.

An affection simulating disease of the medulla oblongata results from bilateral lesion of the anterior third of the internal capsule (Lépine), or of the cortex in the region of the lower extremity of the ascending frontal and posterior extremity of the third frontal convolution (Barlow). Such a bilateral lesion causes paralysis of articulation, and also true aphasia if the lesion is cortical, along with a greater or less degree of double hemiplegia. The diagnosis must depend on the truly volitional character of the paralysis in such cases, the reflex mechanism of deglutition being unimpaired. There will also be absence of affection of sensibility and of trophic degeneration of the muscles, and absence also of disturbances of the cardiac and respiratory rhythm. Defective comprehension of speech, and obvious aphasia—the movements of articulation not being absolutely paralysed, and also agraphia—the hand not being completely powerless, will differentiate cerebral from bulbar paralysis.

D. FERRIER.

MEDULLA OF BONES, Diseases of.—SYNON.: Fr. *Maladies de la Moelle des Os*; Ger. *Krankheiten des Knochenmarks.* The morbid conditions of the medulla of bones are most conveniently described under the head of the several diseases of which they almost invariably form but a part. Thus, injuries, acute and chronic inflammation or osteomyelitis, and the majority of new-growths involving the marrow, affect the bone as a whole, and are accordingly discussed in the article upon these subjects (*see* BONE, Diseases of). Myeloid tumour, which is peculiarly connected with the medulla, is also described and figured in the article on TUMOURS.

The medulla of bones is also the seat of important pathological changes in several chronic constitutional diseases. For instance, it is affected in some cases of leucocythæmia, and of lymphadenoma; in mollities ossium; and in rickets. The reader is referred to the description of the anatomical characters of these conditions in the articles bearing their several names.

MEDULLA SPINALIS, Diseases of.—*See* Spinal Cord, Diseases of.

MEDULLARY CANCER.—A synonym for encephaloid cancer. *See* Cancer.

MEGRIM. — Synon. : Migraine; Sick Headache; Nervous Headache; Hemicrania (ἡμι, on one side of; and κράνιον, the head); Fr. *Migraine*; Ger. *Migräne.*

Definition. — Headache of a periodical character; generally ushered in by some premonitory symptoms; more or less unilateral; and frequently associated with nausea and bilious vomiting.

Ætiology.—The chief predisposing causes of attacks of migraine are hereditary tendency; anæmia; a general want of tone in the system; and the nervous temperament. Among the exciting causes may be included all those of a depressing or exhausting nature, whether physical or mental, such as prolonged mental work, mental excitement, grief, anxiety, bodily fatigue, late hours, sexual excesses, breathing the impure air of a crowded room, and improper food.

Symptoms.—This complaint seems to have two more or less well-defined stages, the headache being preceded for a variable period by certain disorders of sensation. In some persons the malady stops short here, and is not followed by headache; in others the headache appears to be developed without any premonitory symptoms, until careful inquiry reveals the contrary. The two stages therefore are, first, the stage of disordered sensation; second, the stage of headache, with other symptoms.

The most striking of the disordered sensations is a transient disturbance of vision which sometimes takes place. It commences with a wavy glimmering near the outside corner of the field of vision, and spreads all over the visual area with a zigzag outline, in a straight-lined angular pattern, and with or without lines of colour between the darker lines. Or it may commence by the appearance of a blind spot close to the centre of vision, which soon begins to spread, showing a serrated margin, and presenting a tremor or wavy glimmering in its interior. This condition is often associated with a feeling of chilliness, coldness of the hands and feet, or other symptoms; it may last from five to thirty minutes or longer, and then be succeeded by the stage of headache.

On the other hand, the headache may be, and in many individuals always is, developed without the ocular disturbance, but other sensations are substituted for it. The patient has a feeling of chilliness, and the feet are cold. There is mental depression, with a dread of impending evil; the patient is restless and uneasy; 'cannot quite tell,' as he says, 'what he would be at;' and has what is expressively called 'the fidgets.' This condition may continue half an hour or more, and then the slight boring piercing pain is felt in the head, with which the aching begins; and the disorder runs its course, as will be presently described. In other cases, this feeling of depression or uneasiness lasts for several hours, the patient goes to bed, and in the early morning wakes with the headache fully developed.

The headache, when preceded by ocular disturbance, shows itself as follows: When the vibratory movement is at its height, a little aching is felt in the head, on the side *opposite* to that on which the glimmering first appeared; it is slight at first, but gradually increases in intensity. Some persons have said that the sensation was as though a point in the temple were being bored with a gimlet, and the gimlet slowly increasing in size. The pain gradually spreads from this point, which may be covered with the finger, and pressure upon which affords relief, first over one side of the head; and then, but not always, it extends to the other. As the headache increases, the ocular disturbance declines; nausea is felt, which increases with the headache; retching and vomiting occur, the latter sometimes, though rarely, giving relief; the head throbs; the slightest movement increases the pain, and any attempt to move from the recumbent posture increases the gastric uneasiness; the mouth feels clammy; the eyeballs ache, and are tender on pressure, one more so than the other; the pupils are rather contracted, and generally unequally so; and the patient lies apparently more dead than alive, his face pale, and the head hot. After a varying number of hours he is somewhat relieved by troubled sleep; he wakes up next morning, free perhaps from headache; but he is listless; his brain is weary; and he feels as if he had undergone a hard mental struggle. There may be now an interval of a few days, weeks, or years, before the disorder again shows itself.

The headache varies much in character, degree, and duration. In some persons the pain is not localised in any particular spot, but seems generally diffused over the head; others have not noticed that there is more pain on one side of the head than the other, or that the aching radiates from one painful spot, until their attention has been directed to the fact, and then they distinctly recognise it; others, again, have neither vomiting nor nausea; and lastly, the duration of the headache may be very short, or not extend over more than two or three hours, or this symptom may be entirely absent. The disorder may even stop short at the vibratory stage, the vision be restored, and no further inconvenience felt.

In a certain proportion of cases during the vibratory stage a tingling is felt in some portion of the body—the part is 'asleep.' Sometimes it is felt in one arm or in the side of the tongue, or on the side of the face, and it is on the same side as that on which the glimmering in the eye begins. Sometimes the hearing, speech, or memory is affected.

The age at which the attacks generally commence is from twelve to twenty-five. Females are more liable to them than males. After a certain period, with advancing age the attacks, as a rule, are less easily developed, and become much less frequent. They cease generally after fifty or sixty, and in women not uncommonly at the change of life.

PATHOLOGY. — Considerable diversity of opinion exists as to the nature of megrim. Formerly it was regarded as being dependent upon gastric or hepatic derangement—a view, however, which now finds few supporters. Some pathologists hold it to be a form of neuralgia; but though it has a great resemblance to neuralgia, it 'causes much greater disturbance of the sensorium, it spreads much more generally over the head, and is not infrequently accompanied with nausea and vomiting. After the attack there may be an intermission of weeks or months, and the attack itself runs a more uniform or continuous course' (Lebert). The view which the writer has advanced is that the affection is to be referred to the sympathetic nervous system. If by fatigue, anxiety, or other depressing cause, the general tone of the body be lowered, and with it the regulating or inhibitory power of the cerebro-spinal over the sympathetic nervous system impaired, then uncontrolled action or excitement of one or more portions of the latter takes place, causing contraction of the blood-vessels under the influence of the affected portions, and so producing the disorders of sensation which precede the headache; this excitement is followed by exhaustion or paralysis of the sympathetic, and is associated (just as would be the case after section of the nerve) with dilatation of the vessels, and with headache. Dr. Edward Liveing, in his classical and exhaustive work on megrim, combats this view, and maintains that the phenomena are those of 'a nerve-storm traversing more or less of the sensory tract from the optic thalami to the ganglia of the vagus, or else radiating in the same tract from a focus in the neighbourhood of the quadrigeminal bodies.'

TREATMENT.— By careful management very great relief can be afforded to the sufferers from this malady, not only by diminishing the intensity of the attacks, but also by considerably lengthening the intervals between them. We may consider separately the remedial measures to be employed (1) during the intervals between the attacks; (2) during the premonitory stage or stage of disordered sensation; and (3) during the stage of headache.

1. *During the intervals between the attacks.*—It is to the treatment during this period that the greatest consideration must be given. The cause, if possible, must be discovered, and in a very large majority of cases careful inquiry will reveal the fact that a distinct cause does exist. Overwork, prolonged anxiety, over-fatigue, disappointed hopes or affections, sexual irregularities, defective eyesight, and impoverished nutrition of the body, are among the chief causes; and while these are in operation medicine will prove of little avail. Remove the cause, and then endeavour to brace up the bodily and nervous systems. The chief remedies for this purpose are the vegetable bitters, iron, strychnine, and cod-liver oil. But the success following their use very much depends upon the way in which they are administered. For a day or two after a headache the stomach and bowels may possibly be disordered, and not in a fit state to tolerate iron or cod-liver oil. This condition must be corrected, and for this purpose the simple vegetable bitters, such as gentian with small doses of henbane and some aromatic, may be of service; and if necessary one or two grains of blue pill, with four or five of compound rhubarb pill, may be given at night; but strong purgation must be avoided. Iron may then be given, either in the form of the ammonio-citrate alone, or combined with two or three grains of iodide of potassium; and according to circumstances fifteen or twenty minims of tincture of henbane, or twenty or thirty minims of aromatic spirit of ammonia, may be added to each dose. Or the iron may be given in the form of the mistura ferri composita of the Pharmacopœia; the mixture answering better, however, in some cases without the myrrh. Strychnine is, in the writer's opinion, a very important remedial agent in many forms of this disorder, and may be given with the remedies previously mentioned in the form of liquor strychninæ hydrochloratis or tinctura nucis vomicæ, or may be combined with infusion of quassia or calumba. Where iron is contra-indicated from any cause, or when it is not readily borne, the administration of nux vomica with quassia has seemed to act beneficially. In females with a distinct hysterical temperament nux vomica does not answer so well, and better results will be obtained by giving the vegetable bitters with ten-grain doses of bromide of potassium, and fifteen or twenty of tincture of henbane, twice or three times a day. As a rule, however, the bromide is of more use administered during the headache than in the intervals. Cod-liver oil often acts beneficially, especially when there is much nervous exhaustion. It may be given once a day immediately after breakfast, beginning with a small teaspoonful, and gradually increasing the quantity to a tablespoonful, but not beyond, unless in exceptional cases. If the bowels are constipated, five grains or so of the socotrine aloes pill may be given at

night; or if the constipation be habitual, five grains of the aloes-and-iron pill, given twice a day before meals, will generally induce greater regularity in the action of the bowels.

In some individuals megrim is associated with a strongly marked uric-acid diathesis, as shown by the fact that preceding or succeeding an attack the urine is strongly acid and loaded with lithates. In these cases fifteen or twenty grains of salicylic acid, or salicylate of sodium, twice a day, in conjunction with other remedies, to correct or neutralise the uric-acid formation, will often be of signal service.

Other remedies have been recommended, and are sometimes of service, especially arsenic and quinine.

In persons of feeble bodily power, rest is of the greatest importance, and it is often advisable that such patients should remain in bed at least twelve hours out of the twenty-four, and take their breakfast an hour and a half or two hours before rising in the morning. Whenever the headaches recur frequently, this rule should be enforced. In cases where borne, a tumblerful of new milk, to which two teaspoonfuls of brandy, rum, or whisky have been added, may be taken with advantage before breakfast, directly on waking in the morning.

The diet should be liberal; the food plain and easily digestible; and two or three glasses per diem of wine, beer, or porter may generally be taken with benefit, according to the habits of the patient. The more exercise the patient can take in the open air, without fatigue, the better.

2. *During the premonitory stage, or stage of disturbed sensation.*—In the forms attended by disturbance of vision, the longer this lasts the greater will be the headache, and we must endeavour therefore to shorten this stage as much as possible. Directly the glimmering appears the patient should lie down, with the head low; and if the glimmering be on the right or left of the field of vision, he should lie on the *opposite* side. Let him take at once some alcoholic stimulant, a glass of sherry, a tablespoonful of brandy diluted, or a glass of champagne. If alcoholic stimulants be objected to, or if it be not advisable to recommend them, then a teaspoonful of sal volatile in water may be prescribed instead. If the patient be chilly, or his feet cold, the couch should be drawn near the fire, and a hot bottle applied to the feet. By these means the heart is enabled to drive the blood with greater force to the brain, and the duration of the vibratory movement is thereby materially lessened. After the glimmering has passed off, the patient should lie still for a time, so that it may not return. This injunction will only be necessary when the headache is slight; if it be severe, attended with much nausea or vomiting, the patient will be little disposed, or little able, to leave the recumbent position.

If, instead of the disturbance of vision preceding the headache, there be a feeling of depression or irritability, fidgets, and similar phenomena, the administration of such cerebro spinal stimulants as henbane, valerian, asafœtida, spirit of chloroform, or ether, will often cut short the attack. Fifteen or twenty drops of the tincture of henbane, with the same quantity of spirit of chloroform, will soothe the nervous irritability in the slighter forms, and may be repeated in three or four hours if necessary. If there be great mental depression, then valerian or asafœtida should be tried. Half a drachm to a drachm of the ammoniated tincture of valerian, or the same quantity of the fetid spirit of ammonia, may be given. Sometimes indian hemp is very useful, a quarter to half a grain of the extract in a pill, or five to ten drops of the tincture on a lump of sugar. As a rule, in such cases as these, alcoholic stimulants are not advisable at this stage. A small quantity will cause flushing, heaviness, and slight confusion of thought, without relieving the depression; and though the severe headache may be averted, alcoholic stimulants do not answer so well as the remedies previously mentioned.

3. *During the stage of headache.*—If the headache be slight, and the patient soon able to sit up, there is little to be done. A cup of coffee or tea, cheerful conversation, a walk, drive, or ride, may often help to remove the pain. If, however, the symptoms be severe, then the administration of further remedies is called for. The patient should keep perfectly still and quiet, with the room darkened; for every sound or sight causes pain, and the slightest movement is sufficient to produce gastric uneasiness. Sometimes free evacuation of the contents of the stomach, especially if it contain undigested food, is followed by relief; but, as a rule, it is better to try to relieve and check the vomiting. Iced soda-water, with or without two or three drops of diluted hydrocyanic acid or spirit of chloroform; cold tea; or the effervescing citrate of potassium with diluted hydrocyanic acid, may often afford marked relief. The headache may be lessened by applying cloths dipped in cold water or evaporating lotions to the head. If the extremities be cold, and the headache severe, a warm stimulating foot-bath can be tried, as soon as the nausea will allow the patient to sit up. If the attacks occur in the early part of the day, as soon as the pain has subsided it is generally better for the patient to sit up or move about, or even to take exercise in the open air. During the attack the appetite is diminished, the idea even of taking food provoking disgust. Still, after the nausea has passed away, a cup of soup, or some easily digested food, will often have a good effect in equalising the cerebral circulation, and in relieving the headache. If the head-

ache be severe, bromide of potassium is a remedy which will often prove of great service. It may be given in doses of fifteen or twenty grains, with fifteen or twenty minims of tincture of henbane, and to these may be added thirty or forty minims of the aromatic spirit of ammonia, in some cases with advantage. If necessary, the dose may be repeated after an interval of two hours or so. In some cases phenazone may be given with benefit in doses of seven to fifteen grains, with thirty minims of sal volatile, or acetanilide in five-grain doses, and repeated in an hour if necessary. In other cases, often of a gouty character, chloride of ammonium in doses of fifteen grains produces marked relief, and may be sometimes advantageously combined with spirit of chloroform and compound tincture of lavender. Guarana powder is a remedy which is used, often with happy results. The sick-headaches which it seems to relieve are those in which distinct premonitory symptoms usher in the attack, and particularly those preceded by disturbance of vision. It may be given in such cases in doses of fifteen grains, with the same quantity of sugar, and repeated in from half an hour to two hours. In those individuals, however, in whom the headache is developed suddenly, where the attacks come on without any or with very indefinite premonitory symptoms, guarana appears to have little effect.

As a rule, the use of purgatives in this stage is decidedly objectionable, but occasionally a saline purgative at the commencement of an attack is indicated, and is of service.

Peter W. Latham.

MEINBERG, in Lippe-Detmold, in Germany.—Mixed sulphurous saline and chalybeate waters, and mud baths. *See* Mineral Waters.

MELÆNA (μέλας, black). - Synon.: *Dysenteria Splenica*; Fr. *Méléna*; Ger. *Schwarze Ruhr*.

This term is used to denote black tar-like evacuations that are passed from the bowel. The colour and appearance are due to *altered* blood, and the expression is not properly applicable to simple hæmorrhage from the alimentary canal, when blood of a normal appearance is voided.

In order that the blood should have undergone the change which produces the characteristic evacuations, it must have been effused high up in the canal, and in some quantity, as well as retained for some time in the bowel. When hæmorrhage takes place in the lower part of the small intestine, or in the colon or rectum, the blood is passed in a scarcely altered state, or at most renders the fæces dark, without producing the black, viscid motions now referred to.

Blood that is passed into the stomach, from any cause, is subjected to the action of the gastric juice, and undergoes a partial digestion. The acid of the secretion converts the hæmoglobin into hæmatin, a blackish-brown substance, and the exposure of this to the sulphuretted hydrogen produced in the lower part of the intestine converts the iron it contains into a black sulphide. The tar-like consistency is due to the serum, digested clot, and mucus; and the discharged material is usually free from remains of food, being simply altered blood. When the hæmorrhage takes place into the upper part of the intestine, the change is not so completely effected. In place of being submitted to prolonged action of an acid secretion, with considerable power of digesting, the blood is acted upon by alkaline secretions, the efficacy of which is less, unless the ingesta have been previously affected by the gastric juice. The result is that, although the blood is to a great extent altered, and the same black sulphide of iron is formed, it becomes more or less mixed with the contents of the tube, and is not voided in lumpy clots, but almost uniformly incorporated with the fæces, which may be solid, semi-solid, or fluid. The fæces may be blackened by iron, bismuth, and other agents, taken as drugs, but they do not produce the viscid matter like semi-digested blood.

A form of melæna, with or without hæmatemesis, has been occasionally noticed in infants within a day or two after birth. The cause is obscure, but is probably associated in some way with the disturbance of the circulation determined by the ligature of the umbilical cord. Sometimes clean-punched ulcers have been found in the stomach or duodenum in such cases, but oftener there are no indications to be seen *post mortem*. The condition, which is very fatal, is probably allied to other hæmorrhagic states met with in the new-born, such as purpura.

Melæna is the mere expression of a condition brought about by many causes, and these have to be sought for and treated. *See* Hæmatemesis; Intestines, Hæmorrhage from; and Stools.

W. H. Allchin.

MELANÆMIA (μέλας, black; and αἷμα, the blood).—A morbid condition of the blood, in which it contains black and brown pigment-particles. *See* Blood, Morbid Conditions of.

MELANCHOLIA (μέλας, black; and χολή, bile).—Synon.: Fr. *Lypémanie*; *Mélancolie*; Ger. *Schwermuth*; *Melancholie*.—This name is now usually applied to a form of insanity characterised by great mental depression, but formerly it was used by writers to denote *partial* insanity or monomania. The sufferer in this disorder feels his whole existence, mental and bodily, overwhelmed and oppressed by gloom, anxiety, and foreboding. At first it may be only a feeling which takes no definite shape, and there may be no delusions. Sometimes, though rarely, there are none throughout; the morbid feeling constitutes the disorder, which in this form has been called *simple* melancholia. Its access is almost always gradual, and though we may attribute it to grief, overwork, or worry, it often happens that no mental or moral cause can be found, and we are obliged to set it down to inherited predisposition, to some debilitating illness, declining strength, or advancing age. Some are aware that there is no real ground for their sorrow and sadness, and are able to look on it as an illness; others feel that there must be some real cause for the despondency, that something terrible is impending, though they know not what. The majority can argue and converse rationally on subjects unconnected with their feeling of misery.

The bodily health, even if at first it appears good, soon participates in the disturbance. The digestion is disordered, the urine loaded with lithates, the skin dry, the bowels constipated, the pulse slow rather than quick, the conjunctiva dull and yellow. The patient will complain of various uneasy feelings in the præcordial or epigastric region, and this, with the state of the excretions, will confirm the notion, so prevalent amongst many, that the whole mischief is in the liver. Such simple depression may continue for a longer or shorter space of time. It may pass away suddenly or gradually, or the individual will grow worse in one of two ways. The depression becomes greater, and delusions of various kinds present themselves; or it is replaced by the excitement of mania.

Melancholia with delusions is far more common than *simple melancholia*, and is that which most frequently we are called upon to treat. The patient feels utterly changed, which he attributes to various causes, and deduces various results from his condition. He has all manner of diseases—syphilis, leprosy, lice; his stomach is gone, and therefore he cannot eat. He cannot attend to business, and therefore is ruined. He is so wretched that he must have committed sins unpardonable in this world or the next. The bodily symptoms, like the mental, are aggravated. Sleep is absent or scanty; and there is rapid wasting. The bowels are loaded, and resist strong purgatives; the tongue is white and furred; the breath offensive. The patients are for the most part elderly; climacteric insanity is almost always melancholia. Of 338 melancholic patients admitted into St. Luke's Hospital only 9 were below the age of twenty.

It cannot be too strongly impressed upon medical men that all melancholic patients, even those whose disorder seems simple and slight, are, especially in the early stage, very apt to commit suicide. We read accounts almost daily in the newspapers of suicides committed by this class of persons; and most lamentable they are, for it is a class which above all others is amenable to treatment.

An asylum is not absolutely requisite for such, if their means allow of proper companions, house, and exercise. They must not be left alone by night or day; must not be left to attendants only; and must have some amusement or diversion. If all this cannot be provided, to an asylum they must go; for if they are resolutely and constantly bent on suicide, it is most difficult to guard against it in an ordinary house.

Whether they are sent to an asylum or not, it is found to be almost invariably necessary to remove them from home. We may think the case a slight one, and may hope that amusement and cessation from work, with medical treatment and good living, will remove the depression. Again and again we are disappointed. The sight of home and home scenes, of family and friends, and the contrast between past happiness and present gloom, perpetuate the melancholy and prevent its dispersion. After valuable time is lost, we are compelled to send away the patient to an asylum or quasi-asylum.

Prognosis. — The prognosis in cases of melancholia is favourable, and patients get well in great numbers, even at an advanced age. It is also important to remember that recovery may take place from this form of insanity after considerable periods of time. The writer has in the second volume of the *St. George's Hospital Reports* recorded three cases of melancholia in which recovery took place after five, six, and seven years' residence in an asylum; and he has since treated a lady who recovered from a most suicidal attack of the disorder after nine years. In dealing with property it is often necessary to consider the question of probable recovery, and it is well to keep in view the chance of it here, although in perhaps every other form of insanity recovery after such periods would be out of the question.

Treatment.—On examination of a melancholic patient, it is generally found that there has been a considerable loss of flesh. This may be due to the mental care and sorrow, but it is often caused by an insufficient quantity of food, which has been scanty, either because all appetite has been lost owing to the prevailing wretchedness, or because, from various delusions, there has been an unwillingness to take food. Moreover, there is almost always considerable disorder of the digestive apparatus, the result and not the cause of the depressed nervous condition. The first thing to be done is to correct this disorder; and then to restore the defective nutrition of the brain.

One symptom is obstinate constipation. It may be necessary in the first instance to relieve the loaded and obstructed bowel by means of turpentine enemata; after which it will be of advantage to give a daily dinner pill of the extracts of aloes and nux vomica, or a daily teaspoonful of castor-oil, following it up if necessary by an enema, but ensuring an action every, or every other, day, and so habituating the bowels to act. Many melancholic patients, especially women, will be found to be persons who have been accustomed to go for long periods without any action of the bowels, or who never had relief without medicine. Food must be given to this class of patients in large quantities. It constantly happens that it is withheld from them under the impression that their malady is essentially dyspepsia, and that the stomach must not be called upon for much exertion. Many, as has been said, refuse it for one reason or other. In either case the melancholia increases, and the patient gets thinner and weaker. Food must be given with no sparing hand—not merely beef-tea and invalid diet, but solid food, bread, meat, and eggs, with a liberal allowance of wine or malt liquor. Some may require forcible feeding, and this can hardly be carried out except in an asylum; but many by coaxing or threats will take what is given to them with a spoon, and they must be fed frequently till they will take the meals of their own accord. Under this augmented diet the tongue will become clean, the bowels will act without physic, and the patient's appearance will soon testify to the efficacy of the treatment.

Sleep, though not entirely absent here, will be in defect. To procure it opium has been long looked upon as of the greatest value. In melancholia, of all the various forms of insanity, this drug is most useful, and its benefit consists not merely in the procuring of sleep, but in alleviating the feeling of wretchedness. It may be given either by the mouth, or by subcutaneous injection of morphine. It is of importance that we do not give a preparation which shall cause sickness or constipation; the ordinary preparations of morphine, the acetate and hydrochlorate, are apt to do this if given in full doses, and it is better to substitute the solution of bimeconate, Dover's powder, Battley's solution, or solid opium if we can be sure that pills will be swallowed. Chloral hydrate will procure sleep here as in other cases, and may be combined with opium to bring about more speedy action of the latter, but has not such a lasting influence on the malady; when its sleep-producing effect has passed away, the patient does not feel any benefit from the medicine. Paraldehyde, also, is often useful. The bromides should on no account be given. They will increase the emaciation and depression. When the secretions have been corrected, and digestion is re-established, tonics may be useful, especially the preparations of iron and arsenic.

G. F. Blandford.

MELANCHOLIA, Varieties of.—**1. Melancholia, Acute.**—Although the prognosis in simple melancholia, and that which may be called sub-acute, is so favourable, there is an advanced stage which truly merits the name of *acute*, or *acute delirious melancholia*, and generally terminates fatally. The patients are not silent, gloomy, and depressed, but panic-stricken; and in violent frenzy and terror they try to escape from those about them, to tear off their clothes, gouge out their eyes, and injure themselves in every way. They will not lie on a bed unless forced to do so, but will prefer the floor, or incessantly pace the room. Food they resist with all their power, thinking that it is poisoned, or that they will be punished for taking it. Such patients must be fed by force, and fed early, but it often happens that our feeding here is of no avail, and they sink from the exhaustion of this acute disorder. For it is constantly found in those who are already broken and debilitated in health, and is but the last stage of a series of disorders. The incessant agitation, violence, and sleeplessness produce rapid wasting and sinking; the food administered is not assimilated, and fails to restore the wasted force. This form of melancholia runs a rapid course, but nevertheless tends to recovery in the majority of cases. We may administer opium here, with or without chloral hydrate, or paraldehyde; other drugs are of little use. Cod-liver oil may be added to the food. Warmth and stimulants are demanded; and clothes must be kept on by means of a strong suit which cannot be removed by the patient.

2. Mélancolie avec Stupeur (Fr.)—Synon.: Ger. *Schwermuth mit Stumpfsinn*. A more extreme form of melancholia is thus named, where the patient sits or stands, speechless and motionless, and requires to be fed, washed, and dressed. Though such a one will not speak or do anything for himself, he may be watching every opportunity of committing suicide, and he will even strenuously refuse food with the same motive. The vital powers in these persons are greatly depressed, and they require an exceptional amount of nutritious food and stimulant. This form of melancholia has been confounded by some with that variety of insanity termed 'acute dementia' (*see* Dementia); but the latter occurs only in young people, whereas melancholia as a rule occurs in persons of more advanced years; and the early symptoms are quite different, acute dementia coming on rapidly, and without the depression and gloomy delusions which mark the other complaint. G. F. Blandford.

MELANOMA (μέλας, black).—Any morbid growth in which the presence of black pigment is a leading character. *See* Tumours.

MELANOPATHIA (μέλας, black; and πάθος, a disease).—An excess of black pigment in the skin, due to abnormal function of the rete mucosum. Melanopathia is rarely general, more frequently partial. In certain instances, as in the 'bronzed skin' of Addison's disease, it is associated with anæmia. *See* PIGMENTARY DISEASES OF THE SKIN.

MELANOSIS (μέλας, black).—According to the present doctrines of pathology, melanosis signifies the condition of system associated with the presence of pigmented tumours. *See* CANCER; and TUMOURS.

MELASMA (μέλας, black).—A term usually applied to excess of pigment in the skin, from abnormal function of the rete mucosum. *See* PIGMENTARY DISEASES OF THE SKIN.

MELLITURIA (μέλι, honey; and οὖρον, urine).—A synonym for saccharine urine. *See* DIABETES MELLITUS.

MEMBRANA TYMPANI, Diseases of.—*See* EAR, Diseases of.

MEMBRANES OF BRAIN AND CORD, Diseases of.—*See* MENINGES, CEREBRAL, Diseases of; and MENINGES, SPINAL, Diseases of.

MEMORY, Defects of.—There are so many different kinds of memory, and so many different degrees of excellence of each variety in different individuals in health, that it is not always easy to say in regard to any particular person how far his memory is defective. In other cases the degree of impairment is so great as to make its existence perfectly obvious. Between such extremes, all intermediate grades of defect may at times be met with. The nature and causes of the various defects of memory cannot possibly be set forth without giving some account of the different physiological processes involved in its exercise; and also of the several fundamental modes in which this is brought about.

THE COMPONENT PROCESSES IN MEMORY.—What is commonly known as 'memory' is dependent upon two kinds of processes. The *first* of these is a vital, molecular, or organic process of some kind, taking place in various parts of the brain simultaneously, on the occurrence of some 'perceptive act' or thought-process. In a healthy and properly nourished brain certain neural processes, in different regions of the organ, are supposed to coincide with each act of perception and apprehension. Similarly, in 'ideation' or reflection, molecular processes of a closely related kind are presumed to take place, partly in the areas of the brain concerned with perceptions and partly in other regions, and these several changes have the same kind of relation to our thoughts that the others have to our perceptions; in each case they, in fact, constitute the organic basis of the respective processes. These initial organic changes of all kinds were referred to by Laycock, and comprised under the name 'synesis.' The first essential, therefore, for the exercise of memory is that these synetic processes should have been properly accomplished. If they have been imperfectly performed, memory will be either defective or non-existent.

Yet these processes constitute the foundations for memory, rather than memory itself.

Memory essentially consists in a repetition or weak revival of such molecular movements and processes in nerve-tissues, and of the conscious states associated with them. They are similar in kind, and take place in all such parts of the brain as were concerned with the original conscious realisation of the objects, relations, or processes which now recur as 'remembered' impressions or thoughts. This, therefore, is the *second* of the processes above referred to, as essential to the exercise of memory.

MODES OF EXERCISE OF MEMORY.—The repetition or weak revival of foregone processes, and of their associated conscious states, is brought about in three modes fairly distinct from one another. The first mode of exercise of memory (*a*) is found in acts of perception, when, on the presentation of some object to the sense of sight, hearing, touch, smell, or taste, or to any two of them, the remaining qualities of this object become nascent or revived in memory, so that the object itself is perceived or recognised as being of such and such a nature.

This kind of process is only impaired where the nutrition of the brain as a whole is gravely interfered with. Special parts of such a process are, however, not infrequently interfered with by local brain-disease, as when, for instance, the sight of a written or printed word does not rouse its appropriate related memories; or when a spoken word remains unrealised or unapprehended, because its mere sound does not excite all the memories which should cluster round it; in the one case we have what has been rather inappropriately termed 'word-blindness,' and in the other 'word-deafness.' The one set of persons exhibiting such defects may be perfectly well able to recognise natural objects or persons by sight, just as the others may be able to appreciate different kinds of natural sounds, or differences in emotional intonations of the voice, although particular words may not call to their mind any distinct apprehension of the thing, idea, or relation which they are usually employed to designate.

The second, or most common mode in which memory is exercised is (*b*) during the ordinary course of thought, when by natural processes of 'association' the ideas of objects, of persons, of events, and of their relations one with another and with ideas, recur to consciousness, with or without a simultaneous full realisation of the words suitable for the expression of all these phases of our thoughts—according as we are merely thinking to ourselves, or as we at the same time give expression to our thoughts whilst conversing with another person. These, together with the kinds of exercise first referred to, constitute by far the most frequent modes in which memory is called into play. It here manifests itself in a purely automatic manner, without sense of effort on our part (other than that which is concerned with the direction of our thoughts), owing to the fact that present cerebral activities tend to recur in the manner and order which have been most frequently repeated in the race and in the individual—such manner and order necessarily varying according to the particular direction and nature of their or his education, natural or acquired. The study of this order corresponds with the study of the order of mental phenomena, and has resulted in the establishment of certain so-called 'laws of the association of ideas.'

The process by which language incorporates itself with all our perceptions and thoughts is not different from that which associates perceptions and thoughts among themselves. It is, however, a more special association; and consequently a weak or failing memory—whether resulting from old age, brain-shock, or malnutrition—is peculiarly apt to show itself in this direction, and that more especially by an inability to revive the cerebral processes connected with the names of persons, places, or things (*see* APHASIA). But this kind of defect has to be distinguished from the inability to utter or to write words which are nevertheless remembered, that is, where the cerebral processes associated with the word as a mental symbol may be revived, in the main, in some portions of the brain concerned with the reception of auditory impressions, though incitations may not be able to pass over from these centres so as to revive nerve-processes in other centres of the kinæsthetic type, by which the word is either spoken or written, according as the one or other effect is desired (*see* APHASIA). The loss of verbal memory is in these latter cases not so real as it seems to be, and such defects may, moreover, be induced by quite limited cerebral lesions.

In the third mode of exercise of memory (*c*) there is no longer the easy flowing mechanical revival of foregone processes, together with the simultaneous recurrence of copies of foregone phases of consciousness, which should characterise the modes of exercise above alluded to. Now there is a delay in the process of automatic revival; a vague sense of effort intervenes at some stage of the thought-processes, similar to that of which we are conscious when we attempt to 'guide our thoughts' into particular channels; we strive 'by way of association' to find some new molecular channel by means of which the cerebral processes concerned with the forgotten name, event, idea, or relation, may be roused anew, in order that we may 'recollect,' or recall by voluntary effort, what may be needful for the continued expression of our thoughts.

This latter process of 'recollection' is therefore that which is rendered necessary by the first stage of faultiness of memory, a condition which may obviously be brought about in altogether different modes, to some of which we are now about to refer.

ÆTIOLOGY OF DEFECTIVE MEMORY.—It seems clear, on the one hand, that for memory to be good (*a*) the preliminary process of synesis must have been well accomplished. Yet this first and essential condition may be defective from various causes. (1) The original plasticity or receptive potency of the nerve-tissue may have been inferior from birth; or it may have been temporarily lowered by conditions of malnutrition, such as are not infrequently met with in persons who have suffered from severe fevers or from other exhausting diseases. On the other hand, the potency of the nerve-tissue may be good, and yet the processes of synesis may have been badly effected, owing (2) to the individual's lack of attention at the time when what is now to be remembered originally engaged his consciousness; for no truth is more obvious in regard to memory than that of its dependence upon the degree of attention bestowed upon the original impressions or ideas. Those which have been vividly attended to at the time, from whatever cause, tend to become indelibly 'stamped upon the memory,' and all the more so because such impressions or ideas are prone to be often thought of, and thereby strengthened by each revival of the cerebral process; whilst those that have slightly engaged our attention are apt not to be revived, and to be after a time effaced, though it is in this respect especially that so much of individual difference is met with. Greatly diminished power of attention is, moreover, commonly met with in exhausting diseases, and in multitudinous brain-affections.

But, on the other hand, however well the process of synesis may have been accomplished originally, this will be altogether unavailing if (*b*) the avenues are damaged or impaired by which associated processes transmit their stimuli. The automatic excitation of memory is then hindered. Thus, to take only one example, if certain commissural connexions be severed between what we may term the visual and the auditory word-centres, a person may be able to read so as to understand the words which he sees, and yet not be able to pronounce one of them, because the associational stimulus cannot pass to the corresponding part of the auditory word-centre, so as to rouse the particular memory or idea of the word, from the molecular processes concerned with which the outgoing stimuli issue for its pronunciation.

Again, however well the process of synesis may have been originally performed, if (*c*) the whole nutrition of the brain becomes lowered by exhausting disease or old age, failure of memory may present itself because attention cannot be adequately roused, and the cerebral processes generally are too feeble to propagate themselves, as they would have done formerly, into the various collateral channels, so as to rouse the activity of all the previously associated brain-regions necessary for the full realisation of the thoughts of the moment.

From what has been already said, it will be seen that defects of memory may result from very various causes, according as they impede one or other of the successive processes upon which memory depends. Thus, they may depend upon (*a*) synetic defects; upon (*b*) associational defects; or upon (*c*) expressional defects.

PATHOLOGY.—In all those cases in which we may presume that synesis is impaired, we may expect also to find evidence of a greatly weakened power of attention, and there may in addition be an impaired perceptive power. Such defects are mostly dependent upon general causes, affecting the nutrition of the brain as a whole. A condition of this kind may be only temporary, and then, whilst recent events are speedily forgotten, it may happen that the memory of old impressions remains fairly good, or may even be marvellously intensified, so that long-forgotten occurrences or knowledge become revived. At other times the patient's mind may for a time be reduced to a perfect blank—old and recent knowledge, familiar and unfamiliar, is alike blotted out; though after a time recovery of memory may take place, either slowly or with comparative suddenness. In cases of epileptic mania, and in many instances of brain-shock from blows upon the head, the patient may lose all memory of immediately preceding events.

Where the secondary process of revival is that which is interfered with, the loss of memory is generally most manifest in regard to words. The processes of association by which these are recalled to memory are either impaired or disturbed, so that we get one or other variety of amnesia induced, either of the paralytic, or of the incoördinate type (*see* APHASIA). Such amnesic defects are, in the opinion of the writer, specially prone to be induced by lesions of the convolutions contiguous to the posterior extremity of the Sylvian fissure.

Where there is mere loss of power to express thoughts, the loss of memory is often more apparent than real, and is due to a mere non-revival of certain kinæsthetic processes—thus causing paralysis of speech and writing as motor acts (*see* APHASIA). And these conditions, either singly or in combination, are also apt to be induced by lesions in the hinder part of the third or of the second left frontal convolution, or of regions between these gyri and those bordering upon the posterior extremity of the Sylvian fissure traversed by their commissural fibres.

TREATMENT.—The treatment of these defects of memory naturally resolves itself into that of the various general or local morbid conditions upon which they depend, to which reference has been made in the sections on Ætiology and Pathology. Our greatest successes will be in cases in which defects of memory are dependent upon lowered conditions of general health, with defective nutrition of the brain. Here tonics, such as liquor strychninæ hydrochloratis and liquor arsenicalis, alone or combined with preparations of iron or hypophosphites, may do much good. Their action may be aided by maltine and cod-liver oil, together with rest, if the brain functions have been enfeebled by overwork. Where memory is defective in the young from faulty attention, much may be done to strengthen it by the judicious exercise and cultivation of these faculties, either by the patient alone or with the aid of a tutor.

H. CHARLTON BASTIAN.

MENIDROSIS (μήν, a month; and ἱδρώς, sweat).—A term applied to vicarious menstruation by the skin. *See* SUDORIPAROUS GLANDS, Diseases of.

MENIÈRE'S DISEASE.—*See* VERTIGO.

MENINGES, Diseases of.—The treatment of this subject is naturally divisible into two main heads. We have to consider (1) the morbid conditions resulting from disease of the **Cerebral Meninges**; (2) those of the **Spinal Meninges.** Though most frequently affected separately, still it happens on some occasions that these two main divisions of the membranes surrounding the great nerve-centres are simultaneously diseased. This is the case, for instance, in *epidemic cerebro-spinal meningitis*, an important general disease, which is considered in a separate article (*see* CEREBRO-SPINAL FEVER). A similar diffusion of inflammation also occurs, but more rarely, in cases of *sporadic cerebro-spinal meningitis*, which may be sometimes 'simple,' and sometimes of the 'tubercular' order. In the articles that follow, the several diseases of the cerebral meninges and of the spinal meninges will be separately discussed.

MENINGES, CEREBRAL, Diseases of.—SYNON.: Fr. *Maladies des Méninges Cérébrales*; Ger. *Krankheiten der Hirnhäute.*—The following morbid conditions, and varieties of such conditions, have to be considered under this heading:—

1. *Inflammation*—of several varieties.

Inflammation of the cerebral meninges occurs from various causes, and also affects various parts of the membranes, so that the subjoined varieties of the disease will have to be separately considered:—

(*a*) *Simple Meningitis* { α. Idiopathic.
β. Traumatic.

(*b*) *Tubercular Meningitis.*

The simple meningitis of traumatic origin occurs under three pretty distinct forms, according as it affects the dura mater—*pachymeningitis*; the surfaces of the arachnoid—*arachnitis*; or the meshes of the pia mater beneath this membrane—*leptomeningitis.* Both the *idiopathic simple meningitis* and *tubercular meningitis* are forms of leptomeningitis. All are acute diseases.

Concerning *chronic meningitis* we have more of pathological than of clinical knowledge, though even as regards the former side we are bound to say that much of the thickening and opacity of the arachnoid, formerly regarded as due to 'chronic inflammation,' is rather a mere result of degenerative overgrowth—partly brought about as an appanage of advancing age, and partly as a consequence of frequent or long-continued congestion. Still, such conditions may at times be coupled with more distinctive evidences of actual chronic inflammation, for example, in some cases of chronic mania, and also in general paralysis of the insane.

Good reasons, moreover, exist for believing in the frequent clinical existence of local chronic inflammation of the meninges, as evidenced by the presence more especially of localised pain and of tenderness on slight percussion, coupled with other head-symptoms. Fortunately for the patient, however, we have often no opportunity of verifying this diagnosis, because such a condition is of itself not likely to lead to fatal results. It may follow a blow; it may occur as one of the consequences of constitutional syphilis, or it may manifest itself independently of either of these causes. Chronic syphilitic meningitis is the best known of these varieties. Its associated morbid conditions are, however, most closely related to another set of changes, which will be described, and in which we have to do with new-growths or 'gummata.'

Two other varieties of meningitis are occasionally met with as rare events: first, an inflammation limited to the envelopes of the cerebellum, or extending from it only to the pons Varolii; and, secondly, an inflammatory condition of the lining membrane of the lateral, and perhaps of the third ventricles. The natural history of these states is at present so little known as not to admit of systematic treatment. Their ætiology and symptomatology have still to be established. This form of basal meningitis the writer has seen presenting symptoms indistinguishable from those met with in many cases of tumour of the cerebellum.

2. *Hæmorrhage.*

3. *Hæmatoma.*

4. *New-growths* and *Adventitious products.*—Under this head are included, besides the different kinds of tumours originating in the meninges, other bodies of quasi-accidental origin, which may be met with in the cavity of the arachnoid, in the meshes of the pia mater, or in connexion with the vessels of these parts.

5. *Malformations. See* Brain, Malformations of. H. Charlton Bastian.

MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.—Synon.: Simple Idiopathic Cerebral Leptomeningitis; *Leptomeningitis Infantum* (in part); Fr. *Méningite Simple*; Ger. *Acute Hirnhautentzündung.*

Definition.—A simple non-tubercular inflammation of the cerebral pia mater, which may be either limited to the convexity, general, or confined to the base of the brain. It is associated with very variable symptoms in different cases; and is probably caused in many different ways.

Ætiology and Pathology. Our knowledge of the ætiology and pathology of acute idiopathic cerebral meningitis is only vague and indefinite, so that little but unconnected statements or mere suggestions can be here set down.

It appears that sex exercises an influence in the production of idiopathic meningitis, and that the disease occurs much more frequently in males than in females. In regard to age, it is met with almost as frequently in individuals from ten to twenty as in those below the tenth year. In individuals over twenty the disease is much more rare.

Meningitis is apt to occur during, or as a sequence of, some acute febrile disease, such as measles, scarlet fever, small-pox, and rheumatic fever. It may complicate erysipelas of the head and face; or may occur in the course of pneumonia or pleuro-pneumonia; also as an accompaniment of ulcerative endocarditis or pyæmic processes, owing to these conditions leading to minute embolisms of the vessels of the pia mater. Sometimes it is met with in extremely cachectic subjects, who have not previously been suffering from any acute disease. It has been known to follow prolonged exposure to the sun; to ensue after the occurrence of severe moral perturbations; and likewise to follow a shock or blow, even when this has not been complicated with an external wound, or with a fracture of one of the bones of the skull.

In other cases, also, a meningitis really secondary may appear to be primary and idiopathic, as when (*a*) it extends from some focus of syphilitic disease of the meninges, or (*b*) when it occurs as a sequence of some unrecognised chronic inflammation involving the middle ear and portions of the temporal bone.

ANATOMICAL CHARACTERS.—Simple idiopathic inflammation of the cerebral meninges is a condition which varies much in severity in different cases. In its earliest or initial stage, nothing more than a minute and more or less uniform injection of small vessels and capillaries in certain regions of the cortex may be met with. But later on, definite products of inflammation are to be seen; these are for the most part situated beneath the arachnoid, in the meshes of the pia mater. They consist, according to the stage of the morbid process, either of a gelatinous white or yellow lymph-like matter, of actual pus, or of more coherent yellow lymph in the form of membranous layers. In regard to the area involved considerable differences also exist. The inflammation (1) may be limited to the convexity and to the lateral regions of both hemispheres; (2) it may be general, that is, involve the parts above mentioned, and also the base; or (3) it may be limited to the basal regions of the brain. In both the latter cases the ventricles are apt to contain fluid, and the central parts of the brain to be softened, as they are in tubercular meningitis, which also affects the base in a special manner.

Of these varieties as to seat, the first, in which the convexity is involved, is decidedly the most typical, and in this respect simple idiopathic meningitis contrasts in a salient manner with tubercular meningitis, in which the tendency is no less marked to implicate the base of the brain. In the second variety, the inflammation beginning above probably extends to the base by mere continuity, in cases where the condition of the patient, or the intensity of the inflammatory process itself, favours its spread from the original site; or, in certain cases, the inflammation may be from the first general in seat. In regard to the third variety, much doubt may be said to exist. It is by no means clearly established that a simple idiopathic inflammation ever begins to manifest itself at the base, and there only—though no good reason can be assigned why such a distribution should not occasionally exist, except that experience shows it to be at least very rare. If, moreover, such an inflammation be not of unsuspected traumatic origin, there are still two other modes of accounting for its existence, which should be excluded before regarding it as an idiopathic cerebral meningitis of unusual site. Thus, it may be an extension upwards from the spinal meninges of an inflammation beginning there—a case, in fact, of cerebro-spinal meningitis, either sporadic or epidemic. Or, on the other hand, it may be one of those cases of tubercular meningitis where the general disease manifests itself on the side of the brain first, and in which the patient dies before the local process is at all fully developed. In such a case the inflammation may be really of the tubercular variety, and yet to superficial observation not recognisable as such. Although neither of these misconceptions is likely to occur often when the necropsy is made by a competent observer, the case may be otherwise, and either of such mistakes as to the real nature of the affection is more especially apt to occur where the head only is examined.

In all these cases, too, the inflammation may be limited to the meninges themselves, or the surface of the brain may also be manifestly involved in the inflammatory process, so that we then have to do with a *meningo-cerebritis* of varying seat and extent.

SYMPTOMS.—In no disease is the symptomatology more various than it is in acute meningitis—a fact partly due to the varying intensity of the inflammatory process, partly dependent upon the process being localised or more general, and partly according as there is or is not the co-existence of dropsy of the ventricles with inflammation of their walls. Sometimes the disease is almost latent, accompanied only with slight symptoms, merging into stupor and coma a day or two before death. Or the symptoms may be marked and quite tragic in their severity; ushered in either by frightful pains in the head, by well-marked delirium, or by convulsions; subsiding eventually into a condition of stupor or coma; and followed by death within eight or ten days, though this may be delayed till the expiration of three weeks or a month. Recovery, which sometimes occurs, must be regarded as a rare event.

Inasmuch as it is not practicable, within the limits of this article, to give a detailed account of the various groupings of symptoms that may be met with in different cases, we must confine ourselves to an enumeration of the symptoms themselves, most apt to occur (1) in the early stages of the disease, and (2) in its later phases.

(1) Cephalalgia of an intense character, either general, or localised in some particular region or regions of the head, may be complained of again and again where the patient is old enough, or, if he be too young, is indicated by cries, by application of the hands to the head, or by other signs. Sometimes, however, this symptom may be almost absent, or it may come on at a later date. Delirium, occasionally furious, at other times more quiet and of a simply loquacious type, is another symptom; or extreme restlessness. Mere insomnia, too, sometimes exists

from the commencement; whilst at other times a semi-comatose condition, gradually deepening into actual coma, may exist from the first, especially in children, or it may succeed a transitory delirious condition. Nausea and vomiting, and also convulsions, either local or general, may be met with in the early stages of the disease, and sometimes as initial symptoms. With them will go general pyrexia and sometimes rigors; also heat of head, rapid pulse, a furred and often thickly coated tongue, constipation, perhaps some intolerance of light and of loud sounds, together with an easily obtainable *tache cérébrale*.

(2) As later symptoms, we may have localised convulsions or spasms, often of the tonic order, affecting perhaps the head and neck (which are frequently drawn backwards) or one or both arms; or a condition of trismus may exist. The eyes, too, are sometimes drawn upwards. The pupils may be at first contracted, or, if not, they may be of medium size, unequal and insensitive; whilst later on they are most frequently widely dilated and insensitive. The conjunctivæ are often injected. Paralysis of one arm, or sometimes of an arm and a leg, may occur. The sensibility of the skin may be either exalted or deadened. The abdomen is often hollow and boat-shaped. The tongue becomes thickly coated, or dry and brown. Difficulty of deglutition is frequently well marked towards the end; and there is incontinence of fæces and urine as soon as the stupor becomes marked. Sometimes the pulse is unnaturally slow and infrequent from the first; at other times, and especially towards the end, it is very frequent and irregular. The respiration, too, becomes much disturbed, being often sighing and of very irregular rhythm, tending to become stertorous at last. The temperature is frequently high, but pursues a markedly irregular course. Remissions of the pyrexial condition may take place from time to time. The skin is generally hot and dry, though occasionally there may be copious sweats. Stupor and coma almost invariably occur at the last, if not present at an earlier stage.

Prognosis.—A large number of deaths take place within the first week of acute meningitis; a much smaller number survive till the end of the second week; fewer still reach the end of the third; and only a very few survive to the fourth week. It is difficult to say what the percentage of recoveries may be; but probably less than ten would survive out of a hundred cases of acute idiopathic cerebral meningitis.

Diagnosis.—The diagnosis of idiopathic meningitis involves considerations very similar to those arising in the diagnosis of tubercular meningitis, and need not therefore now be discussed. *See* Meninges, Cerebral, Inflammation of, Tubercular.

The diagnosis of simple from tubercular meningitis must oftentimes be a matter of extreme difficulty. Whether the condition of the blood, as recognised by the aid of the microscope, is the same in simple meningitis as it is in tubercular meningitis the writer is unable to say. Should it not be so, some help might be obtained in this direction. The conditions under which the disease seems to develop may throw some light upon the problem. In regard to special symptoms, the possible range is so great in each variety that it becomes difficult to fix upon any that are positively distinctive of the one or of the other. Delirium is, however, rarely so violent in tubercular as it may be in simple meningitis. Retraction of the head is also not so frequent in the tubercular variety. On the other hand, the temperature much more frequently rises over 101° F. in simple than it does in tubercular meningitis. Finally, it must be borne in mind that the former is an extremely rare disease, the latter unfortunately only too common; and that whilst in tubercular meningitis the two sexes fall victims with about equal frequency, in the simple variety two out of three are likely to be males.

Treatment.—In the early stages of acute simple meningitis aperients may be freely administered. A leech or two might be applied to the temples, in cases where pain is greatly complained of; or under the same conditions the head may be shaved and an ice-bag or Leiter's tubes may be applied, should such measures not be deemed useless on account of the extreme restlessness of the patient. The writer believes that little or nothing is at present to be expected from drug treatment towards the cure of this disease, although some alleviation of the more distressing symptoms may at times be brought about by special attention to them. The patient requires to be carefully fed, and assiduously nursed and kept quiet throughout, in the hope that the end may be favourable.

H. Charlton Bastian.

MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.—Several distinct forms of meningitis, of traumatic origin, have to be carefully distinguished from each other. We have (1) a meningitis in which the outer surface of the dura mater is the part chiefly affected—*pachymeningitis*; (2) one in which the cavity of the arachnoid is the seat of the effusion—*arachnitis*; and (3) one in which both these escape, and the subarachnoid spaces, or, it may be, the structure of the pia mater, is primarily involved—*leptomeningitis* or *subarachnoid meningitis*. For the most part, it is possible to distinguish these forms at the bedside, as well as in the *post-mortem* room. Sometimes the case is of a mixed form; especially is it not uncommon for an inflammation which had begun between dura mater and bone to extend through the fibrous membrane, and involve the arachnoid beneath it; but it is still a remarkable fact in pathology that very frequently the delicate arachnoid suffices to restrict an extensive inflammatory process to one or the other side of it.

Of the inflammation between the dura mater and bone it is possibly true that it occurs only in association with disease of the bone. If there be any exceptions to this latter statement, they occur probably in connexion with syphilis. Occasionally cases are met with in which the arachnoid cavity itself contains puro-lymph, the surface of one hemisphere, for instance, being covered, and yet there is no history of injury or of prior inflammation of the scalp or bone. Such cases are, however, rare, and their possible causes need further investigation.

In a general way, children may be deemed more liable to meningitis after injuries than adults, and in them not very infrequently severe and fatal complications ensue after injuries not attended by fracture.

1. **Pachymeningitis.**—Inflammation of the meninges secondary to inflammation of the bone is one of the commonest of the dangers which attach to injuries to the head. The bone is contused, and in most cases there is some stripping off of the pericranium.

SYMPTOMS.—For a week or ten days the patient does well; and then he begins perhaps to complain of headache, feels chilly and uncomfortable, and cannot eat. These symptoms increase, and drowsiness and semi-stupor may come on. If the ophthalmoscope be used, very possibly at this stage the discs may be found hazy and swollen; and this may occur with little or no evident defect of sight. If the trephine be now used, the bone will be found discoloured, its diploe greenish, and beneath it a collection of pus. The pus is rarely in large quantity, and is usually discoloured, whilst all around the collection of fluid there is much coherent and sticky lymph, which loosens the membrane from the bone. It is very rare to find a large abscess, such as those described in the celebrated cases given by Pott. Usually the termination of such cases is that the substance of the dura mater inflames; that the arachnoid is implicated; and that a layer of puro-lymph lines that membrane, and coats the hemisphere. With this state special symptoms are associated, the most noteworthy being hemiplegia of the opposite side. Very commonly, however, another event cuts short the case. In mentioning the early symptoms nothing has been said as to rigors, nor do they, as a rule, occur, unless the complication just hinted at is developed. That complication is pyæmia. This pyæmia has no essential connexion with the meningitis. It depends upon the inflammation of bone, which is the common cause of both, and which may be the parent of either singly, or of the two as twins. With the gangrenous osteitis occurs gangrenous phlebitis of the veins of the diploe; from these the process extends to the proximal sinus of the brain (more commonly the superior longitudinal); infective emboli of decomposing material gain access to the circulation; and all the well-known phenomena of pyæmia follow. It is most important to distinguish the symptoms which belong to the pyæmia, if we would rightly estimate those due to the meningitis, for very frequently they are met with together. Especially must we remember that a severe rigor probably denotes pyæmia; and that, if it be repeated, the diagnosis of this affection is almost certain. It is the almost constant complication with phlebitic pyæmia, which so almost invariably disappoints the surgeon of any benefit from the use of the trephine in this group of cases. If pyæmia does not occur, then probably arachnitis is there, and thus it comes to pass that a recovery after secondary trephining is almost unknown.

TREATMENT.—But little is to be done as regards treatment for this form of osteitic meningitis; the main thing is to adopt measures for its prevention. The careful management of the wound, either by Lister's plan or by the constant use of the lead and spirit lotion, and the exemption of the patient from all risk of contagion, are the matters which will chiefly claim attention. In cases of depressed compound fracture without symptoms, one of the objects of primary trephining is to prevent meningitis, by removing displaced fragments, and by affording free exit for secretions.

2. **Arachnitis.**—The form of meningitis to which the term 'arachnitis' is applicable is a frequent consequence both of inflammation of contused bone and of wounds of the membranes. Enough has already been said as to the circumstances under which it occurs after contusions of bone, and we have chiefly now to examine its pathology and special symptoms.

ANATOMICAL CHARACTERS.—In the *post-mortem* room arachnitis may be easily distinguished from inflammation in the subarachnoid spaces, and the distinction ought always to be carefully made. In arachnitis the puro-lymph covers the cerebral convolutions in an even layer, and does not dip into the sulci, to which, indeed, it has no access; whereas, when the spaces are affected, the sulci are filled, and the convexities of the convolutions remain free. In the latter none of the effusion can be peeled or sponged away, nor does any adhere to the parietal arachnoid. In true arachnitis both the parietal and visceral layers are smeared over.

SYMPTOMS.—One of the earliest signs of

arachnitis occurring after an injury to the head is a peculiar restlessness or nervousness, followed by vomiting. These symptoms may come on first from five days to a fortnight after the accident. Many cases of compound fracture of the skull, with laceration of the dura mater, afford us good opportunities for the study of acute traumatic arachnitis; but, unfortunately, in many of these cases the brain-substance is also punctured, and it becomes at least possible that the condition described as diffuse encephalitis may be present, and may complicate the symptoms. We are helped, however, as regards the avoidance of fallacious inferences by the other set of arachnitis cases, where the arachnitis is secondary to osteitis, in which, there having been no injury to the brain, there is no probability of encephalitis. Speaking, then, from the result of observation of both classes, it may be stated that whenever evidences of arachnitis are found widely spread over a whole hemisphere, there has been during life hemiplegia of the opposite limbs. Exceptions, apparent or real, occur to this, but they are rare, and probably most of them are apparent and not real. The risk of error lies in the case in which, in a patient who is very ill, hemiplegia, which supervened gradually during the last day or two of life, may have been overlooked. The hemiplegia is rarely complete, and, unless the limbs be carefully tested at each visit, both patient and surgeon may be unaware of its presence. Its degree is proportionate to the extent of the arachnitis; and if the latter pass under the falx and involve the opposite hemisphere also, there may be general weakness of all the limbs, which may again to some extent mask the hemiplegia. It is almost certain that the hemiplegia has little or nothing to do with pressure from effused fluid, for the latter is rarely in large quantity. Its immediate cause is, indeed, not very obvious; but as the grey matter of the cortex is almost always discoloured, and changed from a pink tint to a greenish slate hue, it may be conjectured that this in some way has to do with the symptoms. The other symptoms which attend acute diffuse arachnitis are—wandering delirium, rarely violent; increased temperature; incontinence of urine and fæces (part of the hemiplegia); and occasionally unilateral sweating. It should be remarked that the hemiplegia involves both sensation and motion. As, however, it is incomplete, the defect in sensation is almost certain to escape notice. Patients who are obliged to admit that they cannot move their limbs forcibly, will deny that there is any defect in feeling, and it is often impossible to confute them. In well-pronounced cases, however, sensation always fails as well as motion.

Treatment.—It is doubtful whether recovery ever takes place after this form of arachnitis has become well established; and here, again, we have to think rather of prevention than of cure. Cold to the head—spirit lotions being the most convenient form—and very early and efficient resort to mercury, are the chief measures where the dura mater is known to have been lacerated. Strong spirit lotions should be used from the first, and mercury also given. It is too late to commence the exhibition of mercury after the symptoms of arachnitis have set in. Amongst the measures of treatment of more doubtful value are the administration of aconite, in small doses frequently repeated, leeches, blisters, and fomentations. If blisters are used, they should be applied to the neck, or back, or shoulder.

3. **Leptomeningitis.**—This form of traumatic meningitis, which occurs in the subarachnoid spaces, is an exceedingly interesting malady.

Ætiology.—Leptomeningitis may be encountered after any form of injury to the skull involving laceration or puncture of the visceral arachnoid, but its most typical illustrations are witnessed after fracture through the petrous portion of the temporal bone. This fracture, although usually counting as a simple one, is in reality compound, in that it opens up access to an air-containing cavity. It is possible that air may reach the injured bone either through the external ear or the Eustachian tube.

It is a matter of some interest to determine whether arachnitis of these spaces often, if ever, results from severe concussion without any fracture, or after simple fracture without any possibility of admission of air. Whilst it is impossible to speak clearly on this point, it is highly probable that it occasionally does so.

Anatomical Characters.—Results which are scarcely ever witnessed after simple fractures in other regions of the skull may occur here, a fact which can only be explained on the supposition that we have to encounter the risks incident to compound lesions. Amongst the results referred to is the frequent development, some days after the accident, of inflammation in the large subarachnoid spaces at the base of the brain. It is probable that the inflammatory process travels along the course of the nerve-trunks (seventh nerve), and thus gains access to the spaces. Affecting first the parts adjacent to the roots of the nerves, the inflammation may spread downwards on the medulla and cord, or upwards through the posterior fissures into the ventricles, or over the surface of the hemispheres. Usually it is almost confined to the base of the brain and medulla oblongata. These parts are coated with serous lymph, which invests them closely and adheres to all the nerve-roots passing from them. The layers of arachnoid which cover in and confine the exudation remain quite transparent, and show no traces of lymph on their inner surface. It is only when these layers are cut or torn that access to the inflammatory effusion is gained. In performing the necropsy it is needful to use care lest this laceration be made by accident, and the characteristic appearance somewhat spoiled.

Symptoms.—Patients suffering from this form of basal subarachnoid inflammation may become delirious and die very quickly in the first access of the morbid action; but, on the other hand, and more usually, they may live for several days, or a week or two, and show only comparatively mild symptoms. Absolute sleeplessness, with occasional wandering, but without any degree of paralysis, was the most prominent symptom in one very well-marked case. It is probable, though not as yet established, that optic neuritis often attends this form of meningitis. The temperature may be an important aid in diagnosis: in cases of leptomeningitis it appears to be *always raised*—perhaps continuously 101° to 104°. That the subarachnoid spaces are affected may be plausibly suspected whenever, after supposed injury to the base of the skull, vague cerebral symptoms, unattended by definite paralysis, supervene; and if there have been bleeding from the ear and deafness, with facial paralysis in the first instance—a triad pathognomonic of fractured petrous bone—then this is the form of meningitis certain to follow, if any.

Prognosis.—As regards recovery from traumatic meningitis of the base, what has been said on the difficulties in forming a confident opinion as to its presence will sufficiently explain the impossibility, in any given case in which recovery has resulted, of feeling sure that the inflammation in question had really existed. Many patients, however, recover more or less, often perfectly, after prolonged and severe symptoms following fractured base. Some of these are doubtless recoveries from severe contusion only, but others, especially those in which serous fluid and even blood has drained away from the ear, may be plausibly conjectured to be recoveries from meningitis of the base. Recovery has taken place in cases where the occurrence of optic neuritis and strabismus and other symptoms some days after concussion has made that diagnosis certain.

Treatment.—The measures of treatment likely to conduce to recovery in such cases are the same as those prescribed for other forms of meningitis. Mercury carried to the extent of ptyalism is the chief agent; and so impressed has the writer for long been as to the danger of the malady, and the value and harmlessness of the drug, that he has been in the habit of giving it from the first in all cases in which fracture of the petrous bone has been diagnosed.

Jonathan Hutchinson.

MENINGES, CEREBRAL, Inflammation of, Tubercular.—Synon.: Granular Meningitis; Acute Hydrocephalus; *Hydrocephalus Internus*; Brain Fever (in part); Tubercular Leptomeningitis; Fr. *Fièvre Cérébrale*; *Méningite Granuleuse*; *Méningite Tuberculeuse*; Ger. *Tuberculöse Hirnhautentzündung*.

Definition.—An acute and extremely fatal febrile disease, with a predominance of head-symptoms; terminating in stupor and coma, with or without convulsions; and characterised after death by a 'granular' meningitis affecting the pia mater at the base of the brain, with the frequent accompaniment of dropsy of the lateral ventricles, and softening of their walls. The inflammation of the membranes at the base of the brain is often found to be associated with a spinal meningitis.

Tubercular meningitis is not an independent affection; it constitutes one important phase of a many-sided general disease commonly known as Acute Tuberculosis, and marked anatomically by the presence of 'grey granulations' within the thorax and abdomen, as well as in the membranes of the brain. In certain rare cases death takes place from granular meningitis, before the anatomical marks of the general disease have had time to develop within the chest or abdomen. More frequently, however, the manifestations of the general disease are already well developed in one or other, or in both, of these situations, at the time that they reveal themselves also on the side of the brain. In the latter, and by far the most common class of cases, the symptoms met with will be in part those of the general affection, and in part (but in a predominant degree) those due to that implication of the brain and its membranes with which we are now specially concerned. *See* Tuberculosis.

Ætiology.—The ætiology of tubercular meningitis of course resolves itself into the ætiology of the general disease, acute tuberculosis, of which it forms part.

This affection is one which occurs with special frequency in young children, between two and six years old, though it is also met with in infants, in older children, in young adults, and even in persons beyond middle age. In adults it is most apt to manifest itself as an occasional complication in the course of pulmonary phthisis. In children a proclivity to the disease seems often to be inherited, so that two or more in the same family may be carried off by it. But in what proportion of cases any such proclivity exists can scarcely be said to be known.

The central brain-changes—namely, the dropsy and the central softening—are not, in the opinion of the writer, necessary accompaniments of tubercular meningitis, although they most frequently coexist—just as they are also most frequently concomitants of simple or non-tubercular meningitis when it affects the base of the brain. These central brain-changes were, however, the part of the disease that first attracted the attention of physicians, so that the affection with which we are now concerned was known as *acute hydrocephalus* long before the more modern designations of *granular* or *tubercular meningitis* came into use.

Anatomical Characters.—When the calvaria is removed, the dura mater is found to be tightly stretched over the brain; unless, as the writer has seen, the subject be an elderly person in whom some amount of senile wasting had previously occurred. On stripping back this membrane, the arachnoid presents a dull appearance, and it is slightly sticky when touched. The convolutions of the vertex and lateral regions of the brain are mostly seen to be more or less flattened from pressure, and the sulci are correspondingly indistinct. No lymph may be seen; or at most a small quantity, in the lower parietal regions, along some of the branches of the middle cerebral arteries. When the brain is removed, however, and its under surface is examined, a more or less opaque white or yellowish lymph-like matter may be seen, beneath the arachnoid, in the meshes of the pia mater, extending from the optic commissure backwards over the central portions of the base and onwards over the pons. In certain cases lymph and evidences of recent inflammation are found round the medulla, and even along the whole length of the spinal cord. More or less lymph also extends on each side into the Sylvian fissures. A minute inspection will likewise show that the tip of the temporo-sphenoidal lobe, and the orbital surface of the frontal lobe, are flecked with a number of translucent granulations, as though the parts had been sprinkled with fine sand; and on opening up the Sylvian fissure on each side, similar granulations, with others more opaque and of larger size, may be seen amongst the lymph in this situation. Translucent granulations also sometimes exist, scattered more sparingly over the lateral aspects of the hemispheres, especially along the sides of the vessels.

Examination with the microscope shows that the granulations are composed of overgrowths of tissue-elements immediately surrounding the smaller vessels, and within their perivascular sheaths. Within and among these cellular elements the *bacillus tuberculosis* is to be met with, though very sparingly. In these situations the tissue overgrowths may cause a local bulging of the sheath, either all round, or merely on one side of the vessel; and when such growths become opaque from incipient fatty degeneration, they are then more easily visible as minute white specks. A close examination of the prolongations of the pia mater dipping between the convolutions, with the aid of lens or microscope, will often show minute granulations not otherwise recognisable—and that, too, in many regions of the brain. And in cases of incipient tubercular meningitis, where the amount of lymph about the base is extremely slight, the lens or microscope may show the presence of granulations, not otherwise recognisable, in and around the lower part of the Sylvian fissures—that is, in the regions where they are most prone first to manifest themselves.

The pia mater is generally unduly adherent to the surface of the convolutions, so that it can only be removed in small shreds, and then not without tearing the superficial grey matter. This condition of things is the very opposite of what may be met with in some cases of simple meningitis affecting the vertex, in which the thickened pia mater, with all its prolongations, may sometimes be easily stripped off from the greater portion of a hemisphere in one piece.

The substance of the brain is commonly much more vascular than natural. The lateral ventricles are usually moderately dilated, containing from two to four or six ounces of not very clear serum. The veins on their surface are then engorged, and the fornix and other adjacent parts may be more or less softened, or actually diffluent. Microscopical examination of such softened tissue will reveal the presence of an abundance of granulation-corpuscles; and its specific gravity, if estimated, will be found to be diminished — both these characteristics being marks of a pathological softening which has occurred during life, and not of a softening due to mere *post-mortem* maceration. Some have erroneously supposed that such mere maceration has been adequate to produce the softening.

Sometimes the above-described changes are more fully developed in one than in the other hemisphere; and occasionally also in some parts of the brain small nodular growths of a 'tubercular' nature may be met with, varying in size from a small pea to an almond. These growths are most apt to occur in the substance of some of the cerebral convolutions, or near the surface of the cerebellum, or even, as the writer has seen, within the substance of the corpus striatum. In many such cases the small nodular tumours will be found to be in intimate relations with the vessels of the part, and, in fact, to be composed of a mere aggregate of the smaller 'granulations' more or less fused into a single mass.

Pathology. — The granulations begin to appear first in the meninges of the base under those irritative influences, whatever they may be, which lead to the development of similar grey granulations in other organs of the body. These primary changes excite a common inflammation of the membranes around, and thus entail the production of the lymph, which covers the base of the brain, and extends on either side into the Sylvian fissures. Why the grey granulations should tend to develop first, and specially about the vessels at the base of the brain, cannot at present be explained.

This inflammation of the basal meninges also extends, by direct continuity of tissue, over and around the cerebral peduncles to the velum interpositum, and to the connective tissue at the upper and anterior extremity of the middle lobe of the cerebellum. In one or other situation, and often in both, the tissues are thickened by lymph. The writer has seen the velum interpositum thick and leather-like in consistence, and the venæ magnæ Galeni which run through it blocked by thrombosis; and this he believes to be an occasional cause of the central softening and dropsy previously referred to as component parts of the disease. In other cases, where no such thickening or thrombosis is to be detected, there is great swelling of the connective tissue, from development of lymph, opposite the termination of those great veins which return the blood from the surface of the ventricles and from the central parts of the brain—at the point, that is, where the veins of Galen empty themselves into the straight sinus.

In this way the very common association of the central ventricular changes with the basal meningitis may be accounted for, and also the occasional absence of such changes, in instances where the inflammation, apt to be set up through mere continuity of tissue, does not attain sufficient proportions to interfere with the return of blood, either through the veins of Galen, or from them into the straight sinus. It is of course possible that the central softening may also be favoured by an independent affection of the small vessels situated in the walls of the ventricles, and a development of granulations around them—though this has not hitherto been recognised. It is, however, well known that thrombosis is extremely apt to occur in those minute vessels in various parts of the brain which are enveloped by granulations—a fact that goes far to account for the extreme gravity of the symptoms in many cases of tubercular meningitis, in which naked-eye changes appear to be slight and altogether disproportionate in amount.

Symptoms.—The symptoms presented in different cases of tubercular meningitis often vary very widely from one another, although amongst them all there is an underlying bond of similarity. The variation may be easily understood from a consideration of the fact that such symptoms form part of those pertaining to a febrile affection characterised by other local manifestations, of varying importance in different cases; and also from the fact of the differences constantly met with in the relative and absolute development of the different kinds of changes encountered within the cranium itself in this disease—especially in regard to the amount of ventricular effusion and central softening existing in conjunction with the meningeal inflammation, which again itself varies much in intensity and in regard to the area involved in different cases.

It is, therefore, usual and most convenient to enumerate the possible signs and symptoms of this disease as they occur in three stages—artificial and often ill-marked from one another as they are—namely (1) those of the *invasion stage*; (2) those of the *developed disease*; and (3) those of its *closing phases.*

1. *Stage of invasion.*—Among the initial symptoms of tubercular meningitis may be mentioned obstinate and recurrent vomiting, often associated with constipation; coming on frequently after a period of previous malaise; and associated with fretfulness, slight wasting, indisposition to play, and disturbed sleep. Soon after, or simultaneously, there may be more or less marked indications of cephalalgia. Young children who cannot speak are fretful and constantly cry; they often also put their hands to their head. Such children start and cry out in their sleep. The temperature may be as yet scarcely, if at all, elevated; or there may be rigors from time to time, with temporary feverishness, recurring daily about the same hour. The child often cries out when touched, and a more or less general exalted sensibility to painful impressions seems to exist.

2. *Developed disease.* — In the second stage any feverishness that may have existed often abates. There may be less restlessness, so that the child even sleeps more than natural. The pupils are often insensitive to light, and unequal. There is frequently also some slight or perhaps marked strabismus. The pulse is apt to be much less frequent than natural (56-70 per minute perhaps), and decidedly irregular. The hypersensitiveness of skin may have disappeared, but a peculiar vaso-motor irritability exists, so that when the nail of the fore-finger is drawn once across the skin of the abdomen or other part, a deep red linear mark comes out slowly, and persists a long time. This so-called *tache cérébrale*, whilst also met with in other affections, is, as Trousseau rightly enough insisted, rarely absent in tubercular meningitis. Frequent plaintive cries may be uttered, though the child is generally more quiet and drowsy; it is apathetic also in regard to food, not asking or crying for it, but still taking it, perhaps well, whenever it is administered. Convulsions may occur during this stage, or weakness of one or

more limbs may be noticed, especially where larger tubercular nodules occur in certain regions of the brain-substance. Sometimes, however, the paralysis is of a shifting and transitory nature, varying in degree or even in situation in the course of a few days.

3. *Closing phases.*—In the closing stages of the disease the drowsiness may gradually deepen into stupor or actual coma; though in conditions short of the latter the child may still more or less frequently utter plaintive cries. The pulse, instead of being less frequent than natural, now becomes preternaturally frequent; whilst the respiration often assumes a slow, sighing, and markedly irregular type. The face, frequently pale and clammy, flushes at times. The head is hot, and the temperature generally raised, though often not more than to 100°, and rarely beyond 102°, until quite to the close of the disease. The fontanelle is raised, and there may be unnatural pulsation. The eyes, when examined with the ophthalmoscope, may show evidences of grey granulations in the choroid, and perhaps some amount of optic neuritis. The pupils may be unequal, but are generally dilated and insensitive. Occasionally the writer has seen a rhythmical contraction and dilatation go on, especially on exposing them to light. In this stage, when the patient is sufficiently conscious, it may be found that sight is notably impaired or almost lost.

The patient may take the food which is given, up to the last; though at other times there seems to be an actual inability to swallow it, even when it is placed in the mouth, owing to partial paralysis of the muscles of the tongue and pharynx. The abdomen is often boat-shaped and retracted; and an obstinate constipation still continues. Even in this last stage of the disease a temporary and delusive lull may take place; the child may seem to revive a little, but only too soon to lapse again into a state as bad as or even worse than before. Frequent and long-continued convulsive seizures are especially apt to occur during this stage of the disease; and death may take place during or immediately after one of these attacks. At other times the end is brought about more gradually, through progressing failure in the heart's action, combined with disturbance of respiration. In the latter class of cases the temperature may gradually fall, during the last few hours before death takes place, to several degrees below the normal; though in other cases of tubercular meningitis there is a slow and steady rise of temperature up to 105°, or even 106°, before the patient expires.

Diagnosis.—In the early stages the diagnosis of tubercular meningitis may present extreme difficulties. We must wait, before expressing a definite opinion in one of these doubtful cases, till the patient has been seen and examined two or three times. The premonitory symptoms and those of the first stage are often far from distinctive. They may, it is true, represent the beginning of tubercular meningitis, but, on the other hand, they may also represent something less serious—for instance, a mere failure of health from various causes, complicated by dentition, by some gastro-intestinal irritation, or perhaps the commencing outbreak of some one or other of the specific fevers. Details as to the child's condition during the last two or three weeks, comprising the order of evolution of the several symptoms, may, however, throw some important light upon the real nature of the case at an early stage of the disease.

A contributory cause of the difficulties besetting the early diagnosis of tubercular meningitis is to be found in the fact that acute tuberculosis is itself extremely difficult to recognise. We cannot, therefore, readily fall back upon a diagnosis of the general condition in order to strengthen our diagnosis of tubercular meningitis. As a matter of fact, it is just the reverse. Of all the local manifestations of this disease, those within the head produce by far the most definite set of symptoms; so that we can always most safely infer the probable existence of acute tuberculosis with grey granulations throughout the body, from the presence of the developed symptoms of tubercular meningitis. The symptoms produced by grey granulations within the thorax or within the abdomen are far less distinctive or, in fact, not distinctive at all The existence of a particular habit or build of body in cases of acute tuberculosis to such an extent as to make it possible to use the recognition of it as an aid to diagnosis in a case otherwise obscure, is practically non-existent. Our notions as to the existence and nature of a tubercular habit of body need revision; it must not thoughtlessly be confounded with the mere phthisical habit of body; and it seems probable, from modern points of view, that acute tuberculosis is a quasi-accidental disease, occurring at times in individuals of any build of body whatsoever—with no more limitations, that is, than may exist in regard to the incidence upon persons of different bodily types of one of the common acute specific diseases.

The symptoms of the established disease are therefore alone distinctive, to any really trustworthy extent, of the existence of tubercular meningitis, and through it of the presence of its general underlying condition. We may have our suspicions before, but these can only transform themselves into certainties as the disease actually develops, and as it passes, moreover, into the incurable stage.

At this phasis of the disease the alternative conditions to be thought of are in the main these—typhoid fever on the one hand, or else some form of intracranial disease other than tubercular meningitis. Here, as in almost all cases of brain-disease, we have to look not to any one or two signs or symptoms which can be regarded as pathognomonic, but rather to the sum total of symptoms, and to the way in which they are grouped. With the possible existence of some or all of the premonitory and initial symptoms already enumerated, if the patient becomes more somnolent; if the pulse falls much below par in frequency, and is at the same time irregular; if, with a condition of fever still existing, the child does not constantly crave for drink; and especially if there is also the combination of obstinate constipation and a retracted abdomen, together with an irregular and suspirious form of respiration—we may feel more and more certain that we have not to do with even one of the most anomalous forms of typhoid fever associated with head-symptoms—nor, indeed, with any form of intracranial disease other than tubercular meningitis. An examination of the temperature chart may considerably aid us in the same direction, and so also may a microscopical examination of the blood.

Some years ago, the writer made observations upon this latter point, tending to show that in tubercular meningitis there are, in a large proportion of the cases, distinctive alterations in the blood—as drawn by a needle-prick from the tip of the fore-finger and examined at once upon an ordinary microscope-slide—capable of affording very material aid in the diagnosis of tubercular meningitis from typhoid fever, as well as from other brain-affections (such as a new-growth implicating the pons and contiguous parts, thrombosis in some of the cranial sinuses, or perhaps one of the simple forms of meningitis). The characters of the blood met with in tubercular meningitis are these: The white corpuscles are decidedly more numerous than natural, and speedily (that is, within ten to fifteen minutes after the blood has been drawn) show signs of great amœboid activity, by the development of vacuoles within them, and of numerous projections from their outer surface; groups of protoplasmic particles of various sizes are also to be seen interspersed amongst the blood-corpuscles, as well as here and there a small pigment-granule or an irregular block of pigment of reddish or reddish-black colour. The red corpuscles usually run together into irregular masses, rather than into definite rouleaux, though they present no very distinctive changes. This increase in number with exalted amœboid activity of white corpuscles, in conjunction with the other blood-characters above-mentioned, are not met with in typhoid fever, or in the great majority, at least, of other cerebral affections.

For the diagnosis of tubercular from the simple form of meningitis, *see* MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.

PROGNOSIS.—Death is well-nigh certain within three weeks, or at most a month, from the date of the invasion-symptoms of tubercular meningitis. When the disease has arrived at a stage permitting of pretty certain diagnosis, hope rather than rational expectation may still hold out a chance of recovery. Although instances of this have occurred, they are of extreme rarity. If the course of the disease is to be modified by treatment, it must be during those early stages when we are capable of forming only a provisional or tentative diagnosis. In these stages, however, some good observers have hitherto been inclined to think that under judicious treatment the development of the disease may be arrested. This view may quite possibly, and even probably, be an erroneous one. Proof of such a position, or of its opposite, is, from the nature of the case, impossible.

TREATMENT.—From what has just been said, it will be seen that anything like curative treatment is only to be thought of in regard to the early or premonitory stage of the disease, or of conditions of health indistinguishable therefrom. Here the writer thinks he has seen decidedly good results from one to six grains of iodide of potassium, according to the age of the child, administered three times a day, with small doses of cod-liver oil; at the same time attending to the state of the bowels, and giving suitable doses of bromide of potassium at night, till the restless condition with disturbed sleep has passed away.

When the disease definitely declares itself or is further advanced, we may perhaps be able to diminish pain by the application of cold to the head; but we only aggravate the sufferings of the patient by the use of blisters, tartar emetic ointment, or other irritating applications, such as were often had recourse to by our predecessors. Bromide of potassium may do something to keep convulsions in check, though at other times it seems to be quite powerless, and drugs of this type should never be employed in later stages of tubercular meningitis, unless there is some strong indication for their use. Chloral hydrate, again, is probably a dangerous drug for a patient, the action of whose heart is already so seriously interfered with; though chloroform inhalations may be had recourse to in an extreme case where persistent convulsions cannot otherwise be checked. Beyond this, the child needs the most careful nursing, and to be well supported with strong beef-tea and milk, and occasionally with stimulants, so long as it is capable of taking food, whilst attention is paid to the bowels, which are often best relieved by means of enemata. In this way, if the patient's case is to prove one of those rare and exceptional instances in which recovery is possible, we at all events do nothing to thwart the course of natural processes which have a chance, however small, of terminating in recovery.

H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Hæmorrhage into.

SYNON.: Fr. *Apoplexie Méningée*; *Hémorrhagie Méningée*; Ger. *Hirnhautblutungen*.

DEFINITION.—Effusion of blood in one or other of the following situations: (1) Between the bone and the dura mater; (2) between the dura mater and the arachnoid (into the so-called 'arachnoid sac'); or (3) beneath the arachnoid and into the meshes of the pia mater.

ÆTIOLOGY.—The first of these varieties of meningeal hæmorrhage has an almost exclusively traumatic origin; being a result of falls or blows which occasion the rupture of one of the meningeal arteries, lying between the bone and the dura mater. Still, caries of the bone may in very rare cases lead to such a hæmorrhage, by causing erosion of one of the meningeal arteries.

The other two varieties are not so distinctly separated from one another, since a hæmorrhage occurring in the pia mater, if large, is very apt to break through the arachnoid, and thus lead to effusion of blood into the 'arachnoid sac'; and this whether the primary effusion has been the result of a traumatic injury, or is a sequela of some general or local disease. Effusion into the arachnoid may also occur as a result of rupture of some vessel on the inner surface of the dura mater; this being probably a rare consequence of injury, though it is a frequent result of disease in this situation (*pachymeningitis interna*).

Effusions of blood are occasionally found beneath the arachnoid which have not originated there, but which have come to the surface, by laceration of brain-substance, from some intracerebral hæmorrhage: or they may have been caused by intraventricular hæmorrhages, finding their way into the fourth ventricle, and thence into the subarachnoid tissue of the pons and cerebellum.

In very young children, whose vessels are presumably healthy, bleeding into the arachnoid may occur from any unusual amount of strain. This occasionally takes place at the time of birth, especially during prolonged labours. Indeed, according to Cruveilhier, arachnoid hæmorrhage is the cause of the death of about one-third of those infants who die almost immediately after birth. The extreme frequency of these hæmorrhages in infants in cases in which the labour has been difficult or protracted has, moreover, of late been established by Dr. Herbert Spencer. A little later on in life, a similar accident may occur during paroxysms of whooping-cough, or during other spasmodic respiratory conditions, in which the return of venous blood from the head is impeded. Later still, an arachnoid hæmorrhage not infrequently follows a fall or blow upon the head, or it may result from the rupture of an aneurysm on one of the larger vessels about the base of the brain—especially the basilar or one of the middle cerebrals. Small subarachnoid hæmorrhages, often multiple, are not infrequently produced by the occurrence of thrombosis in the longitudinal sinus. They may also occur in persons suffering from scurvy or leucocythæmia. Lastly, they may be met with as one out of the many forms of lesion occurring in men suffering from general paralysis of the insane.

Meningeal hæmorrhages are decidedly more common in males than in females—in the proportion of about three to one. They do not, however, like cerebral hæmorrhages, occur with progressive frequency as age advances, but are much more uniformly distributed through the different decades of life.

ANATOMICAL CHARACTERS.—When death takes place soon after blood has been effused into the arachnoid, as well as in the other situations, it is found in an easily recognisable condition. This is by no means the case, however, after the lapse of many months or even years; then, in the case of small hæmorrhages, we may meet with mere yellowish or rust-coloured stains; whilst where they have been of larger size, we may find decolorised cyst-like bodies, either free or adherent—or else there may be decolorised membranous masses, adhering mostly to the parietal arachnoid. Where the size of the clot has been large, the surface of the brain is more or less pressed upon, so that some atrophy of its substance follows. Many of these latter points are well exemplified in a case recorded by Sir Richard Quain in the *Path. Trans.*, vol. vi. p. 8.

Sometimes the layers of altered blood are neither adherent to the arachnoid, nor do they lie free on its surface; they may be attached to the surface of the dura mater, or lie between new-growths arising from its inner layers, and thus produce a condition which often goes by the name of *hæmatoma*. Prolonged discussions have taken place on the question whether these changes are results of a primary hæmorrhage, or whether we have not rather to do with a *pachymeningitis interna hæmorrhagica*, where an inflammation is the first event, during which effusion of blood takes place into the innermost layers of the altered and inflamed membrane. *See* MENINGES, CEREBRAL, Hæmatoma of.

SYMPTOMS.—The symptoms attendant upon meningeal hæmorrhage will necessarily vary a great deal in severity, according to the amount and suddenness of the effusion. These symptoms are, moreover, in the great majority of the traumatic cases obscured by those depending upon the mere shock and concussion of the brain, which the original accident or blow occasions.

Where subarachnoid hæmorrhages occur in the course of thrombosis of the longitudinal sinus, no distinctive symptoms are as a rule produced; and those of the primary affection are themselves only too variable, and difficult of recognition. Again, where subarachnoid hæmorrhages occur in the course of purpura, leucocythæmia, or allied affections, the amount of blood effused is usually too small to produce definite or recognisable symptoms. At most, the abrupt onset of pain in the head, vertigo, or mental confusion, may give rise to a suspicion that such an event has occurred.

Where a large hæmorrhage takes place beneath and into the arachnoid sac, over one hemisphere, or over both, either as the result of a fall or blow, or from the bursting of an aneurysm on one of the large arteries at the base of the brain, a profound coma is produced which may prove rapidly fatal—that is, in the course of a few minutes or a few hours. Where the amount of blood effused is less, and where it is poured out more gradually at first, there may be premonitory symptoms, in the form of sudden headache, vertigo, mental confusion, vomiting, or convulsions, rapidly followed by unconsciousness. At first there is generally complete relaxation of all the limbs; but later—after some hours or days—the weakness may be distinctly unilateral, that is, of hemiplegic type—though sometimes with very slight implication of the face. There may also be twitchings or rigidity of the limbs on one or both sides. On recovery of consciousness there may be no distinct loss of sensibility, only numbness, in the limbs; and the paralysis may after a time grow less up to a certain point, or gradually disappear.

Diagnosis.—In many of the slighter forms of hæmorrhage into the cerebral meninges diagnosis is, for the reasons specified, almost impossible.

In the more severe cases a sudden apoplectic attack is produced, agreeing very closely with that occasioned by some of the most serious forms of intracerebral hæmorrhage. Causal conditions, especially when they have been traumatic, together with the possible youth of the patient, may in some cases help us to diagnose a large arachnoid hæmorrhage from a copious bleeding into the lateral ventricles, or from a sudden hæmorrhage into the middle of the pons Varolii; though it should be borne in mind that in the former of these two conditions the pupils are almost always widely dilated, whilst in the latter they are as constantly contracted and insensitive; whereas they are likely, so far as the writer's observations have gone, to be in a more intermediate condition in arachnoid hæmorrhage.

Prognosis.—In the case of arachnoid hæmorrhages, whether large or of only moderate volume, should the patient survive the first effects of the effusion (and, it may be, of the injury which caused it), danger to life is no longer to be feared. The only question then is as to the amount of paralysis, mental impairment, or of irritability with cephalalgia, which may remain; or whether or not a tendency to convulsions may be set up, as a consequence of the original injury and lesion.

Treatment.—The treatment of a case of meningeal hæmorrhage does not differ from that appropriate for cerebral hæmorrhage. Perfect rest in the recumbent position, with the head slightly raised, is essential. Cold to the head may be conjoined with hot applications and mustard plasters to the lower extremities. For other indications and details of treatment we must be guided by the varying conditions of the patient. In some cases (especially where the hæmorrhage has been between the dura mater and the bone) the aid of the surgeon has been sought, who, by trephining and giving exit to much of the extravasated blood, has either cured or greatly mitigated the condition of the patient. During convalescence, in the more favourable cases, we must pay great attention to the general health, and above all protect the patient from overwork or excitement of any kind.

H. Charlton Bastian.

MENINGES, CEREBRAL, Hæmatoma of.

—Synon.: *Pachymeningitis Interna Hæmorrhagica*; Fr. *Pachyméningite*; Ger. *Pachymeningitis*.

Definition.—Inflammation of the inner surface of the dura mater, attended with the formation of a membranous vascular tissue, into which hæmorrhage takes place.

Ætiology.—This affection is met with at all ages, but is most common in advanced life and early childhood. Males are said to suffer more frequently than females. It is rarely primary; most of the recorded cases have followed, at some interval, an injury, or occurred in the subjects of insanity or chronic alcoholism. Other cases have appeared consequent on acute rheumatism and other pyrexial affections, especially pneumonia and small-pox.

Anatomical Characters.—According to Virchow, in the early stage, before hæmorrhage has taken place, a delicate reticulated membrane exists on the inner surface of the dura mater in one or many layers—even as many as twenty. It varies in consistence according to its age. The colour is usually reddish, from the number of new-formed vessels; but it is often rust-coloured from degenerated blood extravasated in minute quantity. The position of the membrane is always over the convexity, commonly near the middle line; and it is often symmetrical on the two sides. In the second stage, that of hæmorrhage, blood in considerable quantity is effused between the layers in one or several places, and may extend as far as the limits of the false membrane, thus constituting one or more simple or loculated cysts. These cysts are, of course, adherent externally to the dura mater, and internally rest on the arachnoid membrane and convolutions, which they compress and even depress. Their contents are blood — liquid, coagulated, or in every stage of degeneration. Ultimately only coloured serosity may remain. The thin delicate wall of the cyst was formerly regarded as organised fibrin from a blood-clot, or as the separated parietal layer of the arachnoid; and some pathologists are still of opinion that the hæmorrhage precedes the formation of the membrane. *See* MENINGES, CEREBRAL, Hæmorrhage into.

SYMPTOMS.—Two periods may often be recognised, corresponding to the anatomical stages of hæmatoma of the dura mater just described. In the first, circumscribed headache is the chief symptom, often felt at the vertex. It may be associated with giddiness, uncertainty of movement, lowered mental power, and contraction of pupils. In children, in whom the whole disease commonly lasts only a few days, there is often fever. In adults this stage may last for weeks or months. The second stage, that of blood-effusion, is attended by an increase of the mental dulness to distinct somnolence, at first intermitting, but deepening to actual coma with a rapidity that depends on the rapidity of effusion. The pupils continue contracted, but that on the side of the mischief may become the smaller. Hemiplegic paralysis or contraction may occur when the hæmatoma is unilateral. In children convulsions are common. The duration of this stage in the adult may be weeks or months; and death occurs in coma. In children it usually lasts only a few days.

DIAGNOSIS. The diagnosis of hæmatoma of the dura mater is often difficult, and depends on the slow onset of coma after a period of headache, without symptoms to indicate a localised lesion of the brain. In the child the disease may be mistaken for tubercular meningitis, but the course of infantile hæmatoma is usually more rapid, vomiting is rare, and muscular contractions and convulsions are common.

PROGNOSIS.—The prognosis is very unfavourable, but not absolutely fatal in the adult; in several cases in which the symptoms of hæmatoma have been present, recovery has taken place. In children there is little hope.

TREATMENT. — In the child one or two leeches may be applied behind the ears; and cold to the head, and counter-irritation to the skin of the neck and limbs, are likely to be useful.

In the adult, if by rest, cold to the head, and counter-irritation the effusion can be arrested, absorption of the blood will slowly take place; and this may be furthered by moderate purgation, by diuresis, as well as, perhaps, by the administration of mercury or iodide of potassium. W. R. GOWERS.

MENINGES, CEREBRAL, New Growths and Adventitious Products in. The clinical aspects of the several pathological conditions composing the set of changes included under these heads are comparatively meagre and ill-defined, as compared with what we know of them pathologically. For this various reasons exist, some of which will now be indicated.

SYMPTOMS AND DIAGNOSIS.—Intracranial new-growths or adventitious products are, as a class, accompanied by the most diverse sets of symptoms. The new-growths or products vary in different cases within very wide limits, from the point of view of the suddenness of their onset or increase, as well as of their actual bulk or number, and also as regards the particular intracranial region or regions which they implicate. We may therefore in some measure understand how it happens that some growths or products may be unaccompanied by appreciable symptoms during life; that others may be associated only with vague symptoms of a general order, denoting the existence of some kind of intracranial mischief; whilst, on the other hand, some may be associated with such comparatively definite groups of symptoms as to make it reasonably easy to arrive at a pretty certain diagnosis, both as to the situation and as to the nature of the intracranial growth or morbid product.

But, it may be said, why use the broader term 'intracranial' when we are here only concerned with morbid conditions of the meninges? This brings us to the last source of variation above referred to, namely, that dependent upon differences in locality. But, great as this cause of variation is, it must be clearly understood that it is for the most part impossible to distinguish clinically between mere meningeal new-growths or products, and those which arise from or within related portions of the encephalon. The reasons for our impotency in this direction are also not difficult to find. First, we may cite the general one, of the frequent vagueness or even absence of any appreciable symptoms attendant upon intracranial growths or products, whether they be of meningeal or of intracerebral origin; and, secondly, the more special reason, that growths starting from the meninges will often press upon and implicate the surface of the brain in different regions, in much the same manner as if they sprang from the surface of the brain itself in such regions. And, thirdly, there is the further consideration that intracranial growths or products are frequently multiple in the same individual, and then may partly spring from the meninges, and partly from the substance of the brain itself

For these various reasons it happens that if the diagnosis of a purely meningeal new-growth or adventitious product could ever be arrived at, it would have to be effected through the medium of a previous pathological diagnosis. But how limited are the possibilities in this direction may be gathered from the following considerations. Certain personal or family characteristics presented by a patient may make it highly probable that syphilitic intracranial disease, or that scrofulous intracranial growths exist. Still more rarely the signs and symptoms may indicate that cancerous intracranial growths, or that growths similar to some multiple tumours already existing in other parts of the body, may be the causes also of coexisting head-symptoms. Yet these are almost the only cases in which it may be possible for us to arrive at anything like a positive diagnosis as to the nature of a supposed intracranial growth or product. And of these the first only, namely, syphilitic disease, could with any degree of certainty be diagnosed as a change limited to the meninges; the others would be just as likely to take origin within the cerebral substance as from the meninges.

For these reasons no good purpose would be attained by entering at length into the groups of symptoms that may be produced by meningeal growths or adventitious products. They are apt closely to resemble some of those coexisting with growths within the brain. *See* BRAIN, Tumours and New-Growths of.

ANATOMICAL CHARACTERS.—It will suffice to indicate briefly the nature of the morbid changes which are included in this article.

A. **New - Growths.** — (*a*) *Syphilitic growths or thickenings of the meninges.*—These products are met with principally in the form of yellowish lymph-like masses, connecting the dura mater with the arachnoid, and this, along with the pia mater, to the surface of the cerebral hemispheres in some region (often the parietal), of irregular area and variable extent. This yellow 'gummatous' material probably takes its origin, for the most part, in or on the surface of the dura mater, while it may extend inwardly so as to infiltrate or press upon the surface of the brain, and also outwardly so as to cause erosion of the cranial bones. The membranes around may be thickened, or more or less obviously inflamed. This form of disease does not occur in congenital syphilis; when it exists, therefore, it is invariably met with in persons beyond the age of puberty. Similar growths taking origin completely within the brain-substance are extremely rare.

(*b*) *Scrofulous tumours.*—These are now mostly spoken of as 'tubercular' growths. They, unlike the last, are much more frequently met with in children than in adults, and especially in young children between the ages of two and seven years. They are yellowish nodular masses, varying in size from that of a small pea to a walnut. While some of them may obviously spring from the pia mater, others (and this much more frequently) are met with within the substance of some portion of the cerebrum or cerebellum. As in the last case, these growths are presumed to be dependent upon the existence of a special constitutional state—one which carries with it proclivities to certain kinds of tissue overgrowth.

(*c*) *Cancer.*— Cancer not infrequently affects the dura mater, whence it may extend outwards or inwards, and thus implicate other parts secondarily—either eroding and perforating the bone, or greatly depressing or infiltrating the surface of the brain as it grows inwards. Although more frequent in the second half of life, meningeal cancer may occur also in youth, or even in childhood.

(*d*) *Other growths.*—Other growths of less frequent occurrence, and therefore of less importance, also start from the meninges. We may have the following: *sarcomata*; *fibromata*; *fibro-enchondromata*; *steatomatous or cholesteatomatous growths*; and *structureless or wax-like tumours*, having the so-called 'amyloid' reaction. Such tumours as these may give rise to more or less definite head-symptoms during life. They spring, for the most part, from the dura mater rather than from the arachnoid.

Other smaller, and mostly rare, growths may be met with quite unexpectedly after death, because of their occurrence in the form of flat plates, which do not interfere by pressure or otherwise with the subjacent cerebral substance, and therefore give rise to no obvious symptoms. They are: *osteomata*, which occur either in the falx, in the walls of the lateral sinuses, or much more rarely in the substance of the arachnoid, in the form of osseous plaques; and *calcareous depositions* (belonging, perhaps, more strictly to the next than to this section), which vary in size from a mustard seed to a small nut, and which may be found in or beneath the arachnoid, or also on the inner surface of the dura mater. Sometimes a number of such minute concretions may be met with in connexion with the pia mater or arachnoid (especially when these membranes are thickened or otherwise diseased), in the form of minute granules closely resembling the so-called 'brain sand,' each of which may present traces of several concentric layers.

B. **Adventitious Products.**—(*a*) *Parasites.*—These may be of two kinds, both of them being larval states of tape-worms.

Cysticerci are larval conditions of *tænia solium*, having the form of small bladders, which vary in size from that of a pea to a horse-bean. They often exist in large numbers in the meninges and within the brain of the same individual, and are very rarely solitary. As many as one hundred may be found within the cranium; and when they are thus numerous, many of them will almost certainly be met with in the pia mater, merely pressing upon and slightly indenting the surface of the convolutions, though others will be situated within the substance of both cerebral and cerebellar convolutions. They are not confined to persons of any particular age or either sex, though they occur rather more frequently in those representing the second than the first half of life. Infection is brought about by unclean habits in those who are affected with either of the two common forms of tape-worm, or occasionally by ripe proglottides getting into the stomachs of such persons during acts of vomiting. In such a case the contained ova would be liberated, and the embryos developed therefrom disseminated through the body of the host. *See* ENTOZOA.

Hydatids which are met with in the brain are always barren cysts (acephalocysts), and the outer enclosing membrane is generally very thin. They are usually solitary; may vary in size from that of a marble up to a large orange; are rare even in the brain-substance, and still more rare in the pia mater. Sometimes two, three, or more hydatid cysts exist within the cranium of the same individual, but they are then usually of small size. Davaine refers to an instance in which many hydatids were found in the meninges and at the surface of the brain, as well as within its substance. Out of twenty-four recorded cases, in which the age was stated, the writer has found that no less than eighteen of them were persons between the ages of ten and thirty years, three of the remainder being above and three below these extremes. Infection may well be brought about by means of the dog's tongue, which is at times only too quickly transferred from parts liable to be contaminated by ova of its own tape-worms, to the hands or even the lips of his master or mistress. Besides this more direct method, the ova of the tænia echinococcus voided by the dog may be blown about, or otherwise get by accidental means into water or food taken by man. *See* ENTOZOA.

(*b*) *Aneurysms.*—These, situated either on one of the vessels composing the circle of Willis, or on some one or more of its primary branches, may vary in size from a small pea to that of a walnut. Those of the larger sizes, which are usually single, may give rise to distinct head-symptoms; but at other times, and especially when the aneurysm is very small, there may have been no reason to suspect its existence, or that of any other intracranial disease, till perhaps the rupture of such an aneurysm may lead to the supervention of serious symptoms, speedily terminating in death. These aneurysms may occur, possibly as a sequence of a previous embolism (Church), even in early youth as well as in adult age.

(*c*) *Thrombi in the cerebral sinuses.*—The process of thrombosis is known principally as it occurs in three of the sinuses contained within the cerebral meninges, namely, in the longitudinal sinus, or in one or other of the two lateral sinuses.

(1) The formation of a thrombus in the *longitudinal* sinus is usually a *primary* phenomenon, dependent in the main upon the operation of general causes, such as some alteration in the quality of the blood, combined with slow, feeble, and irregular action of the heart. The operation of these causes has, however, been known to have been favoured in certain cases by local conditions, such as the great development of Pacchionian bodies, and their projection into the sinus—an event most likely to occur in elderly persons. Thrombosis of the longitudinal sinus may, however, be met with also in the early as well as in the middle periods of life. The original thrombus frequently prolongs itself through the straight sinus to the torcular Herophili, and thence on either side into the lateral sinuses. And in this latter class of cases ventricular effusions and superficial cerebral softenings are apt to be associated with the thrombosis. The softenings are of a peculiar and characteristic kind, consisting generally of a number of small red patches, occupying principally the grey matter on each side of the upper surface of the brain. Occasionally softening of a portion of brain of considerable extent has been produced. Besides the ventricular effusion, there may also be an excess of serum beneath the arachnoid, or more rarely small effusions of blood in these situations, together with minute patches of hæmorrhage in the convolutional grey matter, such as have been described by Cruveilhier under the name of *apoplexie capillaire.* The actual combination of these conditions will depend upon the seat of the obstruction, the rapidity with which it is brought about, and the existence or not of marked pathological conditions of the vessels generally. The variation in the symptomatology of this affection in different cases is, therefore, also extreme; the symptoms are sometimes of an excessively grave order, and sometimes almost *nil.* Strange as it may seem, Dr. Gee says: 'I have known a decolorised softening thrombus to occupy the whole bore of the upper longitudinal sinus, to be attended by large subarachnoid hæmorrhages, and to have caused no symptoms during life.'

(2) Just as frequent, however, as the event above referred to, is the formation of a thrombus in one or other of the *lateral* sinuses; only then the process is almost

invariably *secondary* to inflammation of the scalp or cranial bones, whether induced by traumatic conditions or by disease. Caries of the cranial bones is the principal predisposing condition; indeed, in three-fourths of the recorded cases the temporal bone was the part affected, and that as a result of internal otitis. In these cases there is often evidence of a more or less circumscribed inflammation of the meninges, but cerebral softenings and subarachnoid extravasations of blood rarely occur. This, according to von Dusch, is explicable by the fact that in such cases the thrombosis starts from the veins in communication with the inflamed spot, and reaches the lateral sinus only after the collateral circulation has had time to establish itself; instead of forming primarily in the sinus, and before a collateral circulation has been set up.

(*d*) *Serum.*—This fluid may be met with in excess in two situations. It occurs (1) *beneath* the arachnoid, in cases in which one or both cerebral hemispheres have become wasted or atrophied. After fifty or sixty years of age, therefore, it is common to find an excess of subarachnoid serum. This fluid transudes from the vessels as pressure outside them diminishes, owing to brain-atrophy. It is absurd to suppose that it has any other, or at least any important, pathological significance. To speak, as some do, of 'serous apoplexy' as a cause of death, when no very obvious reason for the death can by such persons be assigned, is a mischievous assumption of knowledge where a confession of ignorance would be better. But serum is sometimes found in excess (2) *within* the cavity of the arachnoid, when it constitutes the condition occasionally spoken of as 'external hydrocephalus.' It seems probable that the majority of such cases are instances in which the fluid of an ordinary internal hydrocephalus has, at some period before or after death, in part escaped from the ventricles into the cavity of the arachnoid (*see* HYDROCEPHALUS, Chronic). Still, there may be a narrow margin of cases not capable of being thus accounted for, in which the cause of the presence of fluid in this situation is very uncertain, when it is not, as it may sometimes be, an appanage of meningeal inflammation.

PROGNOSIS.—Some of the smaller and more slowly growing tumours may give rise to no very obvious symptoms during life, and may not appreciably tend to shorten its duration. Again, the accumulation of serum beneath the arachnoid is only a non-disturbing effect of other causes.

The case is, however, of much graver import where we have to do with syphilitic, scrofulous, cancerous, or other growths having a tendency to more or less rapid increase; also where the patient is suffering from the existence of intracranial cysticerci or hydatids, or from the occurrence of thrombosis in the longitudinal or lateral sinuses. In all such instances we may, for the most part, look for a steady increase in the gravity of the patient's symptoms, and (except in the case of the first kind of growth under the influence of proper treatment) for death at no very distant date.

TREATMENT.—Drug treatment can be looked forward to as curative, or nearly so, in only one of these various maladies, namely, in that of syphilitic origin—hence the great importance of a correct diagnosis where this condition is present. In a large number of cases, symptoms of the gravest character, associated, it may be, with paralysis, stupor, severe convulsions, excruciating cephalalgia, and even incipient insanity, one or more, or all, will, when really of syphilitic origin, yield in a truly marvellous manner to the continued and steady use of iodide of potassium in doses of eight grains, gradually raised to twenty or thirty grains, three times a day, especially when given in combination with $\frac{1}{32}$ to $\frac{1}{16}$ of a grain of bichloride of mercury.

Cod-liver oil, with steel wine or the syrup of phosphate of iron, together with good food, quietude, and fresh air, may also do something to retard or even stop the growth of scrofulous tumours in sickly children.

Beyond this, in the class of cases which we have just been considering, medicinal treatment can be merely palliative. We must strive to relieve headache and secure better sleep; to mitigate the severity of convulsive attacks; or, if possible, to lessen the marked tendency to vomiting which may exist. Mental dulness and stupor, in such cases, are mostly beyond the reach of relief from therapeutics; though restlessness and irritability may perhaps be mitigated, by the administration of remedies suitable for the relief of pain, and for the encouragement of sleep.

In certain cases of meningeal tumour, as in tumours which involve the cortex of the brain (and especially in both kinds of growth when they are in relation with the 'excitable area,' and therefore capable of being accurately localised), the question of the propriety or not of a surgical operation for its removal should be entertained. In some instances such a procedure holds out the only definite chance of curing or notably relieving the patient. H. CHARLTON BASTIAN.

MENINGES, SPINAL, Diseases of. The following conditions of the spinal meninges have to be considered:—

1. *Inflammation* of several varieties.
2. *Hæmorrhage.*
3. *New-growths* and *Adventitious products.*
4. *Malformations.* *See* SPINA BIFIDA.

Inflammation affects the spinal meninges in several different forms, though they are divisible into two main categories. Thus we may have: (a) *Inflammation* of the spinal meninges of *traumatic* or *secondary* origin; and affecting either the dura mater (*spinal pachymeningitis*); or the arachnoid membrane (*spinal arachnitis*). (b) *Inflammation* of the spinal meninges of a *simple idiopathic*, or of a *tubercular* nature, and both affecting the pia mater (*spinal leptomeningitis*).

These different forms of spinal meningitis, whether existing alone or in association with a similar inflammation of the cerebral meninges, occur as acute diseases. Occasionally, where such diseases do not terminate fatally, they may lapse into a subacute or chronic condition, and thus persist for a considerable time. In association with new-growths or with adventitious products in the meninges, there may also arise a subacute or chronic localised inflammation of these membranes; but of chronic spinal meningitis beginning idiopathically as such, and pursuing a course chronic from the first, our knowledge is at present extremely slight. Chronic thickenings of the spinal membranes are, it is true, met with from time to time *post mortem*, which are by some deemed to have had an inflammatory origin independently of any acute attack. But as in other situations, so here, considerable thickenings of these serous membranes may be met with as a result of degenerative rather than of inflammatory changes; and such conditions may give rise to no very appreciable symptoms during life till, as a sequence of their thickening and undue adhesion to the surface of the spinal cord, a superficial or annular form of sclerosis becomes established in this organ, either limited in site or irregularly developed in different regions.

H. Charlton Bastian.

MENINGES, SPINAL, Inflammation of, Traumatic and Secondary.—

Ætiology.—In the case of the cerebral meninges, inflammation as a result of traumatic injuries is more common than as a phenomenon secondary to disease of the bone or of the scalp. The proportional frequency of these modes of causation is, however, somewhat reversed in the case of the spinal meninges; partly because the head is more liable than the spine to suffer from direct injuries, and partly because disease of the spine and of adjacent parts occurs with considerable frequency in such a manner as to be capable of exciting a secondary inflammation of the spinal meninges. Among the various efficient *traumatic* influences may be mentioned fractures and dislocations of the vertebræ, and stabs or other penetrating wounds implicating the contents of the spinal canal; while among the most frequent morbid conditions, in the course of which there may be a *secondary* development of spinal meningitis, we must cite the following: Caries and tubercular disease of the vertebræ; syphilitic gummata; deep sloughing bedsores in the sacral region; cancer of the vertebræ; and, more rarely, inflammation of some part of the thoracic or abdominal parietes contiguous to the spinal column, and capable of spreading to the spinal canal from within.

Anatomical Characters.—In all these cases the signs and products of inflammation may be found in one or other, or in both, of two situations; that is, either implicating the dura mater, principally on its external surface, when we have the condition commonly known as *spinal pachymeningitis*; or affecting the surface of the arachnoid so as to produce a *spinal arachnitis*. Thus the same kind of limitation in the distribution of the inflammation is apt to occur when it starts under the influence of such causes as is found to obtain in regard to the traumatic or secondary inflammations of the cerebral meninges. Perhaps there is in the case of inflammation of the spinal membranes, however, a rather more distinct tendency for such inflammations to spread, so as to involve the subjacent pia mater, than is the case in the parallel inflammations of the cerebral meninges.

In *spinal pachymeningitis* the dura mater itself is thickened and more vascular than natural, this being seen more especially on its outer surface; and both it and the surrounding connective tissue are covered or infiltrated either with yellowish lymph-like matter, or with actual pus. The internal surface of the dura mater may also be more or less covered with inflammatory products. The nerve-roots passing through the membrane are likewise generally affected by the inflammatory process, and they may show signs of compression or even of atrophy. Such inflammation may be either limited to the region of two or three vertebræ, or it may affect more or less the whole length of the spinal membranes.

Another more idiopathic and also more chronic form of spinal pachymeningitis has been observed by Charcot and others, affecting principally the inner layers of the dura mater in the cervical region. In this condition, which is described by the author above named as *pachyméningite cervicale hypertrophique*, there seems to be a considerable hyperplasia of tissue-elements in the inner layers of the dura mater, which is apt to develop into an overgrowth of almost cicatricial hardness, often made up of concentric laminæ. These are frequently adherent to the arachnoid and to the pia mater, which also become more or less thickened. In these latter cases, especially, not only are the spinal nerve-roots greatly damaged, but the spinal cord is itself more or less compressed and softened, so that distinct [illegible] symptoms, with muscular rigidities or atrophy, are apt to be produced.

Where *spinal arachnitis* is superadded, or when it exists alone, we find that pus or lymph is situated on the outer surface of the visceral arachnoid, and also to a less extent on that lining the dura mater. The combination of the two conditions is rather more frequent than the existence of arachnitis alone. It is important to remember that all these forms of inflammation are very rarely, if ever, primary and idiopathic (with the exception of the more chronic variety described by Charcot), but that they occur as consequences of injury, or of certain forms of disease adjacent to the spinal canal.

SYMPTOMS, PROGNOSIS, AND TREATMENT.—As the nerve-roots are affected in these forms of inflammation, as well as in the idiopathic meningitis which implicates the pia mater (*spinal leptomeningitis*), and as the symptoms of both sets of affections are in great part dependent upon this, and are therefore in many respects similar (and by no means always capable of being accurately discriminated from one another), it would serve no useful purpose to dwell upon the symptomatology and treatment of spinal pachymeningitis and arachnitis alone. The reader is, therefore, referred to the corresponding sections in the next article.

H. CHARLTON BASTIAN.

MENINGES, SPINAL, Inflammation of, Simple Idiopathic and Tubercular.—SYNON.: Simple and Tubercular Spinal Leptomeningitis.

Simple spinal meningitis of idiopathic origin, and tubercular spinal meningitis, are affections so closely related to one another, both in their clinical and pathological aspects, that no advantage whatsoever would be derived from considering them separately. In each case we have to do with an inflammation involving the spinal pia mater, so that the products of inflammation are situated beneath the arachnoid membrane. In order to distinguish these from other forms of meningitis, such as pachymeningitis and arachnitis, it is desirable that we should use some special term, such as *leptomeningitis*, which is now employed as a distinctive appellation for an inflammation affecting the pia mater, whether cerebral or spinal.

In regard to the extent or area of this kind of inflammation, it must be said that the tubercular variety always involves the presence of a similar inflammation at the base of the brain, though the contrary position is not true—that is to say, the tubercular inflammation may exist at the base of the brain alone, without involving the spinal meninges. Of the non-tubercular forms of spinal leptomeningitis, there are two varieties, and of these one form always involves the membranes at the base of the brain and the spinal meninges simultaneously (*see* CEREBRO-SPINAL FEVER). The other form may or may not simultaneously involve the membranes at the base of the brain, so that we have in these cases either a 'simple sporadic cerebro-spinal meningitis,' or a 'simple spinal meningitis.'

Whenever the inflammation has a 'cerebro-spinal' distribution, no confusion is involved by retaining the use of the simpler term 'meningitis,' as it is generally understood that forms of inflammation having such a distribution involve the pia mater especially. But in place of the name 'spinal meningitis,' if we mean to imply that the inflammation affects the same tissue, it is best to use the more special and distinctive term 'spinal leptomeningitis.'

From what has been said above, it will be understood that the symptoms resulting from meningitis involving the base of the brain alone, or together with serous effusion and softening of the walls of the ventricles (which, as we have seen, so frequently coexists with inflammation of the membranes in this situation), have been principally studied in the purely cerebral forms of tubercular meningitis. On the other hand, the symptoms resulting from spinal leptomeningitis are best studied in the simple forms of this disease. It will also be evident that the simple and the tubercular forms of cerebro-spinal meningitis are likely to agree to some extent in their symptomatology with that of the disease known as 'epidemic cerebro-spinal meningitis.'

ÆTIOLOGY.—Spinal leptomeningitis is most prone to occur in children and in young persons; and is more frequent in males than in females. Persons who are badly fed, and live under very unfavourable sanitary conditions, are more liable to be attacked than those who are healthy and surrounded by opposite conditions.

For the tubercular form the exciting causes are all such influences or conditions, whatever they may be, as determine the outbreak of acute tuberculosis. The affection of the spinal meninges may be either an extension of the inflammation originally existing at the base of the brain alone, or it may be another independent manifestation of the general disease developing within the spinal canal simultaneously with the cerebral meningitis. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular.

For the simple or non-tubercular form, the exciting causes are various, but the best established of them would seem to be these: Exposure to cold, or cold and wet, in various forms; certain acute diseases, or the period of convalescence therefrom; concussion of the spine, as from falling down stairs, or in other ways; wounds affecting the spinal cord or its membranes, as in stabs of various kinds; or fracture and dislocation of the vertebræ.

The last modes of causation mentioned are similar to those which obtain for spinal pachymeningitis and arachnitis. For, although these latter conditions may be excited alone under such traumatic influences, they may also in certain cases, and especially arachnitis, be excited in association with a spinal leptomeningitis. Precisely the same kind of thing has also to be said in regard to the occasional action of other causes, such as caries of the vertebræ, deep-sloughing bedsores in cases of paraplegia, or other instances of inflammatory processes contiguous to the spinal canal. Any of these latter conditions may also set up a leptomeningitis, in association with one of the other forms of meningeal inflammation.

A spinal leptomeningitis may spread so as to implicate the base of the brain; or a cerebral basal leptomeningitis may subsequently implicate the spinal membranes; or, lastly, the inflammation may appear in both regions simultaneously, and thus be from the first cerebro-spinal in seat. The writer has of late seen several cases of the tubercular variety belonging apparently to this latter category; but until the spinal canal has been regularly opened for some time in necropsies of persons dying from this disease, we shall be unable to say what is the exact numerical proportion of such cases as compared with those which are simply cerebral in type. The bulb may be comparatively free from lymph, and yet an inflammation of the spinal meninges may be well-marked. There must, therefore, be a routine opening of the spinal canal for the decision of this question, and not a mere casual inspection of its upper extremity through the foramen magnum.

Anatomical Characters.—According to the stage of the disease at which death takes place, we may meet with the inflammatory process in one or other of three different stages: (1) that of greatly increased vascularity of the spinal pia mater; (2) one in which, in addition to the increased vascularity, gelatinous serum, lymph, or pus exists in the meshes of the pia mater, and often more marked in amount along the posterior columns. This latter is the condition commonly met with; but in rare cases, where patients have survived an acute attack, we may find (3) certain residuary chronic changes in the form of thickenings, opacities, and undue adhesions of the pia and arachnoid to the spinal cord, which perhaps may itself show a more or less marked condition of peripheral sclerosis.

In the tubercular variety we frequently have to do with a mere gelatinous serum, or thin greenish-yellow lymph (similar to that met with at the base of the brain), rather than with actual pus, in the meshes of the pia mater. Careful scrutiny of the vessels in the anterior fissure and in other parts may also show the characteristic 'granulations,' in the form of opalescent, whitish, or yellowish-white specks.

In both forms of the disease the *nerve-roots* are implicated in various ways. They are usually involved in the inflammatory process, and may be much pressed upon by lymph and other hyperplasic products. The nutrition of the cord itself is probably profoundly altered, owing to the existence of an inflammatory process affecting the network of vessels from which its blood-supply is derived; and, moreover. the organic continuity existing between the pia mater and the offshoots of connective tissue which extend into it on all sides, around the blood-vessels that penetrate its substance, makes it only natural to suppose that the inflammatory process would more or less invade the substance of the cord itself. And this, as the observations of F. Schultze have shown (*Berlin. Klin. Wochenschrift*, 1876, No. 1), actually does occur. But further researches are needed in this direction, in order that we may know the frequency with which grave changes of this kind are produced.

Symptoms.—General listlessness and a sense of chilliness have been noticed as premonitory symptoms in some cases of spinal meningitis. At other times the disease has been observed to commence with a more marked feeling of chilliness, accompanied or quickly followed by some febrile elevation of temperature, together with a full, rapid pulse. Soon there supervenes a deep-seated, boring pain in the back, varying in situation according to the degree of intensity of the inflammatory process at different levels. Pains may also extend round the body in girdle fashion, and likewise into the limbs. Whilst the pains in the back are more or less continuous, though greatly aggravated by all attempts at movement, those felt in the limbs and trunk may be only experienced when attempts to move are made. Movement excites the dorsal pain far more than pressure upon the vertebral spines, or light tapping over the same region.

Rigidity of the spine, from muscular spasm, either localised or general, and also rigidity of the limbs, or even of special muscles, may coexist with the pains in the back and limbs. There is often an exaltation of reflex movements in the early stages of the disease, though this condition is nothing like so well marked as it is in tetanus.

At the same time marked hyperæsthesia of the skin exists over considerable regions of the trunk and extremities. The patient cannot bear to be touched, however lightly; and still less can he endure to be moved. He is irritable or plaintive if these proceedings be attempted. Owing to the varying nature and extent of the spasms, and the different degree of pain endured, the position assumed by the patient is very various in different cases.

Difficulty in defæcation and in micturition often exists, especially in the early stages of the disease, and this is supposed to be due to a spasmodic condition of the sphincters. The respiration and the heart's action are principally interfered with in cases where the cervical meninges are gravely involved.

The temperature seems to pursue a somewhat irregular course, but concerning this further information is needed. It may be only slightly above the normal; and may not rise much beyond 102°, even in fatal cases, till near the end. Then it may rise considerably in the course of a few hours; whilst in other cases it may at this same period become depressed below the normal.

In the later stages of the disease some amount of paresis, or actual paralysis, may be noted in one or more limbs; the pains on movement and the skin-hyperæsthesia become less, or may indeed be intermixed with tracts in which actual anæsthesia exists. The bladder may at last be paralysed; and respiration may be most gravely interfered with, so that disturbance of this function, as well as of the heart's action, may be the actual cause of death.

These symptoms are, in all probability, as Erb maintains, due in very great part to the inflammatory and other changes by which the anterior and posterior nerve-roots are implicated. Others may be due to extensions of the inflammatory process to the substance of the spinal cord, thus leaving a somewhat uncertain minority of symptoms to be accounted for by the mere implication of the pia mater itself.

The grouping of symptoms is apt to vary much in different cases, according as there is or is not the coexistence of a cerebral meningitis; or, in the absence of this complication, according as the inflammation is more or less localised in different regions of the cord, or general in its distribution. Much will depend also upon the severity of the process, and upon the extent to which the substance of the spinal cord becomes involved in the course of the disease.

Diagnosis.—Fever; pains in the back and limbs, greatly aggravated by movement; together with stiffness of the neck, trunk, or limbs; local muscular spasms; hyperæsthesia of the skin; retention of fæces and urine; dyspnœa; with a tendency in the later stages to the supervention of paresis, or actual paralysis of limbs—these are the symptoms, the combination of which to a marked extent becomes almost typical of spinal meningitis.

Its complication with a basal cerebral meningitis is, amongst other signs, chiefly indicated by the occurrence of vomiting, headache, slight delirium or stupor, paralysis of ocular muscles, difficulty in deglutition, loss of speech, or convulsions. The presence of many of such symptoms may, from their great importance, tend to dwarf or obscure those due to the inflammation of the spinal meninges alone; on the other hand, if they are absent we may feel assured that the inflammation has not also involved the base of the brain.

The fact that a meningitis is spinal in seat, and unaccompanied with cerebral symptoms, is of itself exceedingly good evidence to prove that it is not the tubercular form of the affection.

To settle the question, which membranes of the cord are inflamed in any given case, we must be guided much by what we can learn concerning the causal conditions and the distribution of the inflammation, rather than by any at present known differences in the grouping of symptoms. Thus inflammations of idiopathic origin, or those which are cerebro-spinal in seat, will almost invariably be found to be instances of leptomeningitis; whilst those set up as a result of caries of the vertebræ, or as a sequence of a sloughing sacral bedsore, are certainly much more prone to take the form of pachymeningitis, or of this in combination with arachnitis.

In reference to the diagnosis of spinal meningitis from other affections, it may be said that a very slight amount of attention to the nature of the pains and attendant conditions will suffice to avoid the mistake of supposing them to be rheumatic in nature. And, similarly, the absence of trismus in the early stages, and of any extremely well-marked exaltation of reflex excitability, together with the presence of severe pains in the back and limbs, will be negative and positive characters sufficient for distinguishing spinal meningitis from tetanus.

Another disease with which spinal meningitis is liable to be confounded is acute softening of the spinal cord. But the distinction should be easy in the early stages; and the history of the course of the affection will guide us later on, when symptoms of actual paralysis may have become developed. Still, in certain cases, a spinal meningitis may entail a softening of the cord to a marked extent, and then the symptoms of the primary affection will gradually be merged in those of the other which it induces.

A very rare condition, once met with by the present writer, is, he thinks, almost impossible to be diagnosed from spinal meningitis—that is, where a sarcomatous or carcinomatous new-growth springs up rapidly throughout the spinal pia mater in the situation usually occupied by lymph or pus, especially when, as in the instance referred to, the disease seems to be the direct sequence of a fall from a height or over a flight of steps, and death takes place within a period of two or three months (see *Trans. Path. Soc.*, 1887, p. 31).

Prognosis.—The prognosis of spinal meningitis depends a good deal upon the nature of the primary or causal conditions; upon the question whether the disease shows a tendency to extend to the cerebral meninges; upon the severity with which it implicates the cervical region of the cord; and also to some extent upon the age and general state of health of the person attacked.

Spinal meningitis is a disease which proves fatal in the course of a few weeks in a very large percentage of cases; complete recovery is certainly a rare exception; but late and partial recovery—that is, after the disease has lasted long, and with the remainder of some amount of muscular atrophy or incurable paralysis—is a little more frequent. In such cases the disease after a time lapses into a chronic condition, and the patient very gradually recovers, except, perhaps, for such incurable sequelæ as are above mentioned. But even in these cases tending towards recovery, a relapse is most easily brought about, owing to the recommencement of the disease in an acute form.

Where spinal meningitis supervenes upon a sloughing bed-sore existing in a case of paraplegia, the end is usually not far distant. The gravity of any case of spinal meningitis is also always greatly enhanced when the disease spreads to the cerebral meninges. And, so far as the spinal meninges themselves are concerned, any great intensity of the inflammatory process in the cervical region is always of the gravest import, because of the liability to secondary implication of the cord itself in these regions, either structurally or functionally, and the bringing about from this cause of serious interference with the functions of respiration and circulation. A continuously rising temperature in such a case—to 105° and onwards—is also of fatal import.

Treatment.—The severity of spinal meningitis is apt to prompt to the use of active measures of questionable utility; among these may be cited free local blood-letting, the free application of ice to the spine, and active purgation. It is difficult, too, to say on what principle it is thought absolutely necessary to apply cold when we have to do with an inflammation within the spinal canal or within the cranium, whilst we almost always apply heat externally in the case of an inflamed pleura, an inflamed peritoneum, or even an inflamed skin-tract. Probably the application of ice in such cases tends to alleviate pain, so that where this is great its use may bring much relief to present suffering, when hot applications would only aggravate it. But were it not for the fact that in meningeal inflammation (whether spinal or cerebral) increased fulness of vessels around sensitive organs shut in by unyielding walls almost necessarily leads to aggravation of pain, the application of heat would probably be more beneficial than that of cold, so far as the possible resolution of the inflammatory condition itself is concerned.

The patient should certainly be kept in a cool, quiet room, and lying either on his side, or, if possible, on his face on a comfortable bed. He should be well supplied with spoon diet of the most nourishing description, together with eggs and a moderate amount of stimulants, according to the indications presented by his symptoms and general condition.

Iodine liniment may be painted along each side of the spine in the affected region every second or third day. Pain should also be eased by opium or morphine; in fact, an opiate treatment may be resorted to in a large proportion of the cases. When opium and morphine do not agree, or are not admissible, Indian hemp would be worthy of trial as a mere anodyne; or we must fall back upon bromide of potassium and chloral hydrate, though the latter must be used with great caution where the heart's action is slow, irregular, and seriously interfered with. Belladonna and ergot have also been recommended, on somewhat doubtful grounds, as anti-inflammatory remedies in spinal meningitis.

We ought, in fact, to endeavour to combat the most urgent symptoms as much as possible, even if we cannot, by counter-irritants and by the judicious use of drugs, modify the course of the inflammation. Also by suitable feeding and judicious nursing we should endeavour to tide the patient through the disease. And if, happily, the activity of the inflammatory process subsides, the most unremitting attention will still be required to protect the patient against a relapse. Should his condition otherwise admit of it, the absorption of inflammatory products would, in this stage, be likely to be promoted by the use of a small dose of perchloride of mercury (such as one-sixteenth of a grain for an adult), in combination with increasing doses of iodide of potassium. At the same time, every effort must be made to restore the patient's general health, and to combat the emaciation which the disease itself usually involves.

H. Charlton Bastian.

MENINGES, SPINAL, Hæmorrhage into or upon.—Synon.: *Hæmatorrachis*; Meningeal Apoplexy (Spinal).

Effusions of blood upon, between, or beneath the spinal meninges are altogether rare events, contrasting notably in this respect with the comparative frequency of parallel conditions on the side of the cerebral meninges.

Ætiology.—Among the causes of meningeal hæmorrhages, stabs, blows, or falls will hold a first rank. After these causes we should have to cite impediments to the circulation of blood, occasioned by various respiratory or muscular spasms, occurring either in the course of whooping-cough, or during some more than usually violent convulsive attack—epileptic, tetanic, or other. The lifting of heavy weights, or other great voluntary muscular exertions, may likewise at times prove causes of spinal meningeal hæmorrhage. Occasionally, however, it occurs independently of any such, or of other readily assignable causes.

Anatomical Characters.—Fluid blood or blood-clots may exist in relation with the spinal meninges in three different situations.

The most frequent site of such hæmorrhage is (1) outside the dura mater, between it and the vertebral arches. Here large clots are sometimes found, wholly or more frequently in part surrounding the dura mater in the region in which the hæmorrhage has occurred. Where the effusion is large, the cord itself may be distinctly compressed, but even smaller effusions may produce some amount of compression of nerve-roots. A clot in this situation, as in other sites, will, of course, become much modified in appearance with age.

Clots and more or less fluid blood may also, but more rarely, be met with (2) inside the dura mater, within the so-called arachnoid sac. This occurs perhaps most frequently as a mere sequence of a similar hæmorrhage taking place in the cerebral meninges, the blood simply gravitating into the spinal canal. Sometimes, however, especially in cases of spinal pachymeningitis, blood is actually effused in this situation—and that where the internal surface of the dura mater is much more vascular than natural. The opening of a thoracic or abdominal aneurysm may also very rarely take place into the spinal canal, and thus produce sudden and grave compression of the spinal cord.

Much smaller extravasations of blood are also met with (3) beneath the arachnoid and within the meshes of the pia mater, over areas perhaps small in extent longitudinally, but more or less embracing the cord in one or more regions. The cord or nerve-roots may, however, be decidedly compressed by such hæmorrhages, even when they are small in amount, owing to the space into which the effusion takes place being comparatively shallow.

Symptoms.—The symptoms of these affections are in a large proportion of cases vague and ill-defined. They may be much obscured by the causal conditions. In other cases they will vary in distinctness according to the amount and abruptness of the hæmorrhage.

As a rule, the onset of symptoms is sudden. Pain in the region of the spine, in which the hæmorrhage exists, or radiating thence along the nerves emanating from this region, may be the first symptom. More rarely, muscular twitchings or spasms may exist, either alone or with pains. These symptoms, dependent upon irritation and compression of sensory and motor nerve-roots, are at other times almost wholly absent. There may then be as abiding symptoms mere numbness or tingling in the parts affected, together with a sense of weight and paresis in the limbs. Actual paralysis is rare; and even when it is present, the rectum and bladder mostly escape.

Where pain exists, there is often stiffness of the spine; and these in combination greatly interfere with movement. Febrile reaction is usually absent or very slight. The severity of the symptoms may abate after a day or two, leaving only more or less paresis. In the case of large hæmorrhages, however, with extensive compression of the spinal cord, death may be rapid, occurring in the course of some hours or of a day or two.

The symptoms will vary as the effused blood presses upon the cord in the cervical, the dorsal, or the lumbar region. Where the effusion is in the cervical region in a traumatic case, in which there is obvious head-injury with a condition of stupor, it is almost certain not to be diagnosed. The patient is not sensible enough to complain of pain; and the irregular respiration and small disordered pulse, with slight tremor or rigidity of one or both upper extremities, may with more probability be ascribed to multiple head-lesions—as actually happened in a case which recently came under the writer's notice.

Diagnosis.—It may be impossible to diagnose hæmorrhage into the spinal meninges in cases where it occurs as a concomitant of other grave diseases—such as tetanus, eclampsia, or cerebral hæmorrhage; and also in cases where it merely complicates a traumatic injury of the spinal cord itself. In other cases, the presence of certain causal conditions, together with the abrupt commencement of spinal symptoms in such combinations as have been above referred to, is sufficient to enable us to diagnose it from hæmorrhage into the substance of the cord, as well as from meningitis, or acute softening (*see* Spinal Cord, Diseases of). The gradual onset of the symptoms arising from tumours of the spinal cord, or of the spinal meninges, makes it more easy to separate these affections from meningeal hæmorrhages.

Prognosis. — Spinal meningeal hæmorrhages are as a class decidedly less grave than meningeal tumours. They are unlike the latter, moreover, inasmuch as the worst symptoms attendant upon them are produced at once, instead of being only very slowly evolved; so that after a short time, unless the blood effused happen to have produced a certain amount of compression of the spinal cord, the symptoms gradually diminish in severity. Large extra-meningeal hæmorrhages, compressing the cervical region of the cord, are by far the most serious forms of this affection.

Treatment.—In the treatment of spinal meningeal hæmorrhage the patient must, of course, be kept perfectly quiet and in the recumbent position. Spoon diet should be administered for a few days; and vascular sedatives, such as aconite, may be given with advantage. Some recommend active purgation, and the abstraction of blood from the neighbourhood of the spinal column by cupping or leeches. These measures, however, are of questionable utility, and the former especially might easily do positive harm.

In certain cases, especially in the extra-meningeal form of the disease, a surgical operation for the removal of the compressing blood-clot may be advisable.

H. Charlton Bastian.

MENINGES, SPINAL, New-Growths and Adventitious Products of.—This subject requires no very lengthy discussion. As has been said in regard to such growths and products springing from or connected with the cerebral meninges, the symptoms to which they give rise are in the main referable to irritation and pressure upon adjacent portions of the nerve-centres, or upon certain nerve-roots. The symptoms, therefore, of meningeal growths or adventitious products are almost, if not quite, indistinguishable from those produced by similar bodies in the spinal cord.

The sections on special symptoms and diagnosis which might otherwise have appeared here may be suppressed; and the reader be referred for their equivalents to what he will find under the head of Spinal Cord, Special Diseases of.

We shall now merely give a few details concerning the ætiology, nature, and precise sites of the various new-growths and adventitious products that may be met with in connexion with the spinal meninges, and shall supplement these details with some few general remarks bearing upon the prognosis and treatment of such affections.

Ætiology.—In accounting for certain tumours, such as those of a syphilitic, of a scrofulous, or of a cancerous type, we may fall back upon the existence of a general 'predisposition'; though what determines the appearance of such tumours in this or that particular situation generally remains as much a matter of uncertainty as when the growths are solitary or of non-diathetic origin. Among such determining or exciting causes only one of those usually cited seems to be of real potency, namely, the occurrence of blows or injuries of various kinds. These certainly appear at times to be—in the spinal meninges as in other situations—the immediately exciting causes of certain new-growths.

Parasites, such as cysticerci and hydatids, gain entry to the system in the way mentioned in the articles on these subjects; but something so indefinite or accidental as to be spoken of by us as 'chance' will determine their appearance in this or that particular tissue or organ.

A. **New-Growths.**—(*a*) *Cancer.*—Cancer occurs most frequently in the spinal meninges, not as a primary affection, but by extending to them from a previous cancerous growth in one of the adjacent vertebræ. The space within the spinal canal being very limited, such a tumour soon begins to press injuriously upon nerve-roots and upon the cord itself. In rare cases, however, a cancerous new-growth may start from the spinal dura mater.

(*b*) *Tubercular growths.*—These masses are met with principally in cases of tubercular disease of the spinal column, and especially where angular curvature is produced, though they are not confined to these more severe forms of vertebral caries. Caseating growths are in such cases apt to extend from the vertebræ, so as to infiltrate the dura mater, and then produce fungating excrescences on its inner surface. Small isolated scrofulous tumours, the so-called 'tubercular' growths, may also be met with, though more rarely than in the cerebrum, springing from the spinal pia mater, and more or less imbedding themselves in the substance of the spinal cord.

(*c*) *Syphilomata.*—Syphilitic growths are also decidedly less frequent in connexion with the spinal than with the cerebral meninges. Small tumours may, however, spring either from the dura mater or from the arachnoid and pia mater. Or, instead of well-defined tumours, there may be thickenings of the membranes in some part of their extent, and adhesions between one another and the surface of the cord, by means of opaque, yellowish-white, gummatous growths.

(*d*) *Sarcomata.*—Sarcomatous tumours of all kinds may be met with in connexion with the spinal meninges, springing occasionally from the dura mater, but more commonly from the arachnoid and pia mater. Instead of being distinctly circumscribed, such growths may exist in the form of diffuse infiltrations, invading the pia mater all round the cord for a variable extent. In one remarkable case the writer met with a growth of this kind involving the pia mater throughout the whole length of the spinal cord, which was most developed on its lateral and posterior aspects. Here in some places the layer of new-growth was about one-third of an inch in depth, and the cord was notably compressed in its postero-lateral aspects (*Trans. Path. Soc.*, 1887, p. 31).

(*e*) *Myxomata.*—Myxomata are met with in the form of small circumscribed tumours, springing mostly from the pia mater. The writer has seen one about the size of a very large almond situated on, and greatly compressing, the posterior columns of the cord. Its presence was associated with very obscure and ill-defined symptoms during life.

(*f*) *Tubercle.*—Tubercles in the form of 'grey granulations' have already been referred to. *See* Meninges, Spinal, Inflammation of, Simple Idiopathic and Tubercular.

(*g*) *Fibromata*, (*h*) *Lipomata*, and (*i*) *Enchondromata.*—These various kinds of new-growth have been met with occasionally, but principally in connexion with the outer aspect of the dura mater.

(*k*) *Osteomata.*—These formations are here of no clinical significance, though they are much more common in persons of all ages on the spinal than on the cerebral meninges. They are apt to occur in the form of small bony plates scattered over the surface of the arachnoid. Sometimes a limited 'ossification' of the dura mater is also met with.

B. **Adventitious Products.** — *Parasites.*—The same two kinds of parasites may be found in connexion with the spinal meninges as we have already had to refer to in connexion with those of the cerebrum—namely, the small and often numerous *cysticerci*, as well as the more solitary and larger *hydatids*. The latter may be found within the dura mater, but they have been met with much more frequently outside this membrane, often forming large tumours contiguous to the spinal canal. These are the only adventitious products of any importance which occur in, or in relation with, the spinal meninges.

Prognosis.—As a class these affections are grave, tending to produce, with some exceptions, various irregular forms of paralysis, and ultimately death, though this latter may take place only after the expiration of two, three, or more years. The symptoms produced by tumours and parasites, as a rule, go on increasing in severity; and the gravity of the prognosis will depend much upon their rapidity of growth, as evidenced by the increase of signs of severe compression of the cord or of its nerve-roots, in connexion with the state of other organs. The supervention of obstinate bed-sores, and paralysis with inflammation of the bladder, may at last greatly hasten the fatal termination.

Treatment.—In the treatment of tumours or parasites within the spinal canal, our efforts must be in the main directed to restoring or improving the general health of the patient, and to combating the more urgent symptoms that may arise—such as pain, spasms, paralysis, sleeplessness, bed-sores, and cystitis. Where, however, we have to deal with growths of syphilitic origin, we can attack the disease itself by means of drugs. Under the influence of small doses of mercury and increasing doses of iodide of potassium, the patient's condition may often be marvellously improved, though the relief is perhaps not so striking as in cases where syphilis affects the cerebral meninges, because in this latter disease the symptoms are more varied in nature, and more dependent upon added functional complications.

In cases of hydatids and also of tumours in connexion with the spinal meninges, the question of the possible relief of the patient by means of a surgical operation should always be entertained. The chances of success in this direction are considerable in the case of hydatids; and in many cases also where circumscribed meningeal tumours exist there is a reasonable chance that a skilful operation may effect a cure, or, at all events, bring great relief for a time.

H. Charlton Bastian.

MENINGOCELE.—*See* Brain, Malformations of; and Skull, Diseases and Deformities of.

MENINGO-CEREBRITIS.—A name given to a pathological condition in which inflammation of the pia mater extends in some regions of the cerebrum so as to implicate the subjacent cortical substance. The fact of such an extension is much less capable of being diagnosed during life than of being discovered after death, but it may then be recognised by the existence of superficial softening of the brain-substance, together with a more or less marked increase of vascularity. This condition probably always exists to a certain extent in meningitis, and might reveal itself on careful microscopical examination—although the inflammatory changes may not have advanced far enough to produce an easily appreciable amount of softening.

MENINGO-MYELITIS is a term used to indicate a condition in which inflammation of the spinal meninges has extended to the surface of the spinal cord. The evidence of such an extension has usually been supposed to depend upon the existence of an appreciable amount of superficial softening. But minor changes of an inflammatory type, capable of recognition by the microscope, may also here exist with frequency, as F. Schultze has shown, although they may fall short of entailing actual softening.

MENOPAUSE (μηνές, the menses; and παῦσις, a cessation).—The natural cessation of the menstrual flow, or 'change of life' in the female. *See* Change of Life.

MENORRHAGIA (μηνές, the menses; and ῥήγνυμι, I burst forth).—Over-abundant menstruation, whether due to excessive quantity or to undue frequency. *See* Menses or Menstruation, Disorders of.

MENSES or MENSTRUATION, Disorders of. Synon.: Fr. *Troubles de la Menstruation*; Ger. *Störungen des Monatsflusses*; *Störungen der Menstruation.*

Menstruation is the periodic discharge of a sanguineous fluid from the female generative organs. The discharge continues each time for from three to eight days. It varies in quantity in different subjects. The estimation of this is surrounded by great difficulties; usually, however, the quantity is from four to six or eight ounces. It takes place monthly; that is, a period of twenty-eight days intervenes from the appearance of one flow to the appearance of the next following. In many cases, however, this interval is less than twenty-eight, and may be as short as twenty-one days; on the other hand, it may be prolonged to thirty-one days, and the function be still performed normally. The discharge does not appear during childhood or old age. It usually appears for the first time between the twelfth and fifteenth years, and for the last time between the forty-third and forty-eighth; but it may appear as early as the ninth, and continue to appear regularly afterwards up to the fifty-third or fifty-fifth year. The function is suspended during pregnancy, and, as a rule, during lactation. The source of the discharge is the body of the uterus. It is not due to a congestion or an erection of that organ, as has been supposed, but to the degeneration, disintegration, and removal of the so-called mucous membrane of the uterus—the decidua menstrualis. In consequence of this degeneration and disintegration, the vessels on the inner surface of the uterus are opened, and hæmorrhage follows. The ultimate cause of the discharge is said to be the separation of ova; such, however, is not the case in every instance, for menstruation may take place without the discharge of an ovum, and, on the other hand, ova may be separated from the ovary without the occurrence of menstruation. It can hardly be doubted, however, that the function is in some manner dependent on the ovaries, for when the latter have been removed menstruation ceases.

The fluid is not in all cases sanguineous: indeed its bloody character may be regarded as accidental, though present in the infinite majority of cases. It may, however, be easily understood that the disintegration and removal of the decidua menstrualis, which is the essential factor in menstruation, may be effected without the occurrence of hæmorrhage, and there is reason to believe that in so-called 'white menstruation' such is the case.

For the due performance of the function two conditions are essential, namely, sound general health, and normally developed organs of generation. Disorders of the menstrual process may be brought about by very many conditions. These disorders are generally divided into: I. *Amenorrhœa*, where the discharge is absent, or deficient in quantity. II. *Dysmenorrhœa*, where the function is performed with difficulty and pain. III. *Menorrhagia*, where the discharge is profuse.

I. Amenorrhœa.—Synon.: Fr. *Aménorrhée*; Ger. *Amenorrhoë.*

Ætiology and Symptoms.—Amenorrhœa is dependent either on *general* states; or on *local* pathological conditions—that is, on lesions of the uterus and ovaries.

(1) All conditions or influences which tend to deteriorate the blood, or which act unfavourably on nutrition, may be causes of amenorrhœa. The most common of these is the demand made on the system in the development of the aptitude for conception, the growth and separation of ova, and the performance of the menstrual function. At this time the breasts develop, the ovaries and uterus enlarge, the pelvis grows, and the whole form becomes altered. Many women who during childhood have enjoyed apparently perfect health, as they approach puberty become gradually or suddenly anæmic or chlorotic, without any assignable cause other than the demand made on nutrition by the process of development through which they at the time pass. Nutrition becomes impaired, tastes perverted, pains of a neuralgic character are felt in various parts of the body, the menstrual discharge does not appear, or it may appear once scantily and then at irregular intervals, or it may disappear for months or even years. All the symptoms of anæmia are present, and the patient is languid and listless, lacks energy, and is in more or less constant suffering. The above course of events may take place even in cases where the surroundings are favourable to healthy development. Hygienic conditions, however, play a most important part in the proper development of the female functions, and when the surroundings are unfavourable, evil is sure to follow. Want of food or improper food, want of fresh air or impure air, want of exercise, foul gases, malaria, are prolific causes of failure or imperfection in the growth and development of the young girl, and are common causes of amenorrhœa. Disease also is by no means an infrequent cause of the condition under consideration, such as phthisis, Bright's disease and diseases of the liver, stomach, and nervous system. Emotion, fright, or grief, change of air and food (as when girls go from the country to London), and cold, may arrest or suspend the monthly discharge.

(2) But amenorrhœa may be due to local conditions. These are absence or disease of the ovaries, of the uterus, or of both; and imperfect development of one or both organs.

In cases where the ovaries are absent, the change in form, from girl to woman, which takes place at puberty, does not occur. The girl grows but does not develop. A masculine appearance supervenes, the breasts remain small, the pelvis narrow, the voice becomes manly and harsh, a beard may grow on the face, sexual passion is absent, and the health remains good.

When the uterus alone is wanting, there may be no indication of the condition in the state of the general health or development, and local examination is necessary in order to detect the circumstance. In these cases the vagina terminates in a *cul de sac*, and the uterus cannot be felt on examination. On introducing a finger into the rectum and a sound into the bladder, it is found that the two organs are in contact, and that there is no uterus between them. There are, however, as a rule, one or two small fibrous masses representing the uterus.

Certain diseases, as scrofulous abscess and atrophy, which involve the whole substance of the ovaries, and also atrophy of the womb, may cause amenorrhœa.

Amenorrhœa from retention.—In these cases the sanguineous discharge is separated, but does not appear externally, owing to atresia of the genital canal. The closure may occur at any point between the os uteri and the vaginal orifice. A membrane may close the os tincæ; the hymen may be imperforate; the vagina may be absent; or its walls may be adherent at any part of its course, or along the whole of it. The occlusion may be congenital, or may arise from inflammation during childhood or after severe labours. In these cases the menstrual molimina are periodically present, but the catamenia do not appear. The molimina increase in severity from month to month; the patient has pain in the back and a sense of weight in the pelvis, and becomes pale and sallow; the abdomen after a time begins to enlarge, and continues to increase at monthly intervals. On examination a tumour having the shape of the enlarged uterus may be felt rising from the pelvis. It is smooth, elastic, and dull on percussion. If the condition be not discovered, the distension of the uterus may go on to rupture, or its contents may pass along the Fallopian tubes into the abdomen, causing peritonitis and death.

Diagnosis.—Whenever a patient suffers from amenorrhœa, pregnancy should be thought of. If this state can be excluded, the general condition should be investigated. Anæmia and its causes should be sought for. The chest, heart, and urine should be examined. If there be no general condition to account for the amenorrhœa, the practitioner should see whether the breasts and pelvis are developed, and examine the vulva and vagina for obstruction, if there be any suspicion of such a condition. Finally, it may be necessary to examine the uterus and ovaries.

Treatment.—The treatment of the first form of amenorrhœa is the treatment of the general state. If there be want of constitutional vigour, change of air, exercise in the open air, mental occupation, but not severe, and nourishing diet should be advised. The stomach and bowels should be attended to; and gentle aperients and salines given if the tongue be foul; then vegetable tonics, iron, iodides, or other appropriate remedies. No efforts should be made to act especially upon the uterus, and this is particularly binding when the amenorrhœa is dependent on phthisis, Bright's disease, or such-like conditions.

The second form is often incurable. In those cases in which the uterus and ovaries are absent nothing can be done. If the uterus be present, but imperfectly developed, much may be done when the cases are seen early, but nothing if seen late. Attempts have been made to promote the growth and development of the uterus by local treatment, but without success. For this purpose stem pessaries, galvanic pessaries, and irritants have been used, but with only injurious results. In these cases, whether they be seen early or late, local treatment is of no use, while general treatment, directed to improve the health and favour growth, may prove of the greatest value. Plenty of good plain food, walking exercise short of fatigue, and freedom from school and hard mental work, are the means which favour the easy and early transition from girlhood to womanhood; whilst over-work, sedentary habits, deficient or bad food, and bad air produce a rich harvest of physical suffering peculiar to women.

In cases of retention of the menses from atresia of the genital canal, an outlet must be made for the flow. If the hymen be imperforate it should be divided, and the fluid allowed to run out. In cases of absence of the vagina, a canal has in some instances been successfully made. This, however, should only be done in cases in which the uterus and the ovaries are developed. In atresia of the os uteri the offending structure should be divided by the trocar or knife. These operations are accompanied by a considerable amount of danger. Patients not infrequently die after them from peritonitis or shock. It should not be forgotten, however, that it is imperative to remove the menstrual fluid retained, for unless this be accomplished death is inevitable.

II. **Dysmenorrhœa.**—Synon.: Fr. *Dysménorrhée*; Ger. *Dysmenorrhoe*.

In dysmenorrhœa, menstruation is accompanied by pain—that is, pain referable to the genital organs. This pain is seated in the pelvis, and radiates to the sacrum, groins, and thighs. In some women the menstrual function is performed without pain or discomfort of any kind. As a rule, however, they suffer more or less from dull aching in the pelvis, backache, headache, languor, and lassitude during the catamenial flow. When the dull aching amounts to sharp pain, the function is performed abnormally, and the woman is said to suffer from dysmenorrhœa. This symptom is frequently met with, and in association with many pathological conditions of the pelvis; diseases of the uterus, such as fibroids; of the tubes, such as congestion and inflammation; of the ovaries; and also with general diseases, such as anæmia, gout, and rheumatism.

Ætiology and Symptoms.—Dysmenorrhœa has been referred to five different conditions, upon one or more of which it is supposed to depend. Hence five kinds of dysmenorrhœa have been described: (1) *Mechanical or obstructive*; (2) *Congestive or inflammatory*; (3) *Ovarian*; (4) *Membranous*; and (5) *Spasmodic or neuralgic*.

1. *Mechanical or obstructive dysmenorrhœa.*—This form of dysmenorrhœa was long thought to be the most common; indeed, it has been asserted that dysmenorrhœa cannot be said to exist without obstruction to the flow of blood from the uterus. Opinions, however, differ greatly with regard to the seat of the obstruction. Dr. Robert Barnes believed it to be seated usually at the os tincæ, and to be frequently accompanied by conical cervix; Dr. Marion Sims thought its most frequent seat was the os internum uteri; while Dr. Graily Hewitt referred the obstruction to flexion of the uterus in the great majority of cases—the obstruction being caused by the narrowing of the uterine canal at the point of flexion. The outer orifice of the uterus may be closed from birth, or in consequence of inflammation occurring subsequently, and thus cause obstruction to the escape of the catamenial fluid. There is no question therefore that this condition is one that may give rise in some way to painful menstruation. Such a narrowing of the os externum as to give rise to dysmenorrhœa is, however, extremely rare. A narrow, or so-called pin-hole os generally admits the uterine sound, and women, subjects of this condition, frequently menstruate without pain. Indeed, it has been abundantly proved that pin-hole os plays no part in the production of dysmenorrhœa. The same may be said of contraction of the inner orifice. This part is rarely or never met with so small as to prevent the passage of the sound, and just as rarely presents obstruction to the escape of the fluid. Wherever the sound can be passed it may be safely inferred that there can be no obstructive dysmenorrhœa. That flexions of the uterus can interfere with the calibre of the canal and obstruct the menstrual flow is a simple theory, and all observations in the dead body go to show that it is fallacious, for the few flexed uteri which are found in our museums present patent canals. The only instances in which the canal is constricted by flexion are those in which senile atrophy has taken place—that is, when the walls of the organ have become thinned by age; but by this time the menopause has been passed, and dysmenorrhœa become impossible. So called retroflexion of the uterus may, however, give rise to dysmenorrhœa when the body of the organ sinks into the pouch of Douglas, and it, together with the broad ligaments, becomes constricted by the sacro-uterine ligaments. Just as hernia of the uterus may give rise to congestion and dysmenorrhœa, so such a condition would prevent the return of the blood along the uterine veins, and lead to swelling and congestion of the body of the uterus, and painful menstruation.

2. *Congestive or inflammatory dysmenorrhœa.*—This name has been given to those cases of painful menstruation in which the uterus is enlarged and heavier than natural. It is met with in the married and in the single, but it is probable that it never occurs as a primary affection. Congestion and inflammation are frequent accompaniments of dysmenorrhœa when they are not the cause of it. They are generally the result of labour or abortion, or of dysmenorrhœa itself, of infection or mischievous meddling, more especially the use of instruments, such as the uterine sound. The symptoms are a continuous dull aching pain, chiefly in the sacrum and thighs, and a sense of weight and fulness in the pelvis. This form does not deserve the name of dysmenorrhœa, for the pain is at its worst at other times than during menstruation, and is frequently relieved by the appearance of the menstrual flow.

3. *Ovarian dysmenorrhœa.*—This does not deserve the name of dysmenorrhœa, for it is not due to menstruation—that is, to the discharge of the sanguineous fluid from the uterus, but to the growth and rupture of the Graafian follicles. The Graafian follicles develop gradually, and take a long time to arrive at maturity. It is not a sudden process. Towards the end of their growth, when they are about to rupture, the ovarian pain is experienced. They usually burst some time before the appearance of the menstrual flow, but the rupture may happen during the flow or after its cessation. Pain usually comes on before the flow—a few days or a week—and may cease with the appearance of the menses, or several days before that event; the suffering may, however, come on at any time during the flow or immediately after it has ceased, or at any time during the interval. It is situated usually in the left ovarian region, for the left ovary is more frequently affected than the right, the pain extending down to the thighs and to the sacro-iliac joint of the same side. Not infrequently the corresponding kidney is tender. Pain may

occur in the right or left side at alternate periods—or a period may pass without pain. Vomiting and hysterical manifestations are often present. There is superficial and deep tenderness over the painful part. Patients often say that they have a swelling in the side, and, on examination, a diffused fulness is found in the ovarian region, which is tympanitic, and evidently due to local distension of intestine with gas. Examination per vaginam and per rectum will often detect a small body or swelling, tender and movable at first —later on fixed—on the affected side and a little behind the uterus. Pressure on the swelling calls forth severe pain and a feeling of sickness. At a later period the uterus becomes less movable and drawn to the affected side. This is, doubtless, due to contraction of inflammatory products, and not to distension of the broad ligaments, for it occurs in long-standing cases only. Micturition is frequent and painful. The pathological lesion is inflammation of the uterine appendages—the tubes, the ovaries, and the peritoneum, the Graafian follicles, the stroma, or the surface of the ovaries, one or all may be affected. This condition is again rarely primary. In women who have had children it is often due to parturition and abortion. In the unmarried, it is often the result of long-standing dysmenorrhœa—sometimes of acute specific disease, or of inflammatory mischief set up by causes mentioned in the preceding paragraph, or exposure to cold during menstruation.

4. *Membranous dysmenorrhœa.*—In this form a membranous sac, having the shape of the body of the uterus, is expelled with the menses. The sac has three orifices corresponding to the orifices of the Fallopian tubes and the inner orifice of the uterus. It has an internal smooth, punctated, and an external flocculent surface. Occasionally during expulsion the sac is turned inside out. It may be passed with every or every other menstruation, or only occasionally. Instead of being passed in the form of a complete sac, the membrane may be broken up and expelled as shreds of various sizes. Microscopic examination shows that the membrane possesses a structure identical with the lining of the body of the uterus. It contains glands and blood-vessels, and is, in fact, the decidua menstrualis. It has been said that this membrane is always the result of conception, but ample evidence has been published in refutation of this statement. Other bodies may be expelled from the uterus during menstruation, such as clots of blood, fibrin, masses of mucus forming casts of the uterine canal, casts of the vagina, and products of conception. Several cases of monthly abortion have been recorded. These substances can be distinguished from the decidua menstrualis by microscopic examination only, and easily, except the products of conception. These present the structure of the decidua; but they also present some additional appearances which, if found, are characteristic, such as the sac—partial or complete—formed by the decidua reflexa and the large cells which are met with in the decidua vera and chorionic villi. When cases of this disorder come under notice the uterus is, as a rule, enlarged. This, however, is not always the case. The enlargement is probably a condition secondary to the dysmenorrhœa or to previous gestation. There is commonly tenderness of the pelvic tissues around the uterus, probably of the peritoneum. Ovaritis is frequently present. These conditions are probably secondary. Affections of other mucous membranes may be present, such as bronchial catarrh. Membranes may be passed from the uterus without pain; or pain may be present, but varying in degree from slight discomfort to intense suffering. The severest pains, however, are not due to obstruction caused by the passage of the membranes blocking the os uteri and causing retention of the fluid, but to spasm of the uterus. The passage of the membrane takes place often on the third day of menstruation, but it may occur later. Frequently shreds are passed from the first or second day to the end of the flow. With the expulsion of the membrane there is usually a gush of blood, after which the flow proceeds normally. The catamenial discharge may be normal in amount, considerably increased, or even scanty.

The pathology of this affection is somewhat obscure. Several views have been held with regard to it, some of which deserve no notice. Inflammation, however, is so frequent an accompaniment, that the view that inflammation is its cause is one which deserves attention. Against this view is the fact that about two-thirds or three-fourths of the cases are cases of primary dysmenorrhœa, in which inflammation could not have been present; and it is consequently inferred that the inflammation, which is so often present, is really a secondary development, being the result of the dysmenorrhœa; moreover, on no other surface of the body is inflammation known to give rise to a periodical exudation of this kind, or to change the character of the mucous surface in such a manner as to cause it to be shed in the way the mucous membrane of the uterus is shed in this disease. More recently it has been stated that the disease is the result of amyloid degeneration of the lining of the uterus. If such degeneration be present in some cases, it is certainly not in all. The cause is probably to be sought in malnutrition of the uterus, which in some cases has existed *ab initio*, while in others it has succeeded to some disease, such as inflammation or imperfect involution of the uterus after pregnancy. It has been met with also in gouty and rheumatic subjects, but it is not known if it holds any relation to these diseases. The pathology of the affection appears to be a failure of the molecular disintegration of the decidua menstrualis which takes place during normal menstruation, and this must be due to the presence in the decidua of some tissue which resists disintegration more than the healthy tissues of that membrane. The only tissue which has been found in the uterine wall which would offer such resistance to disintegration is fibrous tissue. It is known that this varies somewhat in quantity in the wall of the uterus, according as it is diseased or healthy. In cases of inflammation of the uterus in which imperfect resolution has taken place, excess of fibrous tissue is found in the wall. In cases of sub-involution a similar excess is found, and it would be expected that in cases of imperfect development at puberty a similar excess would be found. It is known that the organs in which membranous dysmenorrhœa is met with are imperfectly developed uteri, uteri that have been inflamed, and uteri that have been pregnant and in which parturition or abortion has been followed by an imperfect return of the organ to its natural state; and it is maintained that the presence of an excess of fibrous tissue in the wall of such uteri is the cause of the shedding of the decidua as a membrane. This is the most probable explanation of the occurrence of membranous dysmenorrhœa.

5. *Spasmodic or neuralgic dysmenorrhœa.*—This form of dysmenorrhœa includes the very great majority of severe cases. For a time spasm and neuralgia were regarded as an asylum for ignorance, and other conditions which formed the basis of the mechanical theory of uterine pathology were put forward in their place. Further research, however, has shown that spasm and neuralgia are by no means conditions of no importance in dysmenorrhœa, that the foundations of the mechanical system were laid in error, and that dysmenorrhœa is but another name for uterine colic. It is well known that with dysmenorrhœa, flexions of the uterus, a narrow external orifice, or a narrow internal orifice may be present, and it is equally well established that these conditions may be removed and yet the dysmenorrhœa remain. The inner and outer orifices may be incised, and the flexion straightened, without relief. The observations of Vedeler and Herman prove that the percentage of virgins who suffer from dysmenorrhœa is almost the same whether the uterus be straight or in a state of flexion. In fact, dysmenorrhœa is just as frequent in the absence of flexion of the uterus as when flexion is present; and every practitioner who has seen a considerable number of cases of dysmenorrhœa has ample proof that a narrow external or internal os is not a common cause of it.

Dysmenorrhœa may be divided into two categories—the primary and the acquired. Primary dysmenorrhœa is present from the commencement of menstruation, or soon afterwards. Acquired dysmenorrhœa comes on at a later period of life, after menstruation has been thoroughly established, often after pregnancy, labour, abortion, and in consequence of chills, inflammatory attacks of the pelvic organs, acute diseases, anæmia, and exhaustion. The primary variety forms the majority of cases, and in these no recognisable disease of the uterus is present. It is generally believed that the uterus undergoes regular contractions during menstruation. These cannot be observed in the healthy organ, but they have been witnessed in cases in which the uterus was enlarged by fibroid tumours. In health these contractions are painless. When they become irregular they are painful, and give rise to dysmenorrhœa. The pain is situated in the pelvis, and is referred to the uterus. It is of varying intensity; it may be slight; or it may be extremely severe—agonising. It radiates to the groins, sacrum, and thighs. It is often said to be all round the pelvis or lower part of the trunk, and is often compared to the pain of labour, or that of abortion. The pain may come on a little before, with, or a little after the appearance of the discharge. Usually it occurs during the first twelve or twenty-four hours, and lasts from four or five hours to twenty-four, or even to the end of the flow. It is paroxysmal. There is often tenderness of the skin of the hypogastrium and groins, vomiting, hiccough, headache, hysteria; and even delirium may be present. The menstrual flow may be scanty or profuse. In the former case it is often followed by an abundant yellow discharge lasting for a few days. There may be leucorrhœa throughout the inter-menstrual interval. Micturition is sometimes frequent and painful. Patients who suffer in this way may enjoy good health during the inter-menstrual interval, but often they suffer from neuralgic pains at other times than at the periods, and they frequently suffer from severe headaches at the time of their period.

Treatment.—Dysmenorrhœa is generally obstinate under treatment, and its course is very protracted. In many cases much may be done by attention to the general health, to the state of the stomach, liver, and bowels. During an attack, if severe, rest in bed should be enjoined and hot baths. As drugs, solution of acetate of ammonium, castor, phenazone, and phenacetin are useful; sometimes opium and morphine are called for, for the relief of the pain. Alcohol in small doses is useless, and in large quantities intoxicates. During the interval saline aperients, iron, arsenic, bismuth, iodide of potassium, and ergot are of service; guaiacum resin alone or in combination with sulphur is sometimes of use. If there be a gouty or rheumatic tendency, this should be treated. As a rule, in these cases there is nothing to be gained by local treatment of so-called misplacement and conical cervix. Occasionally, however, in cases of severe retroversion or retroflexion, where the fundus of the uterus is grasped in Douglas's pouch, a pessary may be of use. Incision of the external orifice, in so far as the writer knows, is of no use. Relief sometimes follows incision of the internal orifice. Whether this relief is due to the enlargement of the canal caused by the incision, or to the stretching of the neck of the womb, which is generally carried out along with it, either by the introduction of a plug of lint or of a stem pessary, is still a debated question. The idea of incising the neck of the womb, whether at the external or internal orifice, is based upon an error in pathology, namely, that the pain is due to mechanical obstruction to the flow of the menstrual discharge from the uterus; and, as it is a dangerous, and may be even a fatal proceeding, it should not be undertaken. Dilatation of the cervix, however, is the most efficient means we have for the relief of severe dysmenorrhœa when drugs and other treatment fail. The object of this procedure is not to enlarge the canal for the passage of the menstrual fluid, but to stretch the neck of the womb in order to destroy the tendency to spasm. Indeed, it is done on precisely the same principle as dilatation of the vaginal orifice is done for vaginismus, and of the sphincter ani in cases of spasm of that muscle. The dilatation may be effected by the use of tents made of laminaria digitata or tupelo wood, or sponge; the former are preferable to the latter. They should be allowed to remain in the cervix for from six to ten hours, until the canal has been well dilated. Or, preferably, the dilatation may be carried out by means of bougies; metallic bougies are the best, graduated according to English measurement. The dilatation may be carried out at one sitting, when the patient is put under chloroform, and a series of bougies from No. 6 or 8 to No. 16 to 18 passed; or at several sittings, when one or two bougies should be passed every second or third day, until the required size has been reached. Hegar's bougies are often used for this purpose, but the English metallic bougies are in every respect preferable. Dilators have been used for this purpose also, such as Priestley's or Ellinger's. Some of these have three blades and some have two. Some are opened by a screw and some by hand pressure. There are many instances in which these instruments have lacerated the cervix severely, and, their use being accompanied by greater risk than that of bougies, they should be avoided.

III. Menorrhagia and Metrorrhagia.

Synon.: Vulg. Flooding; Fr. *Ménorrhagie*; *Métrorrhagie*; Ger. *Mutterblutfluss.*

Menorrhagia is used to denote profuse menstruation; metrorrhagia, hæmorrhage from the uterus at any other time than the catamenial epoch. The two symptoms are frequently met with. Menorrhagia often exists alone. When metrorrhagia is present during menstrual life, the catamenia are, as a rule, also profuse. These hæmorrhages may be called forth by many lesions. Indeed, they may accompany the majority of the pathological conditions to which the pelvic organs are liable. They may also arise from general states—as scurvy, the hæmorrhagic diathesis, Bright's disease, phthisis, cirrhosis of the liver, and the acute specific diseases. The most common cases are, however, associated with distinct alterations of structure in the pelvic organs, as sub-involution of the uterus, polypus, fibroid tumour, cancer, displacements, retained portions of placenta, moles (fleshy or vesicular), fungous degeneration of the mucous membrane of the uterus, mucous polypi, ulcerations of the cervix, hæmatocele, inversion of the uterus, and congestion of this organ due to obstruction to the circulation through the heart and lungs or liver.

Profuse hæmorrhages of an irregular character occur also in young girls before the advent of regular menstruation. This form of uterine hæmorrhage is not common, but it is sometimes of very serious import, and occasionally has proved fatal. More frequent is the occurrence of irregular bleeding from the uterus at the menopause. The causes of these climacteric hæmorrhages are really not known. They have been said to be due to congestion, but on insufficient evidence.

Treatment.—The treatment of hæmorrhage from the uterus resolves itself into the immediate treatment of the attack, and the treatment of the condition leading to it. The treatment of the attack, or the means of arresting the bleeding, consists in great part in securing absolute rest. The patient should remain in bed in the recumbent position, and avoid all exertion—mental and physical. At the same time, internal remedies which tend to check hæmorrhage should be given. Of these, those most commonly used are ergot, gallic acid, the mineral acids, and acetate of lead. Mineral acids, in combination with sulphate of magnesium or sodium, often act well. Should acetate of lead be administered, the patient should be carefully watched, as some persons are very sensitive to the action of the drug, and manifest symptoms of acute lead-poisoning after the administration of a small quantity. Should these means fail, recourse should be had to plugging the vagina or uterus. The vagina is plugged in the following manner: The patient is placed on her left side, a speculum is introduced, and the canal is firmly packed with pledgets of iodoform or sal alembroth wool or gauze, tied on a string for convenience of removal. This will arrest the hæmorrhage for a time, but it can only prove a temporary expedient. The plug is liable to become offensive, from decomposition of blood and of the secretions in the vagina, and should consequently be changed in forty-eight to sixty hours, or sooner. A more efficient means of arresting hæmorrhage is plugging the uterus itself. This is done by means of tents of sponge or laminaria, and with a twofold object. The first object is the immediate arrest of the bleeding; but the chief object usually is to dilate the canal of the uterus, so as to permit its exploration by the finger, and the discovery of the cause of the bleeding. This means will not only check the bleeding temporarily, but will in many cases effect a permanent cure. Tents should be rendered aseptic by immersion for some days in a spirituous solution of corrosive sublimate (1 in 1,000). To facilitate the introduction of a tent, a Sims's speculum should be used, and the cervix of the uterus should be fixed by a sharp hook. In many cases, however, tents will not be necessary. The hæmorrhage will be controlled by the other means enumerated, or the cause of the hæmorrhage will be made out without the use of tents. In all cases, however, in which the hæmorrhage is uncontrollable, or so profuse as to threaten life, or in which the cause of the bleeding is obscure, tents should be had recourse to, both to check the flow and complete the diagnosis. When the cause has been discovered, it should, if possible, be removed.

But even after the uterine canal has been dilated, no definite cause may be found for the bleeding. In these cases, styptics, or even caustics, may be applied to the inner surface of the organ. Those chiefly used are a solution of iodine, a solution of perchloride of iron, chromic acid, and carbolic acid. These are best applied through a uterine speculum of platinum or vulcanite, on a probe of similar material. While using these means, it should be borne in mind that internal uterine medication is not free from grave danger.

The rest of the treatment of menorrhagia consists in attention to the general state.

John Williams.

MENSURATION (*mensura*, a measure).—A synonym for measurement. *See* Physical Examination.

MENTAGRA (*mentum*, the chin; and *ἄγρα*, an attack: formed after *podagra*).—A name for affections of the chin. Its application is more general than that of *sycosis*. *See* Sycosis.

MENTAL DISORDERS.—*See* Insanity.

MENTONE, France, on the extreme East of the French Riviera.—A moderately warm, bracing, sheltered, and dry winter climate. Mean temperature in winter 52° F.; rainfall 24 inches. *See* Climate, Treatment of Disease by.

MERCURY, Diseases arising from. Synon.: Fr. *Hydrargyrie*; *Intoxication Mercurielle*; Ger. *Quecksilbervergiftung*.

Though considerable discrepancies of opinion have existed as to the poisonous or innocent properties of the metal mercury itself when swallowed, there can be no doubt as to the poisonous character of its soluble and volatile compounds, nor even as to the insidious nature of the vapours of metallic mercury. Metallic mercury has occasionally been administered in enormous quantities without producing any decided physiological effects; whilst, in other instances, salivation and other specific effects have resulted. These differences are doubtless due to the fact that, in those cases where effects have resulted from the administration, oxidation and solution of a portion of the metal had taken place.

Mercurial poisoning may be either (A) *acute*, or (B) *chronic*; the former resulting from the administration of one or several large doses at short intervals, the latter form of mercurialism arising from the repeated exhibition of small doses of the less active preparations of the metal. There is also a peculiar form of mercurialism which is the effect of the inhalation of the vapours either of the metal or of its volatile compounds, and is characterised by paralysis.

A. **Acute mercurial poisoning.**—Description.—The effects produced by a considerable dose, say 60 grains, of one of the more soluble compounds of mercury, such as corrosive sublimate or the nitrate, are those of a corrosive and irritant poison. The effects are immediate. In the act of swallowing, an intense burning sensation is experienced in the mouth and throat, followed by excruciating pain in the stomach, and extending over the abdomen. The local effects of the poison are frequently visible, as a whitening of the tongue and fauces. There is vomiting, tenesmus, and purging, often of a bloody character. Colic, and great tenderness and swelling of the abdomen, are also symptomatic. Not infrequently there is suppression of the urine. The gustatory sensation is perverted; there is dryness of the mouth; and a brassy or metallic taste is generally experienced after the first local corrosive action of the poison has somewhat abated. The countenance is anxious; the skin is pale, cold, and clammy; and the pulse is small, weak, and rapid. Salivation may supervene, accompanied by fœtor of the breath. Should recovery not take place, death may occur within a few hours, or may be delayed for one or more days; or the patient may more rarely succumb to some of the ordinary sequelæ of corrosive poisoning. When death supervenes speedily after the administration of the poison, the fatal result is usually due to collapse.

Most of the effects of acute mercurial poisoning may result from the application of a concentrated solution of corrosive sublimate to the unbroken skin.

Anatomical Characters.—The *post-mortem* appearances seen after acute mercurial poisoning are inflammation and even erosion of the mucous membrane of the stomach, and extravasation of blood beneath this membrane. Ulceration is rare. The intestinal tract also exhibits signs of extensive inflammation, and this has been noticed especially in the large intestine. The rectum is usually much inflamed, and its surface covered with shreds of bloody mucus. A peculiar slaty appearance of the mucous membrane of the stomach and intestines, where not highly inflamed, has been thought to be characteristic of poisoning by corrosive sublimate.

Diagnosis.—Though the symptoms of poisoning by corrosive sublimate, and other corrosive preparations of mercury, greatly resemble those produced by arsenic, the diagnosis is generally not difficult. The effects following almost immediately on administration, the metallic taste in the mouth, and the greater frequency of bloody stools in mercurial poisoning, serve to differentiate between the poisons. Where doubt exists, an analysis of the secretions may be made; arsenic is most readily detected in the urine, and mercury in the saliva. The existence of salivation and fœtor of the breath—though not always present—may also be valuable aids in completing the diagnosis.

Treatment.—In acute poisoning by corrosive sublimate, the best antidote is albumen, or the albuminoids in any soluble form. The white of one or more eggs should be beaten up with water, and swallowed as quickly as possible. Failing an egg, flour made into a thin paste may be administered. Albumen combines directly with corrosive sublimate to form an insoluble compound. On account of the powerful local action of the poison on the stomach, the use of the stomach-pump is not advisable; but if the vomiting be not free, emetics of as simple character as possible may be administered. The rest of the treatment consists in alleviating pain by means of opiates, and the general treatment applicable for irritant poisons. Thirst must be alleviated by demulcent drinks. For this purpose milk, mixed with once or twice its bulk of lime-water, is excellent; the casein of the milk and the lime both tending to render the mercury insoluble, and so to act as antidotes.

B. Chronic mercurial poisoning.

Synon.: Mercurialism.

Description.—The repeated ingestion of small doses of the more soluble and active preparations of mercury, such as the perchloride and the bicyanide, may give rise to chronic symptoms; but these more frequently result from the administration of one or more doses of the more insoluble preparations of the metal, such as calomel or the oxides. When chronic symptoms follow the administration of one dose of a mercurial preparation, this is not altogether due to the peculiar idiosyncrasy of the patient, but is attributable in no small degree to the slowness with which mercury is eliminated from the system. There appears also to be a remarkable difference, not altogether dependent upon their differing solubilities, between *mercuric* or per-salts, and *mercurous* or proto-salts, in respect to their toxic properties. Mercuric compounds are greatly more potent than mercurous salts. By far the most common result of the continued administration of mercury compounds is salivation. This consists in a profuse discharge from the salivary glands; swelling and tenderness of the gums; and fœtor of the breath. In children, and more rarely in adults, salivation may pass into sloughing and gangrene of the cheeks; and a fatal result may ensue. Other symptoms are nausea, colicky pains, depression, and those nervous symptoms to which the term 'mercurial palsy' has been applied; but this last group of symptoms, which is most commonly met with after inhalation of the vapours of mercury, must be described more in detail.

Mercurial Paralysis.—Workers in mercury, such as water-gilders, looking-glass makers, and the makers of barometers and thermometers, are apt to suffer from a peculiar form of shaking palsy, known either as 'the trembles,' mercurial tremors or metallic tremors, and as *tremblement métallique* by the French. This disease affects those who handle the oxides of the metal, but more frequently those who are exposed to mercurial fumes. Mercury exhibits a small vapour-tension, and consequently is vaporisable at all ordinary temperatures, but the tension of its vapour below 60° F. is very small. The metallic tremors may come on suddenly or gradually, and they may be unaccompanied with salivation. The upper limbs are first affected, and then by degrees the whole muscular system. The patient is affected with tremors when an endeavour is made to exercise the muscles, so that he is unable to guide, for instance, a glass of water steadily to the lips; he cannot put his feet steadily to the ground; and when he tries to walk he breaks into a dancing trot. The muscles of mastication and deglutition are affected in advanced cases. Delirium and mania have occasionally followed the continued inhalation of mercury fumes.

Diagnosis.—The diagnosis of mercurial

tremors is usually not difficult. It must be admitted, however, that in some cases the tremors produced by mercury are in no way distinguishable from those due to the now well-recognised disease known as disseminated, multiple, or insular sclerosis. The former are less readily confounded with ordinary shaking palsy (paralysis agitans) and the convulsive movements of chorea. The history of exposure to mercury will seldom be absent. In paralysis agitans the tremors occur when the patient is at rest; and the peculiar forward gait, as if the patient were endeavouring to pass from a walking to a running pace, is characteristic. The metallic tremors come on only when the muscles are exerted, and usually they entirely cease when the patient is lying at rest or is asleep. The same may be said of the tremors of disseminated sclerosis; but here we have the peculiar consensual rotation of the eyes known as nystagmus. In paralysis agitans, when told to raise the affected hand, or to protrude the tongue, the patient performs both actions steadily. In mercurial tremors, and in disseminated sclerosis, the case is different—the tongue when voluntarily protruded is tremulous, and the patient cannot raise his hand when requested to do so, without shaking. In both mercurial tremors and the tremors of insular sclerosis, the muscular agitation ceases for the most part during sleep. In one form of metallic tremors the movements approach in character the convulsive movements of chorea.

Treatment.—In chronic mercurial poisoning, it is obvious that the patient must at once be removed from the further influence of the metal. Masks worn over the mouth are not of much use. In mercurial tremors cessation from working with the metal, and mild tonics of iron, usually suffice for the speedy restoration to health; but the shaking occasionally persists throughout life. For salivation and the more formidable gangrene of the mouth, besides cessation of the administration of the metal, and the exhibition of tonics, iodide of potassium may be given. Astringent gargles and active local treatment may perhaps be necessary.

Thomas Stevenson.

MESENTERIC GLANDS, Diseases of.

MESENTERIC GLANDS, Diseases of.—Of the lacteal glands, which lie in the folds of the peritoneum connected with the intestines, the mesenteric—corresponding to the small intestines—may be ranked as the most important; and what is described with regard to these will apply to the rest of the group. They are all really of the same nature as the lymphatic glands, and are subject to similar diseases. The statements made, therefore, with reference to these structures, will also apply in the main to the lacteal glands (*see* Lymphatic System, Diseases of); but the latter are likewise liable to certain special lesions, whilst their morbid changes present some peculiarities as regards their effects and symptoms. Thus, when the lacteal glands are diseased, the general nutrition tends to be markedly impaired, owing to the interference with the transmission and due elaboration of the chyle, and if they are extensively involved the entire system suffers gravely. Owing to their situation and anatomical relations, these glands, in certain forms of disease, may originate secondary effects of considerable importance. For instance, peritonitis may be excited by their irritation or rupture; or by their pressure on vessels or other structures, ascites and other conditions more or less serious may result. Enlarged mesenteric glands may in certain cases be felt through the abdominal walls. With these preliminary remarks, the particular diseases of the mesenteric glands will now be considered, so far as they may require special comment.

1. Acute Congestion and Inflammation.—The lacteal glands are very liable to become more or less congested or inflamed in connexion with any inflammatory condition affecting the intestinal canal. The situation and number of glands implicated will correspond mainly with the portion of bowel involved. They become enlarged, but the changes are seldom such as to give rise to any evident symptoms, and they subside as the cause of the irritation ceases to operate. In rare instances the inflammatory process may go on to suppuration, and then there is great danger of serious consequences; in one case which came under the writer's notice, fatal peritonitis appeared to have been set up by the irritation of a suppurating mesenteric gland.

In this connexion allusion may be made to the special implication of the lacteal glands in typhoid fever and dysentery. The nature of the changes which they exhibit is described in the articles on these diseases, and the glands affected correspond to the portions of intestine involved. They do not always return subsequently to their normal condition, but may remain permanently atrophied or otherwise changed. In exceptional instances the glands in typhoid fever have suppurated or sloughed in their interior; and they have even ruptured into the peritoneum, thus causing fatal peritonitis. *See* Dysentery; and Typhoid Fever.

2. Scrofulous or Tubercular Disease Tabes mesenterica.—The nature of this affection has been already discussed in relation to the absorbent glands generally (*see* Lymphatic System, Diseases of), and it will suffice to indicate here the special points which require to be noticed in connexion with the lacteal glands. Scrofulous or tuberculous disease of the mesenteric glands constitutes a most important disease in children and young persons, and its occurrence has been attributed specially to the consumption of milk obtained from cows suffering from tubercle. It may exist independently, but is usually associated with tubercular ulceration of the intestines, to which it is then probably secondary, or with tubercular peritonitis. It is not improbable that the mesenteric disease may be primarily set up as the result of mere long-continued intestinal catarrh. The patient may be evidently scrofulous or tuberculous, but this is by no means constant, and there may be no signs whatever of any such diathesis. The disease may also be accompanied with pulmonary phthisis, although this is comparatively rare in children, and the lung-affection is almost always secondary in these subjects. In adults, on the other hand, tubercular disease of the lacteal glands, when it does occur, is in the large majority of cases a complication of pulmonary phthisis, intestinal ulceration being present at the same time.

The changes in the glands are similar to those characteristic of the scrofulous process in the lymphatic glands, namely, a hyperplasia of the cellular structures, of low vitality, followed by caseation, and ultimately by calcification, should the case last sufficiently long; and it is usual in fatal instances to find these conditions more or less combined in different glands. Tubercle-bacilli have been detected. Occasionally some of the glands suppurate. Should recovery take place, all the involved glands may be converted into inert, chalky masses, in which condition they remain for an indefinite time. A case came under the writer's notice some years ago, in which, the patient having died from an independent acute illness, the mesenteric glands were found to be universally calcified, this being associated with scarring of the external glands, and other signs of past scrofulous disease, from which the patient had quite recovered; the condition of the glands was unattended with any symptoms whatever. The individual glands in mesenteric disease may attain a considerable size, and when they are agglomerated into a mass a distinct tumour is formed.

Symptoms.—It is frequently impossible to recognise definitely the symptoms, either local or general, immediately due to tubercular disease of the mesenteric glands, as they are combined with and masked by those resulting from intestinal ulceration and catarrh, from tubercular peritonitis, or from the implication of other structures. The digestive organs are usually disordered, and, even if there should not be intestinal ulceration, children who suffer from mesenteric disease are very liable to enteric catarrh. Hence diarrhœa, with unhealthy stools, is a common symptom, which it is often difficult to check, or it returns from very slight causes. In other cases the bowels are constipated. Scrofulous mesenteric glands do not seem to be painful in themselves, but colicky pains in connexion with the bowels are of frequent occurrence, and the disease of the glands may have some influence in exciting such pains. The abdomen is almost always distended and prominent, owing to the accumulation of flatus, and it may be markedly tympanitic. Hence, even when the glands are much enlarged, it is often impossible to feel them, but they may sometimes be made out by deep pressure with the fingers over the abdomen. In some instances the abdomen is retracted, and then the glands may be more readily felt. Signs of fluid in the peritoneum, or of chronic tubercular peritonitis, may be present. Peritonitis has also, in exceptional instances, been set up by suppurating scrofulous glands bursting into the peritoneal cavity.

The general symptoms in tabes mesenterica are usually very prominent, as evidenced by wasting, which may reach extreme emaciation, anæmia, debility, and pyrexia, marked hectic fever ultimately supervening in some cases. How far, however, the mesenteric lesion originates these symptoms is a matter of doubt, but it is highly probable that it accounts for them in some measure. Cases in which mesenteric glands are the seat of scrofulous disease differ much in their severity; and the symptoms may be so indefinite that it is impossible to make any positive diagnosis of its existence. A large number of cases prove fatal; but it must be remembered that even after severe symptoms recovery may take place, the glands becoming calcareous and inert. When the glandular affection is secondary to pulmonary phthisis, it helps to hasten the fatal termination.

Treatment.—This mainly consists in the treatment required for scrofulous disease in general, such as the administration of cod-liver oil, preparations of iron, quinine, and other tonics; favourable hygienic conditions and surroundings; change of air, especially to the country or to the sea-side; and other appropriate measures. The diet needs particularly careful attention. It should be nutritious and digestible, but has often to be modified so as to render it suitable for the condition of the alimentary canal. Remedies directed to the improvement of the state of this canal, or to the relief of symptoms connected with it, are also often required. No local application can possibly have any effect upon scrofulous mesenteric glands; but symptoms might be benefited by friction with some simple liniment, the application of a flannel bandage, or the use of dry heat, fomentations, or poultices in connexion with the abdomen, should occasion call for them. Any secondary morbid conditions which may arise must be attended to. Paracentesis may be demanded for ascites.

3. **Hypertrophy.**—It will suffice to remark under this head that the lacteal glands are liable to be more or less hypertrophied in cases of lymphadenoma, and in the form of leucocythæmia attended with glandular enlargement. The writer has met with instances where the growth was very considerable. They might possibly be detected during life by physical examination, or they might cause symptoms by their mechanical effects; but, as a rule, their existence is only ascertained at the *post-mortem* examination.

4. **Atrophy and Degeneration.**—The mesenteric glands atrophy in old age, and they may also become wasted and withered after previous disease, such as typhoid fever. The caseous and calcareous changes which they undergo in connexion with scrofulous disease have been already alluded to. It may happen that atrophic or degenerative changes in these glands affect the general condition; but it is certain that they may be extensively calcified, and yet the patient remain apparently in excellent health.

5. **Morbid Formations.**—The mesenteric glands may be the seat of *albuminoid* disease. It is said that they can then be felt through the abdominal walls, firm, distinct, and easily movable; but this is by no means always the case. *Cancer* is chiefly met with as a secondary formation, the lacteal glands being particularly liable to become affected if the intestine is the seat of malignant disease, and the localisation being determined by that of the intestinal lesion. It may occur, however, as a primary affection. The cancer is usually of the softer variety, but it will depend to some extent on the nature of any primary deposit. A considerable tumour may be formed, firm and nodulated; or the glands may remain separate. Physical examination often reveals the presence of the disease. Further, localised pain, with symptoms due to pressure, should it exist, together with evidence of a cancerous cachexia, and of the implication of other organs, especially of the intestines, constitute the clinical phenomena to be found associated with malignant disease of the lacteal glands. No treatment can be of any service except as a palliative.

FREDERICK T. ROBERTS.

MESENTERY, Diseases of.—*See* PERITONEUM, Diseases of.

MESMERISM.—DEFINITION.—The name of the process by which, rather more than a century ago, Anthony Mesmer, the deluded (or at all events the deluding) promulgator of the doctrine of 'animal magnetism,' induced the so-called mesmeric trance or sleep. *See* MAGNETISM, ANIMAL.

This mesmeric trance is identical with the condition now known as 'induced somnambulism,' or still more commonly as 'hypnotism' or the 'hypnotic state.' The condition itself is one which presents to the observer many highly interesting phenomena, and it, together with the means of inducing it, was first investigated in a full and scientific manner by James Braid of Manchester (1843).

In this place it is not intended to speak of the subject from its old point of view. The reader who desires to gain some notion of the errors, deceptions, and vain pretensions with which the whole subject was enveloped by those who have been content to style themselves 'mesmerists,' may with advantage consult the article on 'Mesmérisme,' by Deschambre (*Dict. Encycl. des Sc. Méd.*, tom. vii.), at the close of which they will also find a valuable bibliography. In that article the proceedings of Mesmer and his followers in France are fully exposed.

As a sort of transition between this old state of things, with its erroneous theory and vain pretensions, and the scientific standpoint taken by Braid in regard to the more correct limitation of the phenomena observable and their altogether intrinsic mode of production, came the observations of Elliotson in London, as conducted in the years 1837–38, when he sought to inform himself and others as to the phenomena and curative virtues of mesmerism. He encountered a storm of opposition, principally on account of his mode of dealing with the subject. He was unquestionably honest and enthusiastic in his search for what he believed to be truth; but he unfortunately did not, as Braid by his keener insight was enabled to do, reject and otherwise explain the so-called phenomena of clairvoyance, of transposition of the senses, and of prediction or prophecy. It is to be regretted, however, that Braid did not also reject all the so-called phenomena of phreno-hypnotism.

An independent practical study of the subject and of its therapeutic applications was shortly after the date of Braid's labours commenced by Esdaile in India (1846), as well as by J. K. Mitchell in the United States. They have more recently been succeeded by other investigators, amongst whom may be mentioned Girard Teulon and Demarquay (1860); Ch. Richet (1875); Charcot (1878); and also Weinhold, Beard, Preyer, Berger, Grützner, and Heidenhain (1880), Bernheim, and many others.

The induction of the hypnotic state or sleep has hitherto been possible in only a certain, but variable, percentage of the persons with whom trial has been made, though a successful result has been much more frequent with women than with men. According to Richet, however, the operator should not be discouraged by the failure of his first attempts with the same person; as persons may succumb on the fourth or fifth trial, and subsequently prove thoroughly good subjects for experimentation. Persons who have once been hypnotised can in general be again brought with comparative ease into the same condition, and the facility of hypnotising such persons goes on increasing after each operation, owing to the existence of a predisposing mental state. A condition of excited expectancy is indeed a decidedly favouring mental state, though one which is not essential, since, according to Braid, Heidenhain, and others, even male adults who have heard nothing on the subject, and do not know for what purpose they are being experimented with, can often be hypnotised.

In persons who are favourably disposed for passing into the hypnotic state, the condition is easily induced by weak, long-continued, and uniform stimulation of the nerves either of sight, of touch, or of hearing. This state is, on the contrary, almost always easily capable of being abruptly terminated by some strong or suddenly varying stimulation of the same nerves.

Many of the lower animals, such as frogs and fowls, can be thrown into an extremely similar condition as a result of certain sudden and powerful sensorial impressions. Preyer distinguishes the state into which they are thrown by a different name, namely, 'cataplexy,' because the mode or physiological process by which it is induced seems to be different from that by which hypnotism is caused.

The hypnotic state or sleep is one which varies much in intensity in different persons, and in the same person at different times. The principal phenomena that are exhibited or which can be detected in hypnotised persons are the following: (1) imitation movements; (2) exaltations of special sense; (3) illusions and hallucinations; (4) analgesia, general or unilateral, or even a condition of hemianæsthesia, general and special; (5) increased reflex irritability and tonic spasms of the voluntary muscles; and (6) other miscellaneous phenomena, such as spasm of the accommodation apparatus in the eye, dilatation of the pupils, increased rapidity of respiration and of the pulse, together with profuse perspiration.

According to Charcot, when hypnotism occurs in hysterical subjects more especially, it is divisible into three states, definitely related to one another, though not always occurring in the same order. He says: 'These different states which, taken as a whole, include all the symptoms of hypnotism, may be referred to three fundamental types: first, the cataleptic state; second, the lethargic state; and third, the state of artificial somnambulism. Each of these states, including, moreover, a certain number of secondary forms, and leaving room for mixed states, may be displayed suddenly, originally, and separately. They may also, in the course of a single observation, and in one subject, be produced in succession, in varying order, at the will of the observer, by the employment of certain methods. In this latter case the different states mentioned above may be said to represent the phases or periods of a single process.' For details concerning this and the many other points of importance in connexion with hypnotism, the reader should consult Binet and Féré's work on *Animal Magnetism* (1887), in the 'International Scientific Series.'

A discussion of the mode of production of these several phenomena, or of the exact nature of the hypnotic condition itself, would lead us into details too purely physiological for our present purpose; suffice it to say that the hypnotic state, in one or other of its stages, seems to be akin to that met with in some sleeping persons, as well as to the states known as trance, somnambulism, and catalepsy, and that its physiological cause is presumed by Heidenhain to be some inhibitory arrest of activity of the ganglion-cells of the cerebral cortex, or, as the writer would rather put it, of certain tracts of these ganglion-cells, varying in their nature or situation in accordance with the different stages of the hypnotic condition that may exist. (See *Animal Magnetism: Physiological Observations*, by R. Heidenhain, 1880.)

The scientific study of the phenomena presented by hypnotised persons is unquestionably of great interest and importance, from the point of view of the higher cerebral physiology. But whether the systematic induction of such a state can ever be used as a legitimate or potent means for curing disease, or even for the alleviation of certain distressing symptoms, must be left for the future to decide. The investigations that have been made in recent years are far from being decisive in favour of the method as a remedial agent, especially when taken in conjunction with the actual harm which may result from its induction in some nervous and impressionable persons. The good use to which it was put by Esdaile in India, as a means of inducing insensibility during surgical operations before the general introduction of chloroform, ought, however, never to be forgotten. (See his *Mesmerism in India, and its Practical Application in Surgery and Medicine.*) The whole subject is one of great interest for the practitioner of medicine, and for the psychologist, now that the absurd theories with which its early history was shrouded have been got rid of. We must be careful, however, to pursue the study of the condition itself in a strictly scientific manner, and watch lest the too ready adoption of hypnosis or Braidism as a curative agent may do harm rather than good—and that not to the patient only, but also to the practitioner. One thing seems now to be very generally admitted, and that is that public exhibitions of the effects of hypnotism by non-medical persons are most unadvisable and capable of doing much harm. They ought undoubtedly to be made illegal in this country. Such steps have already been taken in France, Belgium, and elsewhere. H. Charlton Bastian.

MESOLOGY (μέσος, between; and λόγος, a discourse).

This term, suggested by Bertillon, conveniently expresses the investigation of the mutual relationships existing between living beings and their surroundings.

The physiological life of any organism may be regarded as the resultant on the part of the tissues of two sets of influences—intrinsic or hereditary, and extrinsic. To the former are due those structural, and consequently functional, characteristics which are common to ancestors and progeny alike, whilst the fluctuating nature of the environment determines those variations which distinguish different species. Within certain assumed limits these stimuli are regarded as normal, and the resulting manifestations of the tissues are said to be healthy; whilst disturbances in either of these groups of influences constitute the causes of disease—that is, abnormal function dependent on abnormal structure, which in its turn has been brought about by a change in the usual conditions under which it exists.

Mesology, therefore, may be looked upon in a restricted sense as a branch of ætiology, dealing, as it does, with such factors as temperature, atmosphere, climate, locality, food, clothing, and the more subtle agencies of habit, profession, domesticity, mental states of depression, excitement, or irritation; in short, with any and every circumstance, whether material or psychical, which acts upon the body. W. H. Allchin.

METALLIC.—A peculiar quality of sound, which the name suggests, either elicited by percussion or heard on auscultation, especially in connexion with certain adventitious sounds in pulmonary cavities. *See* Physical Examination.

METAMORPHOSIS (μετά, a preposition signifying change; and μορφόω, I form). In a pathological sense this word signifies a form of degeneration, in which one tissue or substance becomes chemically changed into another, as, for example, albuminous structures into fat. *See* Degeneration.

METASTASIS }
METASTATIC } (μεθίστημι, I change place).—These terms are supposed to imply the translation of a disease from one part of the body to another, such as seems to occur occasionally in gout, rheumatism, mumps, and certain affections of the skin and mucous membranes. Modern pathology, whilst admitting the existence of the phenomena to which the term 'metastasis' has been applied, refuses to accept as satisfactory the explanation of the fact implied in the term.

METEORISM (μετεωρίζω, I raise up).—A synonym for tympanites. *See* Tympanites.

METRALGIA (μήτρα, the womb; and ἄλγος, pain).—Pain in the womb. *See* Womb, Diseases of.

METRITIS (μήτρα, the womb).—Inflammation of the womb. *See* Womb, Diseases of.

MIASM (μιαίνω, I pollute).—This term has been used very vaguely in reference to poisonous emanations generally, but its application ought to be limited to the malarial poison. *See* Malaria.

MICRO - ORGANISMS.[1] — Synon.: Microzymes; Fr. and Ger. *Microbes*.—Under this term will be considered those minute organised bodies which are found associated with various morbid states. Strictly speaking, the term might be applied to any living body of microscopic dimensions, but in medical parlance it has come to be limited to those which may be associated causally or otherwise with disease. And it is even more restricted, for it is generally understood to mean only such organisms as are presumably of vegetable nature. Hence it is largely synonymous with Bacteria, although it may perhaps be extended to some other lower fungi and algæ. The term 'microbe' will here be used synonymously with 'micro-organism.'

Preliminary Remarks. — The rapid development of bacteriological literature, and the enormous amount of work which has been done in the subject during the past few years, render it extremely difficult to concentrate within a small compass so much of the ascertained facts as may be most useful to the practitioner. A vast army of investigators have been and are engaged in its study; and whilst there is no kind of scientific investigation which demands more rigorous precautions in experiment, and more caution in inference, it is certain that a large number of observers have been too ready to announce supposed discoveries. Hence it is a matter of extreme difficulty to do justice to work of real value, or to disentangle the true from the false. Nor can the facts which are of ascertained value be readily condensed into a small compass without risk of error. It seems therefore best to devote especial attention to the present standpoint of the subject and the modes by which it is studied, and only to outline briefly those parts in which our knowledge is at present liable to rapid modification.

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[1] This article was written conjointly by Professor Greenfield and Dr. Robert Muir. The only exception is the section on Anthrax, for which Dr Muir is solely responsible. The illustrations were drawn by Mr. Richard Muir, under the direct supervision of Professor Greenfield, and are, with three exceptions, from specimens prepared in his laboratory.

Theoretically, disease might be produced by the introduction into the system of a poison or ferment generated outside the body, and acting as any other poison. But in order that it might be contagious to other individuals, it is essential that the poison should be reproduced in like form within the body. The conditions which we know to be present in contagious and infectious diseases can only be satisfied if the virus is itself capable of development and activity within the body, reproducing its like.

The study of fermentation, and especially the remarkable investigations of Pasteur on organised ferments, presented at first an analogy to, and afterwards an illustration of what we know to occur in contagion. All subsequent work has been a study of the nature and mode of action of mycotic contagia.

But in order to a full knowledge we require to know—the nature and characters of the contagium; its conditions of introduction and of activity; its mode of reaction in the production of the phenomena which we group as 'disease'; and, lastly, the manner in which it is eliminated from the body, and the modes in which the living body protects itself from its action. Our knowledge up to the present time is very largely that of the nature and characters of the contagium, although there is now marked progress in the other branches of the study.

It may be well to indicate briefly the grounds on which any micro-organism can justly be regarded as the contagium or actual cause of disease, according to the admirable canons laid down by Koch.

1. It must be constantly associated with the disease, being present in the fluids or tissues of the diseased animal, and in the virus by which the disease is communicated.

It may indeed be in a different form in the virus, *e.g.* in the form of spores, whilst in a more developed form when in the full activity of disease-production.

And we should expect that if there is a special characteristic lesion, such as an eruption, or some special affection of one or more organs, for example, the spleen, the organism should be especially found there. This, although proved to be the case with regard to several diseases, is not theoretically essential, *unless the virus of the disease especially resides in the specific lesion*—as in the vaccine vesicle, or in the glanders or syphilitic sore.

2. The constant presence and association of a definite organism is not of itself sufficient to prove that it is the virus. For it may be only a part of it, or may be an accidental accompaniment. And we also know that there are constantly in the air we breathe, and in other places, very numerous and varied organisms, which may under suitable conditions enter the body, and which can do so when the normal resistance is lowered; and which might therefore be found wherever any disease-process was going on.

It is, therefore, further essential to proof, that the organism should be capable of absolute isolation and separate cultivation outside the body, and that then, being introduced into the body, it should produce the same disease and be capable of retransmission to other individuals.

It is obvious that this rigorous scientific proof is almost solely capable of being attained in the lower animals, seeing that we cannot, in the more serious diseases, thus experiment on man. And even in the lower animals we meet with numerous inherent difficulties, which may be briefly considered.

(1) Some micro-organisms can be cultivated outside the body only with great difficulty, others at present not at all. Yet the early difficulties in this respect are being largely overcome.

(2) The specific disease-producing properties may be greatly diminished, or even lost, when the organism is cultivated outside the body. Here, again, by careful adaptation of the conditions of artificial culture, this loss of activity may to a considerable degree be prevented.

(3) A further difficulty, which forms an especial barrier to the study of human diseases, is found in the fact of the variations of disease when communicated from one class of animal to another, and in the relative degree of susceptibility to disease of different classes, or even of species or individuals of a given class. Thus we shall find (*a*) that a virus which causes a general blood-poisoning in one class of animals, will produce only a local eruption in another, and (*b*) neither may correspond with the disease as we are familiar with it in the human subject. Only a very careful study and comparison in a large number of cases can suffice to show what is the corresponding disease; for instance, if a specially characterised sore is found to be produced by inoculation of one class of animals with the disease of another class.

Again, (*c*) some human diseases are transmissible to animals only with difficulty, or not at all. Or, amongst a number of animals experimented on, only a few may be susceptible, the others having a natural or acquired immunity. Some of the animals most readily obtained for experiment are peculiarly unsuited for the purpose, particularly rabbits. A vast number of fallacious discoveries have been due to the too frequent employment of rabbits, it being assumed that because they have shown various indications of disease, such as fever, the virus employed had some specific characters.

It may be thought that these elementary facts have been too much dwelt upon. But experience has shown that the intense desire for discovery, and too eager emulation, have enormously hindered true advance in this branch of science; and the medical public at large should insist on proof of a more rigorously scientific nature. But such rigorous proof is not always attainable. We may, then, be provisionally content with a less exact knowledge as a guide to practice and further experiment. If by strong analogy in all essential points a disease comes into the group of contagious specific diseases, and is strictly comparable with one in which a bacterium has been proved to be the actual virus; if, further, there is constantly present in the body, and especially if in the specific lesion and in the virus, an organism having definite characters, we may provisionally regard it as the essential contagium. And still more may we do so if we find that the disease can be transmitted with the same characters to another individual by employment of fluid or tissue which contains this organism, and that it is not transmitted if the fluid or tissue employed for inoculation does not contain the specific organism, although derived from an animal suffering from the disease and containing the organism in other parts.

Our most complete and absolute knowledge is, of course, that of some diseases which are peculiar to lower animals, yet are so closely analogous to some human diseases that they may be accepted as evidence with regard to the latter.

It will be found that, at the present time, we have conclusive evidence of the bacterial nature of the virus in only a small number of human diseases; that in a considerable number we have the secondary kind of proof; whilst in a much greater number our knowledge is as yet fragmentary, and lacks on one or other side the completely conclusive evidence.

Of the diseases affecting man, anthrax and tubercle may be mentioned as good examples of the absolutely proved. Leprosy is one in which the final proof of inoculation of isolated cultures is yet wanting, but is the only missing link. Relapsing fever is an instance of inference from transmission of the organism and the fever to monkeys. Syphilis is an example of evidence from analogy only, although some of the organisms discovered may eventually prove to be the virus. In the case of traumatic tetanus recent discoveries appear to leave no doubt of its bacterial origin.

MORPHOLOGY AND LIFE-HISTORY OF BACTERIA.—In the consideration of bacteria it is well to regard as a separate order the forms which show a higher degree of complexity and greater variation in the forms or stages of development under different conditions of life—such as the groups Cladothrix, Crenothrix, and Beggiatoa. They have been included by some botanists under Bacteriaceæ, but may more properly be regarded as constituting an order or orders somewhat higher in the grade of vegetable life. This arrangement has at any rate the advantage of simplifying the descriptions of the life-history. Moreover, with the exception of the Actinomyces, which has been shown to be a Cladothrix or allied form, none of these orders are known to be concerned in the production of disease.

General characters of bacteria.—Bacteria are unicellular organisms, belonging to the lowest class of chlorophyll-less[1] algæ, and constituting the most elementary and lowest form of vegetable life. They multiply by fission, hence the name Schizomycetes; but for many of them there is also a mode of propagation or reproduction by the formation of *spores*.

In structure they consist of a protoplasmic body, the protoplasm having peculiar chemical and physical characters (*mycoprotein* of Nencki), and a cell-envelope, composed of a carbohydrate allied in composition to cellulose. Whether the cells are nucleated is at present an open question. The protoplasm is frequently granular, showing differences in the staining reactions in different parts; and, in addition, granules of distinct chemical qualities have been detected in some of the higher forms (*e.g.* sulphur in Beggiatoa). The irregular staining may perhaps indicate some definite structure. Moreover, marked changes affecting the entire cell may be observed during the process of spore-formation. Further, various degenerative changes may lead to alterations in the staining reactions, and to the formation of granules of apparently oily nature, or to irregular swelling with formation of so-called vacuoles. The tendency to such changes and the form which they take vary with different species, and may give special characters to the particular species. The forms when thus altered are sometimes known as degenerated or *involution* forms.

The variety in the chemical reaction, especially the staining reaction of the protoplasm in different species, is an important aid to their recognition, *e.g.* the tubercle-bacillus.

The *cell-envelope*, which can be detected with certainty only in some of the larger forms, and is inferred to be present in others from the associated characters, can be brought into view by reagents, such as iodine, which cause shrinking of the protoplasm: or in some cases by staining. It is highly flexible. Its thickness is very various; and it possesses, especially in some species, a great tendency to swell and undergo partial solution, or rather to form a gummy or jelly-like material, like gelatine or gum-tragacanth when soaked in water.

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[1] Some bacteria are now said to contain chlorophyll granules, but the general fact is as stated.

To the partial solution of this material is due the hyaline 'capsule' which is characteristic of some bacteria (*e.g.* the pneumono-coccus of Friedländer), and the intercellular substance of 'zooglœa' masses, by which the masses adhere to surrounding objects and cohere into a sticky mass.

Motility.—Many bacteria are spontaneously motile; indeed, the property is so common in several of the species associated with decomposition in organic fluids, that it was at first thought to be almost universal. But we now know that many never display this property.

Where present, it has in several species been long known to be associated with the presence of cilia or flagella, whilst in others no cilia could be detected, and it was believed that the movement of the cell-body itself sufficed to produce independent locomotion. But from recent researches by a method devised by Löffler (for details, see *Staining of Bacteria*), aided by photomicrography, we know that flagella are present in several forms where they were hitherto invisible, for instance, the cholera spirillum; and we are not as yet entitled to assume their absence in other motile forms.

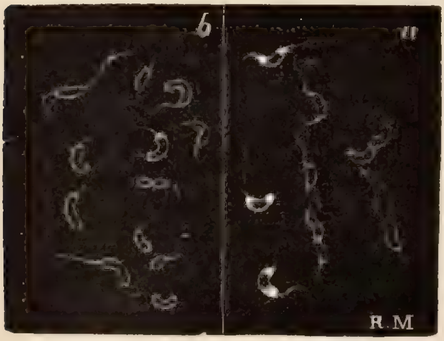

Fig. 68.—Finkler's Spirillum and Koch's Cholera Spirillum, both prepared in the same manner, stained by Löffler's method, to show flagella; and placed side by side for comparison. × 2,000 diam.—*a.* Finkler's Spirillum. From a culture made in the Pathological Laboratory, Univ. Edin. *b.* Koch's Cholera Spirillum. From a specimen from the Berlin Health Laboratory.

The flagella are apparently continuous with the cell-envelope; whether with the cell-protoplasm also is not certain.

Forms of the cells.—The cells are spherical, ovoid, or cylindrical, and usually symmetrical. They may be in short cylinders, bulged in the centre and somewhat pointed at the end (*clostridium* form). The cylinders may be short or long rods, straight or slightly curved (*bacillus* form), or much curved (*spiral* form). They may grow into long threads, straight, or curved, or twisted (*leptothrix* form, *vibrio* form, *spirillum* form, &c.), and appear to be homogeneous throughout; but in most cases we may by reagents discover that the apparently uniform thread is composed of cells arranged endwise, but remaining attached to each other. Such elongated forms are especially seen when growth occurs in fluids at rest.

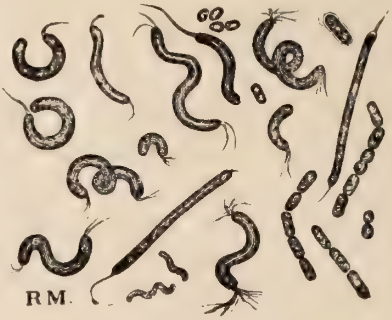

Fig. 69.—Spirillum Undula.—From a culture, stained by Löffler's method for showing flagella. The various forms and stages, and also the variety in number of the flagella, are seen. ×800 diam.

Position and arrangement of flagella.—Flagella have been discovered in several of the rod and spiral forms, and in one species which is spherical or nearly so (*Micrococcus agilis* of Ali Cohen).

In some of the lower and simpler forms (*i.e.* excluding Beggiatoa, &c.) the flagella are terminal and single only at one end of the cell; but in some there is one flagellum at each end. More rarely, two or more are present at one end. They are often long, and may greatly exceed the cell in length. They are usually of extreme tenuity (*e.g.* ⅛ to ⅕ the diameter of the cell in the cholera bacillus), and hence are detected with great difficulty.

In typhoid bacilli, in which Löffler was unable to detect flagella, a very remarkable condition has been discovered, namely, the presence of multitudes of short lateral cilia along the entire length of the cells. A similar condition has also been more recently detected in one or two other species.

Colouring matters.—Many bacteria, when grown in mass, show distinctive colours—red, yellow, brown, &c. These may develop only in certain conditions of growth, or in parts exposed to the air. On examination with the microscope, the pigment may appear to be in the cells (as in magenta micrococcus); but it is readily dissolved out, and would appear in most cases to be an excreted or formed product, which mainly lies in the intercellular substance, staining the cell wall. Or it may in some be the product of some substance excreted by the cell acting on the culture-medium, and especially in presence of oxygen.

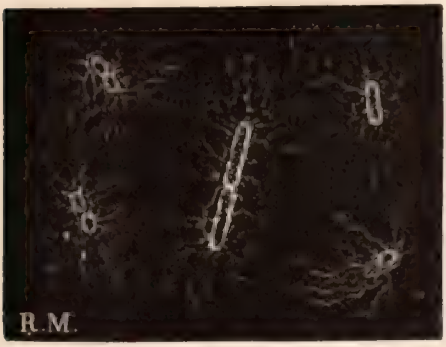

FIG. 70.—Typhoid Bacilli.—Stained to show cilia. × 2,000 diam. From a specimen prepared in the Berlin Health Laboratory.

Multiplication and fission of the cells.—Division occurs by fission, usually dichotomous, the segments being often of nearly equal size. This is usually preceded by elongation of the cell, so that in the spherical forms, as fission becomes complete, each of the new cells is nearly spherical before separation occurs. Transverse fission is the rule in the simpler rod and the spiral forms. But in some spherical forms it may take place in two planes at right angles to one another, hence forming tetrads (as in *M. tetragenus*, *M. gonorrhœæ*); or, further, in three different planes and directions at right angles to one another, forming a bale-like mass (*sarcina* form).

During the process of fission, a constriction may appear at the line of approaching segmentation, or none may be seen; hence different characters, especially in the elongated forms. The first cells may remain united in chains, threads, or groups, and may thus give special characters, from which names have been derived. But since such persistent union is inconstant, varying with the conditions of growth, and best seen in quiescent growth in fluid or semi-fluid media, it should not be regarded as other than a subordinate character. For example, all micrococci, if growing freely and kept in motion, must become 'diplococci' during the stage of division.

In bacilli the cells elongate, and if the segments do not separate they come to form threads. These threads do not form false branching, as occurs in the case of cladothrix.

Spore-formation.—The production of spores, and the properties with which these are endowed, are amongst the most important facts concerning bacteria. Discovered at first in some of larger size, such as the hay bacillus and anthrax bacillus, by Koch, the process is now known to be common to many of the straight, and some of the curved rod forms. For the latter there is less evidence, and the question is at present unsettled for most spherical forms. But from known facts in the life-history of many species in which the existence of spores is not proved, there is strong probability that for all the rod forms, and very possibly all curved and spherical too, there is a like capacity, given favourable conditions of life.

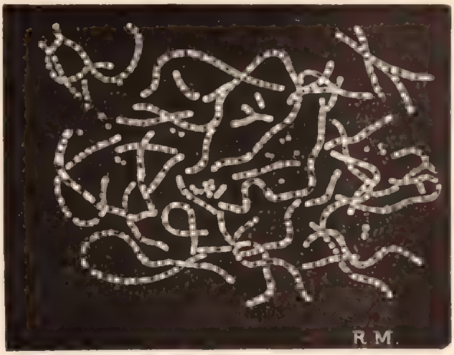

FIG. 71.—Cladothrix dichotoma. From a culture × 800 diam.

The process of spore-formation takes place only under certain favourable conditions, and may be prevented by growth under unfavourable conditions, especially of temperature. It was formerly believed that spore-formation occurred especially when the nutriment was deficient, but there is now no question that it is a normal phase of their life, occurring especially under certain favouring conditions of growth.

Mode of spore-formation.—This can best be studied in some of the larger bacilli, such as the *Bacillus subtilis* and *B. anthracis*. The protoplasm of the cell appears to undergo condensation, its more solid portion becoming agglomerated and retracted, usually towards one end of the cell. At the same time it becomes more highly refracting, and often assumes different staining properties. The remainder of the cell may appear hollow or granular, but this is not always the case. Swelling may and frequently does take place at the site of the spore, so that the rod appears beaded. This swelling may be so considerable that the diameter of the spore may be twice as great as that of the rod, or more (*e.g.* tetanus bacillus). This fact is very apt to be exaggerated, owing to the different refraction of the spore and the rest of the protoplasm, which renders it difficult both to estimate and to photograph.

The spores are usually ovoid, more or less elongated, sometimes nearly spherical. When formed within bacilli arranged in chains, it commonly happens that the spores are situated one at the end of each cell, and in such a manner that the cells form pairs with the spores at the adjacent ends. If now division of the cells takes place between the adjacent spores, rods imperfectly divided will be formed with a spore at each end; if at the end distal to the spores, a pair of spores will be seen near the centre of a rod. When the division is complete, each rod will contain a single terminal spore.

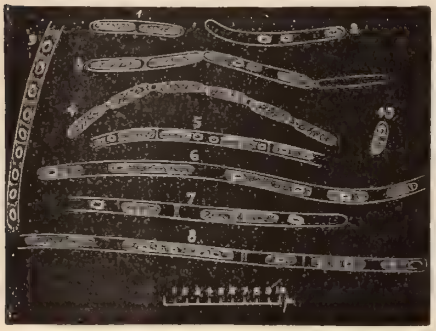

Fig. 72.—Stages in the Growth of a Bacillus, and of Spore-formation.—(1) Bacillus as seen before division; (2) Undivided bacillus showing spores; (3) Thread formed of segments, which have not separated; (4) Another of the same; (5) Part of a long filament, showing the lines of cleavage; (6) Another filament, showing aggregation of the protoplasm, and commencing spore-formation, without any sign of segmentation; (7), (8), and (9) show other appearances in undivided filaments; (10) Bacillus in process of growth from a spore. × 1,500 diam.

This fact, trivial as it may appear, is important to note, since distinctions of specific value have been adduced from this common fact.

Much less frequently the spores are situated towards the centre of the cell, or, in an apparently undivided rod, at irregular intervals. All these modes of arrangement may be seen in the same species, and they have no specific value.

Structure of the spores.—Beyond the facts that they consist of a highly refracting protoplasmic mass, with great endowments of vitality and peculiar staining reactions, surrounded by a capsule or cell-wall resembling that of the parent cell, but of greater resisting capacity, we know nothing. That they have an intimate organisation we suppose from what we know of other cells.

Staining reactions.—It has already been stated that the staining reactions of the spore protoplasm differ from those of the cell protoplasm, and may do so to a remarkable degree. By selective staining the spores may be stained of a different colour from the rest of the cell. And it may here be mentioned that in one of the common bacteria of water the spores show normally a definite coloration of a reddish tinge (*Bacillus erythrosporus*), when examined fresh, without staining.

Germination.—When placed under favourable conditions the spores germinate, and reproduce cells like those from which they originated. According to some, this takes place by a sprouting through the capsule; whilst others allege that the entire spore elongates to form the new cell, which then multiplies by fission. Except as possibly giving a clue to the structure of the spore, the question is unimportant. What is of consequence is that the spore always gives rise to cells like those from which it sprang.

Vital capacity of spores.—The remarkable power of resistance of the spores of many species will be referred to under the life-history in general, and in relation to particular species.

Classification of Bacteria. — We are now in a position to refer briefly to the classification of bacteria. Many attempts have been made to arrive at some satisfactory division, but hitherto with very limited success. The difficulty arises in great measure from our defective knowledge of their complete life-history, and of the variations which they may show under varying conditions of growth. Most of the attempted classifications are valueless for our purpose, and are also unscientific. The only true basis is of course a botanical one, and such properties as the production of colour, of fermentation, or of disease are useless, unless as provisional. We may therefore omit all mention of these. For the more recent scientific classifications botanical works may be consulted. For our purpose it is sufficient to adopt the nomenclature usually employed, it being understood that the names given are merely convenient appellations, and not scientific distinctions.

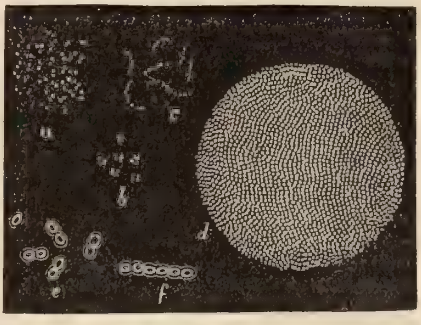

Fig. 73.—(*a*) Single and double micrococci; (*b*) groups of four, 'sarcina' form; (*c*) chains; (*d*) zooglœa; (*e*) single and double micrococci, more highly magnified, showing process of division; (*f*) a chain, more highly magnified.

The basis of this nomenclature is the form of the cells, and the arrangement commonly seen in their growth:—

(1) Spherical or slightly ovoid cells. *Cocci* or *Micrococci*—

Cells usually in pairs—*Diplococci.*

Cells in chains—*Streptococci.*

Cells in groups of four—*Tetragena* or *Tetracocci.*

Cells in bale-like masses, comprised of groups of eight—*Sarcinæ.*

Cells in masses or balls—*Staphylococci.* (Grape-bunch like.)

(2) Elongated, rod-shaped, or thread-like cells—*Bacilli.*

(3) Curved rods or filaments—*Spirilla.*

Various names have been employed to distinguish abruptness of curve, length, &c., as Spirochæte, Leptothrix, &c., but they are of no practical value.

But, whilst these names suffice for our purpose, it must be understood that, in dealing with bacteria as a whole, much more elaborate distinctions would be essential.

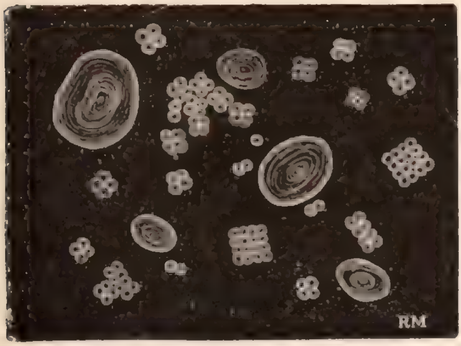

FIG. 74.—Sarcina ventriculi. Showing sarcinæ and starch-granules in vomited matter. × 400 diam.

CONSTANCY OF SPECIES. — *Variation or transmutation.*—Amongst the very important questions which underlie the subject of the pathogenic activity of bacteria, is that of the constancy of species, the possible variation under cultivation, and the acquisition or loss of specific activity.

If marked variation or transmutation can occur, and if one species can not only pass into another, but can under varied conditions of life assume different capacities for fermentative and like activities, then not only is the subject rendered far more complex, but the relation of bacteria to virulent diseases is put on an entirely different footing. For they may be not so much the essential virus as the carriers of contagion, carrying in, as it were, a catalytic process from one individual to another. If, for example, a common bacterium, innocuous in itself, were liable, when grown in the blood of an animal suffering from some disease, to carry on the ferment-like activity of similar kind to another animal, it is obvious that the bacterium is not the specific virus. It simply transmits a process. Analogies to such a process may be found even in that of crystallisation. But if one species can do this, another may also; and so a similar disease-process might be secondarily induced by a variety of bacteria.

Two questions then arise: Are the species essentially and persistently distinct? Are the specific pathogenic activities innate or acquired?

VARIATION OF SPECIES.—From what we know of the variations of low organisms under cultivation, we should anticipate a high degree of capacity for variation or mutation in bacteria. Nevertheless, the amount of such variation appears to be small. For we find that a large number of species, which have been cultivated through hundreds of generations, not only maintain their morphological characters, but produce like effects as to colour production, fermentative changes in the cultivating media, and even pathogenic results. It has already been mentioned that differences are observed in the characters when grown under different conditions, but these do not impair the reproduction of the original characters when sown again on the original soil. Some characters, such as colour production or special fermentations, may only appear when special conditions are present.

It must, however, be stated that the pathogenic activity is capable of diminution or loss, and, conversely, of intensification, as will be seen in some cases to be mentioned. But this appears to be explicable rather on the hypothesis of acquired habit of growth, than of actual alteration or loss of capacity, and in some cases is associated with lowered vitality of growth. When re-acclimatised in the body, the virulence may be speedily regained. There is further the question whether great mutations of form, from spheres to threads, from these to spirals, and the presence or absence of cilia in the same species under different conditions, do not militate against the view of the specificity of bacteria. The answer to this is that in the lower fungi not only are great differences of form observed in the same species at various periods of life, but that two or even more modes of reproduction normally occur in some which have been carefully studied—resting spores and motile or free-swimming spores, for example, as in Saprolegnia. The discovery, then, that a species of bacterium exhibits great variety in its form, &c., at different periods of life, only shows that it belongs to one of the higher groups, in which such cyclical changes are part of the normal life-history. It is partly on this account that the lower forms, with which we are mainly concerned in disease, should be kept distinct from the higher groups in which such multiplicity of form is normal.

TEMPERATURE IN RELATION TO GROWTH.—The temperature of cultivation has been shown by numerous observations on many species to have a most important bearing not only upon the rapidity of growth, but also upon the phases of life and the reactions of the organism. More especially spore-formation may occur with certainty and readiness only under particular conditions of temperature. An example of this is found in the tetanus-bacillus. But there can be no doubt that some of the statements which have been made on this point have given too rigid a limit to the possible temperature-range. For example, it has been alleged that the tubercle-bacillus can only grow at a temperature of at least 37° C. outside the body, but this is no doubt an error. In order to successful growth under unfavourable conditions, some of the more markedly parasitic bacteria do require a regulated temperature not lower than that of the human body.

Speaking generally, those bacteria which are normally concerned in fermentations and decompositions, and are only accidentally or potentially parasitic, grow most actively at a range of 17°–25° C. (about 60°–77° F.), and better over 70° F.—a normal summer temperature. Those which are most definitely parasitic, such as tubercle and anthrax, thrive best at 35°–40° C. (95°–104° F.). Some of these, however, can be readily grown at ordinary temperatures, such as typhoid and anthrax, whilst others require to be carefully incubated at the higher temperatures (*e.g.* tubercle, diphtheria).

At the lower temperatures spore-formation may not occur, or may be very slow; thus anthrax bacillus is said not to form spores below 20° C. (68° F.).

Resistance of Bacteria to Temperature.—Not only the temperature of most active growth, but also that of the death-point, differs for different species, and at different stages of life. Speaking generally, the spores, when fully formed, show a far greater capacity for resisting both heat and cold.

The death temperature of several species has been carefully studied. With few exceptions, even spores are entirely killed by exposing to a moist heat (steaming water) of 100° C. for a few minutes. But in some as long as half an hour may be necessary, and in some even an hour, in a current of steam.[1] Superheated steam of 110°–120° C. is rapidly and invariably fatal even in a few seconds.

Dry heat is far more variable in effect and less active, especially if the spores have been first allowed to dry thoroughly. Dry heat kills spore-free bacteria in an hour and a half of a little over 100° C.; spores of moulds, an hour and a half of 100°–115° C. A temperature of 130°–140° C. may be borne for some hours without completely destroying all spores (*e.g.* spores of anthrax bacilli); but this is only true of a few, so far as is known.

On the other hand, most spore-free bacteria, or bacteria in which the formation of the spores is incomplete, are readily killed by much less elevated temperatures, and may perish at 50°–60° C. Some few are known still to grow at 60°–70° C.

The heat-resisting capacity of the same species is also found to vary in different cultivations, the degree of vitality at different ages evidently undergoing modifications.

On the other hand, the resistance to cold is equally great. The spores of some bacteria, and the cells of some micrococci, are not destroyed even by the most intense cold.

The freezing death-point is difficult to determine for spore-free bacteria, owing to the difficulty of excluding the results of physical changes in the media, and also of ensuring the entire absence of spores; but freezing kills many, and alternate freezing and thawing may also kill some spores which are not killed by freezing (Prudden).

These studies have, it need hardly be pointed out, a most important bearing upon the subject of disinfection.

Alternations of Temperature.—*Tyndall's sterilisation method.*—Bacteria when in fluids are seriously injured by extreme alternations of heat and cold. Thus, if a cultivation be heated to 58°–60° C. (136·5°–140° F.) for half an hour to two or three hours, and then allowed to cool to the ordinary temperature, 17°–20° C., and if the process be repeated on the following three or four days, nearly all bacteria, whether spores or cells, will be killed, and the fluid will be 'sterile,' or bacterium-free.

It is supposed that the mechanism of this process is that the cells present are destroyed by the heat; and that the spores germinate, and the cells developed from them are on the following or successive days destroyed also. But some facts lead us to doubt whether this is the entire explanation, for the destruction occurs whether they are in a suitable soil or no, and alternations of freezing and thawing have a like effect.

It must also be mentioned that, whilst most bacteria, when spores have not been formed, are killed by a temperature of 60° C., *e.g.* typhoid, glanders, cholera, and tubercle bacilli, some require a higher temperature; thus, *Staphylococcus pyogenes aureus* requires 80° C.

Other Conditions Unfavourable to Growth.—*Exposure to direct sunlight* has a powerful influence in arresting the growth of bacteria, as of many other of the lower fungi. Actual death may occur, or the processes of development and spore-formation may be arrested or prevented. *Deficiency of nutriment* has a like effect. So also has *deficiency of oxygen* in aërobic species, oxygen being essential to spore-formation in them. On the other hand, the presence of *free oxygen* may be equally deleterious to some which are anaerobic, especially some of the putrefactive species. The *presence of free acid* is found to be incompatible with growth in many, if not most, bacteria, whilst it is alleged that mould fungi flourish equally or better in an acid than in an alkaline or neutral medium. Further, many bacteria generate, as by-products, substances of 'antiseptic' nature, such as some of the coal-tar group, and these, if produced in sufficient quantity, and not removed, may arrest growth.

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[1] A recently described potato-bacillus required four hours of steaming at 100° to destroy spores.

From these facts in relation to nutriment and temperature the conditions under which artificial culture must be carried on can be readily deduced. We must have a medium which contains nutriment in a moist or fluid form, with free access of oxygen, or in some cases (anaërobic) with its exclusion, and a suitable temperature must be maintained. The nutriment should contain proteid substances; and, if possible, some of these should be in forms in which they are readily broken down—hence the use of prepared peptone.

Modes of Study.—For the complete study of micro-organisms. various modes of investigation may be followed. The microscopic characters, even when aided by special staining reactions, do not afford a sufficiently satisfactory means of discrimination between allied forms. Nevertheless, when these characters are very peculiar, and when the organism is found in constant association with a peculiar change, as in the case of the tubercle-bacillus, its identification in the tissues is comparatively easy.

The sources of fallacy in microscopic study are briefly these:

(1) The very minute size of many microbes makes the more delicate points of difference hard to appreciate with our present powers, and slight failure in preparation may especially obscure them. Hence able investigators have described the same organism with quite different characters—a bacillus as diplococcus.

(2) The size of the organism, never constant as regards length, varies in different animals and under different conditions of cultivation, both as regards diameter and length. Absolute statements of size must therefore be received with caution. The fact is now well established for numerous organisms, and appears to be a general law.

(3) The apparent size, as in the case of all cylindrical or spherical bodies, whose substance is of different density at the centre and surface, will appear different in different refracting media, partly owing to the difficulty in focussing the widest part. This is also true when the body is stained, partly because the staining is unequal. Hence cylindrical bacilli, with spores of nearly equal diameter at the end, have been represented as pin-shaped.

(4) The action of reagents or of heat, both in preserving and hardening tissues or fluids, or in staining and mounting processes, has a marked effect upon the apparent size of the organisms. Many of them are proportionately less affected than softer tissue-elements, but the effect is pronounced in nearly all to which special study has been directed. Reagents may also obscure peculiar characters—for example, the *Umhüllung*, or material which forms a sort of shell or capsule around some organisms, and which is derived from a softening of the cell-wall.

And, lastly, it is found that for the recognition of some pathogenic microbes, it is almost essential that the tissues should either be fresh, or that they should be very carefully preserved by special methods. Otherwise, success is exceptional, and the number found very small compared with those actually present.

Cultivation.—Fortunately, in the case of a large number of micro-organisms we have a far more perfect and easy mode of study, that of cultivation or pure culture (*Reincultur*). By this method, introduced by Klebs, and perfected by Koch and others, organisms are not only isolated, sown in fresh soil in successive generations, and thus removed from all addition and impurity, but they can be studied in a pure condition as to their morphological, physiological, and chemical characters. By growth in different media, their fermentative effects and products can be investigated. This at present constitutes one of the most important and hopeful branches of bacteriological research.

By culture, especially when aided by microscopic study, the recognition of various forms becomes easy. For each organism possesses its own peculiar characters, especially when grown upon or in semi-solid media. These characters comprise form of the mass, colour, rate of growth, results and effects on the nutrient media, effects of the presence or absence of oxygen, capacity of growth on different media and temperature. They may vary for the same organism in different media, and when taken together constitute almost absolute distinctions of the various known forms. By the aid of a lens, the earliest groups and colonies may be studied, and will often be found to branch and grow in a characteristic way.

Mode of Cultivation.—Of this a very brief outline must suffice, as the practical details would occupy too much space.

The soil may be: (1) Fluid, as milk, aqueous humour, broths of various kinds, hay and other vegetable infusions, urine, or chemical combinations, such as Cohn's fluid; (2) Semi-solid, as boiled potato, bread paste, &c.; or (3) A jelly, as various broths gelatinised with isinglass, gelatine, or agar, or serum inspissated by heat. The introduction of gelatinised media by Koch has been an enormous aid to the study of bacteria. All these media may be used with advantage in various cases; but of most universal application, owing to their translucency, ready manipulation, and wide range of utility, are the gelatinised media. They may be used in mass, or spread out in a thin layer on a glass plate or slide, or lining the interior of a test-tube or flask.

The basis of the soil commonly consists of meat broth (fowl, beef, veal, &c.), to which is added a certain quantity of prepared peptone, and in some cases cane or grape sugar. A sufficient proportion of gelatine is added to produce a jelly at normal temperatures. Or if agar-agar is used, the jelly melts at a much higher temperature. The addition of 5 to 8 per cent. of glycerine to the agar jelly appears greatly to increase its activity and range of use, and retards drying up of the jelly ('glycerine agar'). Mixture of serum with jelly may also be employed.

Sterilisation, both of the vessels and cultivating media, is essential; and the absolute exclusion of all external organisms. The former is mainly effected by heat, the latter either by sterilised cotton-wool or by the action of gravity.

The sowing of the microbes in the cultivating soil is effected in the case of solid or gelatinised media by a sterilised platinum wire or glass rod, the vessel where possible being inverted: in the case of fluid media by the same, or by various ingeniously devised forms of apparatus. Practical experience shows that, with ordinary care and some practice, an organism may be absolutely isolated and cultivated through scores of generations with little risk of failure.

Isolation of Micro-organisms.—It is evident from the above that when a micro-organism is present in a fluid or in the tissues in a pure state, its cultivation is generally a matter of little difficulty. All that is necessary is to transfer to the culture-medium in a test-tube a small quantity of the material containing the micro-organism, by means of the sterilised platinum needle. If the medium is solid, the inoculation is made either in the form of a 'stroke' on the surface, or a 'puncture' into the substance of the medium. When several varieties of organisms are present together, various methods have been devised for separating them; and of these the 'plate-cultivation' method, introduced by Koch, is the most useful and most commonly used. The principle of the method is that single organisms in suitable conditions give rise to single colonies of the same organism; and that accordingly, if the colonies are sufficiently separate from one another, pure cultivations can be made from each.

To accomplish this, three or four test-tubes containing peptone-gelatine are taken, and their contents are thoroughly liquefied at about 38° C. One is then inoculated by a platinum needle with a drop of fluid containing the organisms, and its contents are thoroughly shaken so as to distribute the organisms uniformly. Two or three drops of the mixture are then transferred to a second tube, which is also thoroughly shaken. A third is inoculated from the second, and sometimes also a fourth from the third, in the same manner. The contents of the tubes are then poured out in succession on sterilised flat glass-plates or shallow glass-capsules, and allowed to solidify. The plates are then placed in a sterile moist chamber, and allowed to remain till signs of growth appear. In the first, and probably in the second plate, the number of colonies arising from single organisms will generally be too great to allow a satisfactory separation; but in the third, a small number of scattered colonies may appear, and separate test-tubes may be inoculated from any of them by means of a fine platinum needle. The colonies of different bacteria in plate-cultivations present different appearances, according to the colour and form of the colony, the characters of its margins and surface, the position in the medium, and its liquefying the medium or not. This method, therefore, affords a valuable aid in distinguishing different species.

In the case of organisms which do not grow at ordinary temperatures, gelatine plates are not suitable, and agar must be used, or a mixture of agar and gelatine, &c. The agar requires a high temperature to liquefy it (generally about 90° C.), but it remains in the fluid condition down to 40° C., at which temperature it is used.

Instead of using plates, Esmarch rolls the tubes containing the liquid gelatine under a stream of cold water, so that the gelatine forms a thin solid layer lining the tubes. The growth of the colonies in the gelatine layer can then be very conveniently watched.

Modes of Staining Bacteria.—In staining bacteria we employ almost exclusively the basic aniline dyes, which are found to stain all known bacteria with greater or less readiness (though for such as tubercle bacilli special combinations must be used); and of these, methyl blue, fuchsin, methyl and gentian violet are the most suitable. In examining cultures microscopically, a small portion of the culture may be broken down and mixed with a few drops of a weak watery solution of one of these colours; a cover-glass is then placed over the fluid, and the examination made. In order to observe the movements of the organisms, it is better to examine them first simply in distilled water, and they may be coloured afterwards by placing a drop of the staining solution at the edge of the cover-glass, and allowing it to mix with the water. Permanent preparations of pure cultures are best made by spreading a small quantity of the culture on a cover-glass (if the culture is solid a small quantity ought first to be mixed with a sterile fluid), allowing it to dry, and then passing it two or three times through a gas-flame. The film may then be stained by floating the cover-glass on a weak watery or alcoholic solution of one of the above-mentioned stains; or some of the special staining methods may be used, and for certain bacilli this is necessary. Fluids containing bacteria, the juice of tissues, &c., may be examined in a similar manner.

In staining bacteria in sections of tissues, in fluids rich in cells, &c., the tissue-elements are apt to become stained in such a way as to obscure the organisms, and accordingly various methods have been devised in order to remove the stain wholly or partially from the tissues, and leave the bacteria coloured. The principle of all these methods is the same, namely, the employment of chemical agents along with the stain, which aid its penetrating power, and tend to fix it in the bacteria—mordants, for example, aniline oil, carbolic acid, tannin, and various metallic salts; and the subsequent treatment with decolorising agents, such as weak alcohol, acetic acid, and mineral acids, in order to remove the excess of stain. The combinations of stain, mordant, and decoloriser are very numerous; of the mordants, aniline oil and carbolic acid are the most commonly used. One of the most useful combinations is gentian violet with aniline oil, made as follows: A watery solution of aniline oil is made by shaking about 5 parts of aniline oil in 100 of water; this is filtered, and there is then added to it 5 to 10 parts of a saturated alcoholic solution of gentian violet; the mixture is then carefully filtered. Sections are stained in this for a few minutes or longer (according to the properties of the bacteria), and then decolorised by a weak solution of acetic acid to the required extent. Another well-known solution is Ziehl's carbol-fuchsin solution, whose composition is: Carbolic acid, 5 per cent. in water, 100 parts; alcohol, 10; fuchsin, 1. Kühne's carbolic methyl-blue solution is made in the same way, methyl blue being used, in somewhat larger proportions, instead of the fuchsin. The sections may be afterwards decolorised in acetic acid or alcohol. We have found this a most useful stain for general use. Alkalis as a rule increase the staining power of the aniline dyes, and accordingly we have various combinations of methyl blue or violet with carbonate of ammonium, potash, &c. An excellent formula is that of Löffler—30 cc. of a concentrated alcoholic solution of methyl blue, added to 100 cc. of a weak solution of caustic potash, 1 : 10,000. Sections are stained for varying lengths of time, generally about half an hour, and then decolorised by weak acetic acid.

By these various methods the nuclei of the tissues also retain their colour to a greater or less extent; and a method has been devised by Gram by means of which a staining of the bacteria alone is obtained. In this method the iodine forms with the gentian violet a combination within the micro-organisms which remains after the nuclei have lost their colour. Sections, &c., are first stained in the gentian violet aniline-water solution, are washed in water, and are then placed for about two minutes in the iodine solution (iodine 1, iodide of potassium 2, water 300). They are then washed repeatedly in alcohol till the colour is almost completely discharged, and the tissues can then be counterstained by eosin, picro-carmine, &c. Günther has modified the method by placing the sections in weak hydrochloric acid (3–5 per cent.) for ten seconds after they have been half a minute in alcohol, and thus removes a precipitate of the stain which is sometimes liable to form. Gram's method, though excellent for many purposes, is not universally applicable, as it is found that many bacteria lose the colour along with the tissues during the washing with alcohol; and accordingly, in the description of the various species of bacteria, one of the points generally stated is whether or not they become decolorised in Gram's method, though many of the statements made are too absolute.

In order to obviate the decolorisation which occurs in the case of some bacteria during the process of dehydration with alcohol, various means have been employed, one of the best of which is that of Weigert. In this method the sections, after being stained in an alkaline gentian violet solution, are dehydrated with pure aniline oil, cleared in xylol and mounted in balsam. One of us has also found that sections of tissues embedded in paraffin can be stained in a very simple manner. The sections, which ought to be as thin as possible, are floated on the surface of a weak solution of the aniline stain, and the liquid is very gently heated. The sections become quite flat, and the stain is seen to penetrate into the tissue After a few minutes they are washed well on the surface of water, placed on a slide, and allowed to dry. The paraffin is then removed by xylol and the section is mounted in balsam. By this method bacilli which are decolorised with the greatest readiness with alcohol remain deeply coloured, whilst the strength of the stain and the time of staining can easily be regulated so that the tissues are not over-stained.

Tubercle bacilli afford an example of micro-organisms which do not readily take up the stain, but they retain it with great tenacity. Various methods have been devised, the best being probably the Ziehl-Neelsen method. Films of sputum, &c., are stained with the carbol-fuchsin solution, and heated till steam arises, for three or four minutes. They are then decolorised in dilute sulphuric acid (20 per cent.), till the colour is almost gone, then they are placed in water. The acid is then thoroughly removed by washing in water, and they may be counterstained by placing them in a watery solution of methyl blue for one or two minutes. The tubercle bacilli are thus stained bright red; the tissues and other bacteria are stained blue. The heating facilitates the penetration of the stain and accelerates the process; but it is better to stain sections for a longer time in the cold (seven to eight hours), as they are apt to become crumpled by the heating. The process of staining can be still further shortened by combining the processes of decolorising and counterstaining by means of the following solution: Water 50 parts, alcohol 30, nitric acid 20, methyl blue to saturation. Sections, &c., after being stained in the carbol-fuchsin solution, are placed in this for about a minute, and are then washed in water, &c. (B. Fraenkel). Further details will be given in the description of special organisms.

Staining of spores.—In ordinary staining with gentian violet, &c., the spores of bacilli do not generally take up the stain, but appear as bright uncoloured points. By using the carbol-fuchsin solution, however, with the assistance of heat, they can be coloured, and if a strong decolorising agent be then used it is found that the cells lose their colour whilst the spores retain it. A contrast stain such as methyl blue may then be used. This method succeeds well in the case of some bacilli (*B. subtilis*), but not of all; and as it is somewhat uncertain in its results it cannot be always relied upon as a test for demonstrating spores.

Staining of flagella.—Löffler's method for demonstrating flagella consists of two stages—first, treatment with a mordant; secondly, the application of the staining solution. The mordant has the following composition: 10 cc. of a 20 per cent. solution of tannic acid, a few drops of a saturated solution of ferrous sulphate, and 4 to 5 cc. of logwood infusion (logwood chips 1, water 8). A few drops of this are placed on the cover-glass preparation, and the fluid is heated for a minute or two till steam arises. The cover-glass is then washed in water; and we have found that a very prolonged washing is necessary for a successful result. The preparation is then stained, Löffler's special stain having the composition—Saturated watery solution of aniline oil 100, solution of caustic soda (1 per cent.) 1, gentian violet in powder 4; the mixture being thoroughly filtered.

Relations of Micro-organisms to the Living Body.—It may now be accepted as an established fact that the healthy tissues and fluids within the substance of the body are free from microbes. But the surfaces, both external and internal, constantly teem with them in the most varied forms. Doubtless a large proportion of these are of innocuous character, in however large quantity they might enter the blood; although by artificial cultivation some of these forms can be produced in sufficient quantity to be toxic if injected. And since some pathogenic forms, which are common, must frequently come into contact with the various mucous surfaces and the skin, we cannot exclude them from consideration.

The mechanism, so to speak, by which this bacterium-free condition is maintained during healthy life has been the subject of much experiment and controversy. Since foreign particles of various kinds, much larger than microbes, can and do enter the lymphatics (and blood-vessels) of the air-passages, alimentary canal, and even the skin, it is certain that microbes can also enter. Experiment has shown that even if large quantities of certain cultivations are injected subcutaneously or into the blood-stream, they rapidly disappear, and in some cases after a few hours they can hardly be detected in the blood, or even in the lungs, spleen, and kidneys, where they appear to be largely arrested. Those discovered are often in various stages of degeneration or decay, and sometimes many are contained in leucocytes and connective-tissue corpuscles.

According to some, it is especially by the activity of leucocytes and connective-tissue corpuscles that micro-organisms are destroyed. Of late years this view has been especially developed by Metchnikoff and his followers, who have alleged for some leucocytes the special *rôle* of *phagocytes*, ingesting, amœba-like, noxious foreign particles, and having as one of their highest functions the elimination of microbes. That such a part is played by leucocytes and by connective-tissue and by other cells which have considerable amœboid activity (epithelia of pulmonary alveoli and of peritoneum), has long been admitted; and this not merely for the absorption of living organisms, but also for other particles, such as molecules of decayed protoplasm, effete hæmocytes, pigment particles, &c. But whilst they react in a similar manner in relation to microbes, the latter may continue active and germinate in the leucocytes, and may in some cases cause their destruction.

That the freedom from organisms is not solely due to the leucocytes is shown by the fact that blood-serum and other materials, which are free from leucocytes, also exert a destructive influence upon microbes. The freedom from bacteria may therefore be regarded as due in part to the fact that the healthy fluids and tissues of the *living* body exert an antagonistic action to, or do not serve as a suitable soil for, the growth of bacteria. The chemical or physical nature of the antagonistic condition is a highly important question, and one which at present is being closely investigated. That the antagonistic condition may be a very minute chemical change is suggested by the facts of immunity, natural or acquired, and by modified susceptibility under variations of nutriment.

The power of resistance to inoculation or infection may be extremely slight for some kinds of microbes; where it is considerable, it may be insufficient to resist a large dose of the virus. Direct experiment has shown that by great increase of the number of the organisms introduced, or by repeated inoculations, pathogenic effects may be produced, even where the power of resistance is great. Resistance to one microbe may be lowered by the previous or concurrent activity of another. The introduction of unorganised ferments into the blood (*e.g.* papayotin) may, it is alleged, so diminish the normal resistance, that the common forms of bacteria readily enter into and multiply in it.

During the last stages of life, and apparently also in some conditions of disease, the power of resistance may be so lowered that common bacteria are found in the blood, and penetrate more deeply into the tissues with which they are normally in contact—*e.g.* in the alimentary system. But it must be remembered that resistance to the entrance of microbes, and resistance to the effects of pathogenic microbes, are two entirely different orders of facts, and can only be used to explain one another within restricted limits.

Some general statements may here be briefly made as to our present standpoint on the subject of contagion and immunity. These statements are intended only to represent what we have strong evidence for believing, but what as yet is not fully and generally proved.

The pathogenic activity of a microbe in any given case is dependent upon—

1. As regards the virus:—the active vitality of the organism, its stage of development, the nature of the nutrient medium or soil on which it has grown, the quantity of the dose, and the presence in the virus of unorganised ferments or other substances, usually generated by the growth of the microbe, which lower the vitality locally of the tissues, or generally of the body, into which the virus enters. Such substances may in some cases be generated by the concurrent action of other microbes.

2. As regards the individual:—the inherent or acquired capacity of resistance (of unascertained nature), the healthy activity of the leucocytes and other cells, and the normal healthy condition of the fluids of the body. Under this head must be included the absence of any local deterioration or area of malnutrition or necrosis, which can afford a nidus for the development of the microbe within the body.

And, further, in so far as the known facts of contagious or infectious diseases can be accepted as evidence, the presence and activity of one virus may prevent or retard the action of another equally potent, but may tend to render the individual more susceptible at a later period.

Some medicinal substances may also possibly prevent the activity of the virus, but as yet our experimental knowledge is very limited. Thus corrosive sublimate in considerable doses may fortify against anthrax inoculation (Cash). A wide field is here open for future investigation.

And, lastly, the facts of immunity acquired by an attack of some diseases have laid the foundation for protective inoculation by a modified or attenuated virus.

Some of the facts bearing upon the statements here made will be briefly mentioned under the head of various diseases.

RELATIONS OF BACTERIA TO SPECIAL DISEASES.—In considering the various diseases associated with bacterial infection, we find that in some the evidence that they form the virus is absolute, in others it is incomplete in varying degree, whilst there are some which from their close analogy, and from some partial evidence, may be provisionally included in the list.

In studying individual diseases and their relation to bacteria, we may conveniently group together those which have close analogies either in their clinical and pathological features, or in the characters of the organisms which produce them. Some of these groupings will be fairly accurate from a scientific standpoint, others can be only provisional. The advantage of such grouping lies in the fact that it avoids much repetition, and facilitates the study of allied diseases. But it must not be regarded as anything more than a convenient mode of arrangement with our present knowledge.

GROUP I.—(1) Suppuration (especially in acute and spreading forms), Pyæmia, and Septicæmia; (2) Osteo-myelitis or Acute Necrosis; (3) Ulcerative Endocarditis; (4) Erysipelas; (5) Gonorrhœa (grouping doubtful); (6) Acute Pneumonia (grouping doubtful).

GROUP II.—(7) Malignant Œdema; (8) Tetanus.

GROUP III.—(9) Tubercle; (10) Leprosy; (11) Glanders; (12) Actinomycosis; (13) Rhinoscleroma; (14) Syphilis.

GROUP IV.—(15) Cholera; (16) Relapsing Fever.

GROUP V.—(17) Anthrax; (18) Diphtheria; (19) Typhoid; (20) Epidemic Influenza.

GROUP VI.—Diseases in which, though

alleged by some, there is as yet no sufficient evidence of bacterial origin.

And it seems desirable to append a brief account of the micro-organisms of malarial fevers, although they are not bacterial in nature.

Group I.—*Suppuration, Pyæmia and Septicæmia, and 'Wound-Infection Diseases' in General.*—This group includes those common 'septic' conditions which are frequently the sequel of wounds and allied conditions. They are usually associated either with suppuration or spreading inflammation, and more or less intense blood-poisoning. They are produced by various bacteria, of which some are common, others rarer causes. To some extent the form of disease produced is dependent on the mode of introduction or on special conditions which modify the action of the virus. Thus, the organism of osteomyelitis can produce ulcerative endocarditis, as can also certain other bacteria. What we call erysipelas may be produced by various bacteria, *e.g.* experiments on the lower animals have shown that the bacillus of mouse-septicæmia, a blood-disease in mice, causes local erysipelas in the ear of a rabbit. But in man, experience shows that the commonest causes are few and well defined.

Under this head should also be included the various forms of Infectious Gangrene, such as 'hospital' gangrene, cancrum oris, &c. But our knowledge of these conditions is, as regards man, too incomplete to allow of any definite statements, and we have therefore not discussed it separately.

1. Suppuration, Pyæmia, &c.—To avoid ambiguity, it may be stated that we look upon suppuration as a sequel of inflammation under certain circumstances in which, by gradual accumulation of leucocytes which have passed from the blood-vessels, and gradual liquefaction of the tissue-elements, the part affected becomes occupied by the cream-like fluid known as pus. Such a process, after starting at one point, may spread to a greater or less extent, and sometimes occurs in association with similar lesions in various parts of the body. Suppuration is accordingly to be distinguished from those conditions in which, by the action of a severe irritant, a co-extensive local necrosis of the tissue occurs, which may afterwards undergo some softening. Some of the most important questions in connexion with this subject are: Can suppuration occur apart from the action of micro-organisms? What organisms are generally concerned in the process? And what is the relation of strictly local abscess-formation to those conditions in which so-called metastatic abscesses occur, and which are commonly grouped under the head of *pyæmia*?

Whilst various pyæmic conditions present the characters generally associated with diseases of bacterial origin, the theory that suppuration is in all cases caused by micro-organisms might *à priori* be open to doubt. Partly, however, as the result of early bacteriological investigations, partly as the result of the antiseptic treatment of wounds, the belief gained a wide currency that without bacteria suppuration could not occur. Within recent years, extensive series of experiments have been performed by various workers in order to determine whether suppuration can be produced by a simple chemical substance. The methods of performing these experiments have been various. In some, the substance to be tested was simply injected under the skin with antiseptic precautions, the puncture being closed immediately afterwards; but as this was open to certain objections, the method was devised of placing the chemical substances in sealed glass tubes, which were introduced into the tissues, and were broken after the external wound had healed. In others, again, the tubes had sharp ends, so that after a time they could be moved under the skin to another part of the body and there broken. Though it has been clearly proved by such experiments that in most cases suppuration does not follow, and that its occurrence is not dependent upon the intensity of the irritant, yet many observers (Councilman, Grawitz and De Bary, Steinhaus, Christmas, and others) agree in finding that certain chemical substances (*e.g.* nitrate of silver, mercury, &c.) can produce local abscesses, whose contents can be shown by inoculation on culture-media to be free from the ordinary pyogenic organisms. Amongst the substances found to be capable of producing suppuration in this way are the chemical products of several of the pyogenic bacteria.

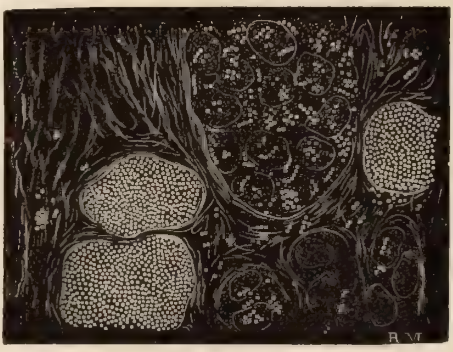

Fig. 75.—Masses of Micrococci (Staphylococci probably) in the vessels in 'surgical' kidney.

But even if it be admitted that pus, with all its essential characters, can be produced by the action of a simple chemical agent, much more important questions must be answered, namely, What are the actual causes of suppuration as met with clinically? What organisms are present? and Have they pyogenic properties?

Amongst the first to demonstrate the presence of bacteria in ordinary suppuration was Ogston of Aberdeen, who, in a paper published in 1881 (*Brit. Med. Journ.* 1881, i. p. 369), described the practically invariable presence of micrococci in acute abscesses, and affirmed them to be the causal agents in the process. Some of these organisms, from their growing in the form of clusters, he called *Staphylococci*; to others which grew in the form of chains he applied the name *Streptococci* (previously given by Billroth). The former he found to be specially associated with circumscribed abscesses; the latter with spreading erysipelatoid suppurations—facts which have since been confirmed ('Micrococcus-Poisoning,' *Journ. Anat. and Phys.* 1882-3). Shortly afterwards Rosenbach (*Mikroorganismen bei den Wund-Infectionskrankheiten des Menschen*, 1884), by means of solid culture-media, obtained pure growths of these organisms, and separated several distinct species. The three most important of those he called *Staphylococcus pyogenes aureus*, *Staphylococcus pyogenes albus*, *Streptococcus pyogenes*; whilst another, less frequently met with, he called *Micrococcus pyogenes tenuis*. Other organisms have been found in acute abscesses, *e.g. Staphylococcus pyogenes citreus*, *Staphylococcus cereus albus*, *Staphylococcus cereus flavus*, *Bacillus pyogenes fœtidus* (Passet, *Fortschr. d. Med.* 1885, Nos. 2 and 3), *Bacillus pyocyaneus*, &c.

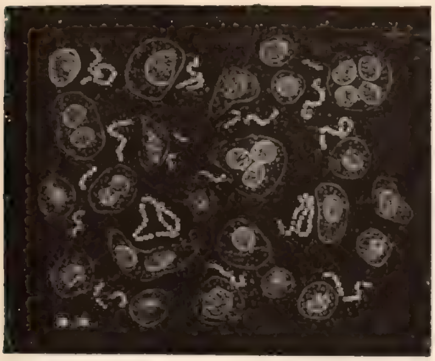

Fig. 76.—Streptococci in Fœtid Sputum. × 800 diam.

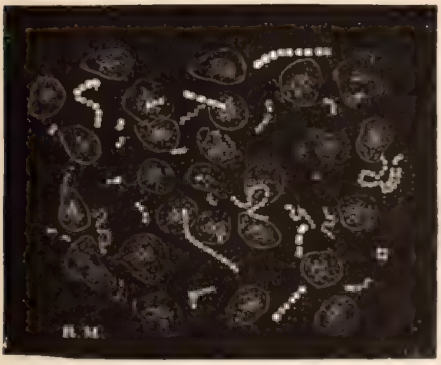

Fig. 77.—Streptococci of Suppuration.—Dried pus from an empyema of some duration. Showing chains of streptococci, some of which are swollen, probably from degenerative changes. × 800 diam.

Staphylococcus pyogenes aureus.—The most frequently present of these organisms, and that which has been the subject of most investigation, is the *Staphylococcus pyogenes aureus* (yellow cluster-coccus, *Gelbtraubencoccus*). This organism, when grown on culture-media, has certain characteristics which render its recognition comparatively easy. In puncture-cultivations on gelatine, growth is seen first (in about twenty-four hours at the ordinary temperature) as a greyish-white line along the needle-track. The growth soon assumes a yellowish colour, and, as liquefaction of the gelatine rapidly occurs around it, forms a flocculent mass at the junction of the fluid and solid portions, being afterwards of bright orange colour. If a stroke-cultivation be made on agar a similar growth takes place along the line, which soon shows a bright orange colour; and as its surface is smooth and shining, its appearance has been aptly compared to a streak of orange oil-paint on the surface of the medium, which does not undergo any liquefaction. It also grows on potatoes, producing here also the characteristic yellow colour. Its growth on these media after a few days has a peculiar sour smell. On gelatine-plates it grows as minute round points, which soon reach the surface, and then liquefaction occurs around them, so that small masses of growth are seen lying in small cups, the centres of growth having by this time acquired a yellowish colour. In

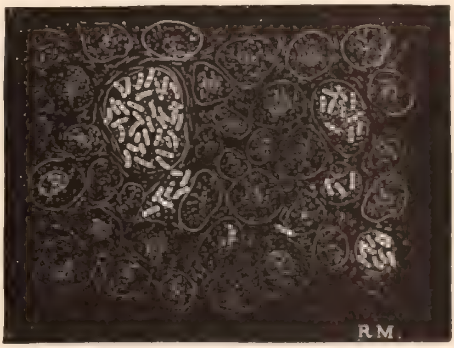

Fig. 78.—Multiple Suppurative Septic Nephritis ('Surgical Kidney').—Shows short bacilli in capillaries and in cells. × 800 diam.

its growth on gelatine a considerable amount of peptone is produced—a fact which has been employed to explain some of the phenomena of suppuration. It renders the medium acid, and hence causes coagulation of milk, in which it readily grows. It is capably anaërobic, but when it is grown in the dark and in the absence of oxygen the yellow colour is not produced. As has been already mentioned, it stands a higher temperature than most bacteria, and has great tenacity of life, fresh cultivations being sometimes readily made from cultures more than a year old. Microscopically, the growth is found to consist of spherical cocci about ·9 μ in diameter, which are seen growing in the form of large masses or clusters.

Staphylococcus pyogenes albus. — The *Staphylococcus pyogenes albus* has similar characters to the preceding, with this exception, that its growth never assumes a yellow colour, but is always white. The two species, however, are quite distinct from one another, and all attempts to permanently deprive the aureus of its power of producing the yellow pigment have failed.

Streptococcus pyogenes. — The *Streptococcus pyogenes* grows more slowly than the two organisms just described, and differs from them also in that it never causes liquefaction of the gelatine. In gelatine puncture-cultivations a faint line first appears, which may be seen by means of a lens to consist of numerous minute points, of a whitish translucent appearance. These gradually enlarge and appear as round discrete centres, which rarely exceed a pin's head in size, though fresh centres may form around them. On the surface of agar, growth takes place in a similar manner on either side of the stroke, giving a characteristic fernleaf-like appearance. Little or no growth occurs on potatoes. Microscopically, the growth is seen to consist of spherical cocci a little larger than the staphylococci described, generally growing in the form of chains, which may contain many cells, also occurring singly and in pairs. The same characteristic arrangement is seen when the organism is growing in the tissues.

All these three organisms stain readily with Gram's method.

Coming now to consider the association of these organisms with acute suppurative conditions, we find a wonderful agreement in the observations of a great many independent workers. The original statement of Ogston, that in all acute abscesses the presence of micrococci can be demonstrated, has been proved by subsequent extensive researches to be a law to which there are few, if any, exceptions. The researches of Rosenbach, Passet, Garré, Krause, Watson Cheyne, and many others may be mentioned in this relation. Sometimes only one kind of bacterium is found, sometimes two or more together, the most frequently present being the three micrococci above described; and of these the Staphylococcus pyogenes aureus is perhaps the commonest. These organisms have been found in the utmost variety of suppurative conditions—whitlows, boils, subcutaneous abscess, diffuse phlegmon, empyema, &c. In some chronic abscesses, as Ogston stated, it may be impossible to detect their presence.

Are these organisms, then, the cause of the suppurations with which they are associated? In considering the experimental side of the question we may take the *Staphylococcus pyogenes aureus*, as it has been the organism most commonly employed. At the outset it may be stated that its power of producing suppuration depends upon the number of micrococci injected; and that number varies not only for different animals, but for different parts of the same animal, for example, suppuration is much more easily produced in the anterior chamber of the eye than in the peritoneum. When introduced into the subcutaneous tissue (most conveniently as an emulsion in neutral salt solution) it produces a local abscess with typical characters. Shortly after being injected, the cocci multiply in the connective-tissue spaces, and are found not only lying free, but also within the leucocytes, connective corpuscles, and the endothelium of capillaries. Inflammatory action rapidly supervenes, and leucocytes pass in great numbers into the tissues from the capillaries, the emigration progressing till the tissue appears quite filled with leucocytes of the multinucleated type, in many of which micrococci may be seen. At the margin of the affected area cocci are still found lying free in the lymphatic spaces. As the aggregation of leucocytes becomes more and more marked, the connective-tissue elements undergo softening and liquefaction, the ultimate result being that the part affected becomes occupied by typical pus. The spread or arrest of the suppuration depends upon the growth of the micro-organisms. In favourable cases this ceases after a time, and the process of repair sets in.

The liquefaction of the tissue-elements, and the non-coagulability of the inflammatory exudation, have been ascribed to the peptonising power of the organism; and the vascular phenomena, in part, to the actual invasion of the capillary walls by the organism, though chiefly to the action of its chemical products. According to late observers (*e.g.* Steinhaus, Christmas) the sterilised cultures of Staphylococcus pyogenes aureus have also the power of producing suppuration, and Brieger has isolated a tox-albumin which he finds to have the power of producing suppurative liquefaction of the tissues.

It may also be mentioned that experiments with this organism have been made on the human subject. Garré (*Fortschr. d. Med.* 1885, No. 6) inoculated Staphylococcus pyogenes aureus on a few small scratches near the root of the finger-nail, and produced a small cutaneous abscess; and by rubbing a cultivation on agar into his arm he caused a carbuncular condition, which only healed after some weeks. Bockhart and Bumm have confirmed the observations of Garré.

Staphylococcus pyogenes albus has the same pyogenic properties, but many observers have found that it is less virulent in its action. *Streptococcus pyogenes* in its growth in the tissues has rather a tendency to spread by the lymphatics over a wide surface, than to form a local abscess. It causes suppuration when injected into the serous cavities and joints, and clinically is often met with in those positions when suppuration is present. Several other organisms have been proved to possess pyogenic properties.

Injection of Staphylococcus pyogenes aureus into the blood produces effects according to the dose: if the amount be small no result may follow, if very large the animal dies with septicæmic symptoms within a few hours. If the animal survive a large injection for more than a day, changes often occur which form a type of what is seen in various pyæmic conditions in the human subject. For a time after the injection the organisms can be found in the blood, but they gradually disappear from it, and are found in the capillary walls, kidneys, liver, &c. According to Lübbert (*Der Staphylokokkus pyogenes aureus, &c.* 1886) and Krause (*Fortschr. d. Med.* 1884, Nos. 7 and 8), they also pass into the urine, and can be cultivated from it; but this probably occurs only after the organisms have actually grown into the tubules, and cannot be regarded as a true excretion, as some have supposed. Of the changes found after twenty-four hours, the most constant are those in the kidneys. Under the capsule are seen a number of paler points, surrounded by a zone of intense injection, and corresponding to those there are found on section numerous areas of pyramidal or oblong shape in the cortex, while in the medulla pale streaks or lines of pale dots are seen running between the tubules. Microscopically, many of the small arteries and capillaries in these areas are seen to be plugged with collections of micrococci, whilst these are also found in the lining of other vessels, both arteries and veins. In the tissue surrounding these vessels micrococci may be found, and the cells of the tubules show necrotic change, while at the margin infiltration of leucocytes is seen. Later the affected areas undergo purulent infiltration and softening, and form small abscesses. Quite analogous changes are found in other parts of the body, though less constantly than in the kidneys. In the muscle of the heart small vessels may be plugged in the same way, the fibres around being the seat of necrotic change with infiltration of leucocytes, leading ultimately to foci of acute suppurative myocarditis. Abscesses are also occasionally produced in the ordinary striped muscles, in the joints, under the periosteum, and in the medullary cavities of bones.

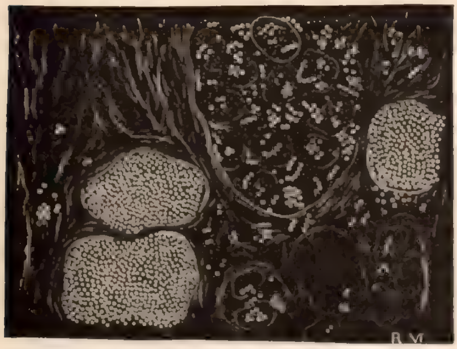

FIG. 79.—Micrococci in capillaries of kidney in Multiple Septic Abscess. Showing masses of cocci like Staphylococcus pyogenes aureus.

Similar phenomena are sometimes observed in the human subject in cases of ulcerative endocarditis and osteo-myelitis; and though ordinary pyæmia presents some differences, these are to be explained by its method of production. In pyæmia the series of events generally starts with a septic phlebitis caused by an external wound, and associated with the formation of a thrombus which afterwards softens and becomes the source of emboli. The softening of the thrombus is for the most part due to pyogenic organisms, though others may be associated with them; and as the portions of softened thrombus are in the course of the circulation carried first to the lungs, and there plug the pulmonary vessels, pulmonary abscess is an almost constant feature in the common form of pyæmia. In experimental intravenous injections of staphylococci, on the other hand, points of suppuration are very rarely found in the lung, as the organism seems unable of itself to gain a foothold and flourish in the lung-tissue. Various organisms have been cultivated from pyæmic abscesses and from the blood in pyæmia, but by several observers a streptococcus has been found to be most frequently present, and Rosenbach considered it the chief organism concerned, though not regarded as specific. The rare occurrence of 'metastatic' phenomena in the course of ordinary suppuration is probably to be explained by the fact that, even if a few organisms do enter the blood, their growth is arrested by the bactericidal power of the serum and leucocytes, as is shown by direct experiment. If, however, there be a weak locality to which they are carried by the circulation, they may there undergo development, and from that point as a focus secondary infection may occur.

We may therefore conclude that practically all cases of acute abscess-formation occurring under natural conditions, as observed clinically, are due to the growth of bacteria; that there is not one specific organism of suppuration; but that several organisms have pyogenic properties, though the three species of micrococci above described are those most commonly present. The results vary according to a great many conditions, and especially as to whether or not the organism obtains a foothold in the blood. The actual virulence of the bacteria has also been found to vary under different conditions, as is the case in so many diseases.

2. Osteo-myelitis and Acute Suppurative Periostitis (Acute Necrosis).—

In 1883 Becker (*Deutsch. med. Woch.* 1883, No. 46) cultivated a micrococcus from the pus in cases of osteo-myelitis, which he considered to be peculiar to the disease. Shortly afterwards Krause confirmed his observations as regards its presence and characters, but after careful observations and experiments found it to be identical with the Staphylococcus pyogenes aureus. His conclusions have been confirmed by Rosenbach, Passet, and many others; and there is now little doubt of the identity of the two organisms. The micrococci from osteo-myelitis have been injected subcutaneously and have produced local abscesses; and, on the other hand, staphylococci from abscesses, &c., when injected into the circulation produce the same results as those from osteo-myelitis. As regards the presence of organisms in osteomyelitis, it may be stated from a comparison of the results of many different observers that Staphylococcus pyogenes aureus is the organism most commonly present, less frequently Staphylococcus pyogenes albus and Streptococcus pyogenes; here, too, as in ordinary abscesses, more than one kind of organism may be present. Some cases are also recorded of osteo-myelitis due to the pneumonococcus (Fraenkel's), and in one or two other cases other organisms have been found. The invariable presence of bacteria in the disease is a well-established fact.

It has already been mentioned that foci of suppuration in the bones sometimes occur as a result of the intravenous injection of Staphylococcus aureus, but on this point various observers have obtained different results. Some have failed to find the lesions (Lübbert), whilst others have found them frequently, and some have produced a large abscess when the bone was broken or crushed before the injection. The small abscesses are found under the periosteum, in the substance of the bone, and in the medullary cavity. It has also been found that young animals are especially liable to become affected in the bones (Colzi). Lannelongue and Achard (*Ann. de l'Instit. Past.* April 1891) found these abscesses frequently in their experiments, not only when Staphylococcus aureus was used, but also when Staphylococcus albus and Streptococcus pyogenes were injected. They found Staphylococcus albus to be less virulent than Staphylococcus aureus, and they found certain peculiarities in the case of Streptococcus which accorded with some features of osteo-myelitis due to this organism which they had investigated clinically. The foci of suppuration in these experiments are generally of smaller size than in the human subject, but otherwise closely correspond in their characters. We must also bear in mind that the condition in clinical cases and in experiments are not exactly the same, for in the latter a large number of organisms are introduced suddenly into the blood, some of which settle in the bones—in the former probably a small number at first take root in a specially susceptible nidus.

We must therefore consider it proved that the cause of acute suppurative periostitis, and allied conditions, is the growth of certain pyogenic organisms (especially the Staphylococcus pyogenes aureus) under the periosteum of bones, in the marrow, &c., under conditions specially favourable for their development. It may also be noted that in the course of this disease secondary lesions are sometimes met with in the kidneys and other organs, which are quite similar to those produced by the intravenous injection of Staphylococci.

3. Ulcerative Endocarditis. —

This condition has for a considerable time been believed to be due to micro-organisms, and the microscopic examination of a great many cases has revealed their presence, chiefly in the form of micrococci, in the diseased valves. These organisms are sometimes present in enormous numbers, and by their growth cause a necrotic change in the tissue-elements, which is followed by ulceration, and by embolism in various organs. Cultivation-experiments have shown the organisms present to be chiefly pyogenic organisms of various kinds, the most common being Staphylococcus pyogenes aureus and Streptococcus pyogenes. These cultivations have been made by many independent observers, and considerable harmony prevails amongst their results.

It has been observed that in some cases of the disease the ulcerative condition has supervened on a simple endocarditis, especially of the vegetative form, whilst in others it is apparently primary. The former condition has been experimentally imitated by Orth and Wyssokowitz (*Centralb. f. d. Med.*

Wis. 1885, No. 83), who injured the aortic valves by a rod introduced through the right carotid artery, and afterwards injected staphylococci into the blood. The micrococci were by this means enabled to gain a foothold at the injured spot, and ulcerative endocarditis followed. Ribbert (*Fortschr. d. Med.* 1886, No. 1), however, afterwards found that by introducing certain quantities of an emulsion of a potato-culture of Staphylococcus pyogenes aureus (there being in the injected fluid small fragments of potato containing micrococci), an endocarditis could be set up on the mitral and also on the tricuspid valves, without any previous injury to these valves. In some cases the small fragments appear to have become arrested at the attachment of the chordæ tendineæ, and thus the organisms were brought into closer and longer contact with the endothelial surface. They formed at first a layer on the surface of the endothelium, but afterwards grew into the substance of the valves, whilst thrombi formed over them. In the course of ordinary intravenous injections of Staphylococcus aureus, Lübbert found that endocarditis was produced in one case only.

In some cases of ulcerative endocarditis occurring in the course of or following croupous pneumonia, Fraenkel's pneumonococcus has been found to be the organism present; and Netter (*Archiv. de Phys.* 1886, p. 106), after cultivating this organism from the ulcerated valves, produced endocarditis experimentally by a similar method to that employed by Wyssokowitz. He found, however, that not all the cases of ulcerative endocarditis associated with pneumonia were due to pneumonococci, for in some streptococci alone were present. In other cases still, bacilli of different kinds have been found in the diseased valves—one of which was traced by Martha and Netter to an abscess in the liver, in which the same organism was present.

It may therefore be stated that a variety of organisms may cause the ulcerative lesion on the heart-valves, especially if they have been the site of previous disease, but that staphylococci and streptococci are most frequently the causal agents.

4. **Erysipelas.**—A spreading inflammatory condition of the skin, attended with redness, can be produced by a great many causes, and especially by several varieties of micro-organisms—for example, an erysipelatous condition is sometimes produced by the bacillus of anthrax. Nevertheless, cutaneous erysipelas as met with in the human subject is a fairly typical disease; and it is to this disease, or rather perhaps to its most common variety, that the following statements apply.

Erysipelas, besides presenting some peculiar problems, is also of interest because its contagium was at a comparatively early period proved to be of bacterial nature, by experiments actually performed on the human subject. Though the presence of organisms in the lymphatics of the affected area in erysipelas had been observed before (first by Lukomsky and v. Recklinghausen), Fehleisen (*Die Aetiologie des Erysipels*, Berlin, 1883) was the first to isolate and cultivate an organism which he found capable of producing the disease, and which he affirmed to possess distinctive characters. This organism he called *Streptococcus erysipelatis*. Its characters, however, closely resemble those of the Streptococcus pyogenes, and there has been much discussion as to whether the two organisms are the same. The differences in the manner of growth of the two organisms on culture-media, at first stated to exist, have since been found by most observers to be insufficient to distinguish them, and inoculation-experiments on animals have given practically similar results. Passet found by inoculating the ear of a rabbit that an erysipelatous condition was produced by both organisms, but that the action of Streptococcus pyogenes was rather more severe—whilst other observers have failed to find any difference in their mode of action in animals. It has also been stated that the Streptococcus erysipelatis is capable of producing suppuration. It is accordingly the opinion of many authorities that the same organism is concerned in the production of both conditions, and that it depends upon the point at which the organism settles and multiplies after inoculation, and on other conditions, whether erysipelas or a spreading cutaneous suppuration is produced. The question cannot be fully discussed here, but this explanation seems scarcely in accord with clinical facts, for erysipelas once started has the tendency to spread from case to case as erysipelas, and its whole course is that of a disease due to a special organism brought from without. It therefore appears possible that, though they cannot be distinguished by their manner of growth, there are really two or more distinct species, one of which commonly produces erysipelas in the human subject. Indeed there are many facts which make it likely that there are several species of streptococci very similar in their method of growth, but which play different parts in the pathological processes, as in diphtheria.

Fehleisen had observed that several patients suffering from malignant tumours showed signs of improvement after having become affected with erysipelas, and accordingly considered it justifiable to produce erysipelas as a therapeutic measure. The results of these experiments as regards their effects upon tumour-growth need not concern us here; but in a series of cases he was able to produce erysipelas with all its accompanying features by inoculation into scratches on the skin of pure cultivations of the Streptococcus erysipelatis, some of these being cultivated through many generations. A similar condition was also produced in rabbits, but many other animals appear not to be susceptible to the disease.

In erysipelas the micrococci grow in the lymphatic system of the cutis, and produce an inflammatory condition attended with exudation, indicated clinically by the well-known area of spreading redness with slightly raised margin. The micrococci are found in great numbers, growing in chains and singly, in the lymphatic spaces immediately beyond the swollen edge, often plugging the lymphatic channels. They are also found within the cellular elements of the part. As they spread by their growth they produce the usual phenomena of inflammation, attended with a considerable amount of exudation, which may coagulate. The tissue-elements undergo some swelling and may show some degenerative change, but no actual softening or liquefaction occurs as in suppuration. The micrococci rapidly break down and disappear after the inflammatory condition has been established, whilst they continue to multiply in the lymphatic spaces beyond the inflammatory margin. After a time their growth generally comes to an end, but the means by which this takes place cannot be discussed here. The growth of the organisms is practically confined to the lymphatic system, and although probably a few do enter the blood-stream, they do not appear to be able to multiply there, and cultivation-experiments both in clinical cases and in artificial inoculations have almost invariably failed to show their presence in the blood. The general symptoms, often of severe character, attending the progress of erysipelas, are most probably due to absorption of the products of the growth of the organisms in the tissues; and Manfredi and Traversa have found that the products of the growth of the erysipelas micrococcus when injected into animals cause grave nervous phenomena, partly of convulsive, partly of paralytic nature.

Fehleisen found that a patient who had suffered from erysipelas a short time before was insusceptible to fresh inoculation, and the same has been observed in the case of animals. This immunity, however, he found only to be of short duration, and this accords with the fact that erysipelas in the human subject may show a tendency to recur.

5. **Gonorrhœa.**—The first account of an organism peculiar to this disease is that of Neisser, who in 1879 (*Centralb. f. d. med. Wis.* No. 28) described a micrococcus, whose morphological characters and relations to the pus-corpuscles in the secretion served, he considered, to distinguish it from other organisms which might be accidentally present. He found it in the acute stage of the disease, both in the male and female subject, and also in gonorrhœal conjunctivitis, but in no other conditions. This organism is now generally known as the micrococcus of gonorrhœa, or Neisser's *Gonococcus*, and his statements have been in the main confirmed by other observers. Attempts to cultivate it followed, but we now know that many of the earlier statements with regard to pure cultivations of this organism are erroneous, as these were made on media on which it does not grow. Later, however, several observers, by using human blood-serum as the culture-medium, have succeeded in isolating the gonococcus, and in cultivating it through many generations; and inoculation-experiments on the human subject have practically proved it to be the cause of the disease. (*See* the papers of Leistikow, Krause, Bokai, Bockhart, and especially the monograph of Bumm, *Der Gonokokkus Neisser*, Wiesbaden, 1887.)

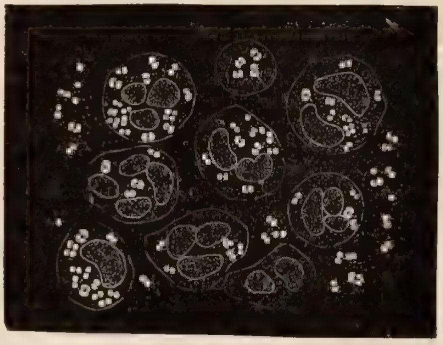

Fig. 80.—Micrococci of Gonorrhœa in the discharge from a case of acute gonorrhœa. The cocci are seen mostly as pairs or groups of four, and are mainly in the protoplasm of the pus-cells. × 850.

On microscopical examination this organism is found to be of the diplococcus variety, nearly all the cells being arranged in pairs, single spherical cocci being comparatively rarely seen. The two members of a diplococcus have often their adjacent sides flattened, or even slightly concave, so as to appear like two small beans placed side to side. In some, transverse division of the two halves is seen, and distinct tetrad forms thus occur (*see* fig. 80). They never grow in the form of chains. These characters, which are seen both in gonorrhœal pus and in cultivations, were at one time thought to be characteristic of the gonococcus, but have now been found to belong to many diplococci. The size varies according to the phase of development, but a fully formed diplococcus measures about 1·5 μ in length.

The micrococci of gonorrhœa stain readily with the basic aniline colours; and their presence in gonorrhœal pus can be very readily demonstrated by staining dried films for thirty seconds in a strong watery solution of fuchsin or a saturated alcoholic solution of methyl blue, then washing in water, allowing to dry, and afterwards mounting in balsam. They readily lose the stain when treated with decolorising agents, and accordingly are not stained by Gram's method. In the pus from gonorrhœa the organisms have a special relation to the pus-corpuscles, being found in large numbers, and almost exclusively, within their protoplasm, never in the nuclei. They are arranged in pairs, tetrads, or in small heaps, and sometimes they fill the corpuscle almost completely, giving the appearance of a small darkly stained ball of cocci. In the early stages, when the secretion is glairy and translucent, the organisms also occur free and in the epithelial cells; but when it is distinctly purulent almost all are within the pus-corpuscles.

In the early acute stage of gonorrhœa they are present in large numbers (according to Bumm no other organisms occur then in the male urethra, and pure cultivations can be made); later they become less abundant; whilst in chronic cases it may be impossible to detect any. We cannot enter here into the discussion regarding the relation of the gonococcus to the various concomitants and sequelæ of gonorrhœa, but it may be stated that many at least of these are due to the entrance of other organisms, such as pyogenic staphylococci. It has been stated that the organism may be found in the joints affected with gonorrhœal rheumatism; but this is doubtful. In blenorrhagic conjunctivitis it is found in the secretion along with other organisms, though it has the characteristic relation to the pus-corpuscles; whereas in conjunctivitis of non-gonorrhœal origin it is never found.

The cultivation of gonococcus outside the body is attended with considerable difficulty; and, while a certain amount of growth does take place on some other media, solidified blood-serum (especially human) is found to be the most suitable medium. To obtain cultures on this medium, small quantities of gonorrhœal pus should be placed in little heaps, and the pus must be free from other organisms. The best temperature is from 34° to 37° C., and below 25° growth practically comes to a standstill. Even at a suitable temperature growth is very slow. It is generally visible on the second day after inoculation, and appears as a minute circular film on the surface, almost colourless, showing a varnish-like appearance, with sharply marked edges, which often run out into little processes. The growth spreads slowly, and never reaches a large size. About two to three days after its first appearance it comes to a standstill, and a few days later all the organisms are found to be dead. By making fresh cultures at suitable times, however, it can be kept alive through an indefinite number of generations. When a microscopic examination of the growth is made, it is found that a considerable number of cocci, even in a recent cultivation, are in a state of degeneration, thus showing that their duration of life is short. In cultivations they are very easily killed, both by high and low temperatures, and they show comparatively little resisting power to chemical antiseptics.

Animals appear to be insusceptible to the disease, and all attempts to produce it by inoculations, whether of pure cultivations or of gonorrhœal pus, have failed. On one or two occasions, however, experiments have been performed on the human subject, the first being by Bockhart, who inoculated the urethra of a general paralytic and produced the disease. In this case, however, there must have been some fallacy, as the inoculation was made from a peptone-gelatine culture, on which medium the organism does not grow. Probably some of the original pus may have been present in the material injected, or the condition produced may have been a septic inflammation. Bumm, however, in two cases inoculated the healthy urethra with pure cultivations, in one case of the second, in the other of the twentieth, generation, and produced gonorrhœa, which showed all its typical clinical symptoms, and ran an ordinary course, the organisms being found in large numbers in the pus in proportion to the activity of the disease. It has also been found that when inoculations are made on the human subject with the pus of chronic gonorrhœa in which no gonococci can be found, no result follows.

In gonorrhœa there is therefore present a specific organism—a micrococcus which is distinguished from all others by certain characteristics, especially by its conditions and manner of growth on various media. Whenever the disease is in an active stage these organisms are present in large numbers; in fact, the activity of the disease is associated with active proliferation of the micrococci. Moreover, the few experiments performed on the human subject entirely confirm the view that they are the causal agents in the production of the disease. The morphological characters of this organism, its reaction to stains, and its relation to the cells in the secretion, though possibly not absolutely peculiar, still, when taken collectively, are sufficient to form an aid in the diagnosis of gonorrhœa.

6. Pneumonia, Acute.—The common form of acute lobar pneumonia presents many resemblances to an acute specific fever, both in the comparative regularity of course and duration, the sudden defervescence, and the regular erysipelas-like spread in the lung. Instances of infection and of epidemic occurrence are not wanting, although in the great majority of cases no such evidence is at present available. But the analogies with acute infective disorders are sufficiently striking to encourage research.

Of the kinds of micro-organisms which have been discovered in the pneumonic lung, two have especially gained prominence, Friedländer's and Fraenkel's pneumonia bacilli. Both have been found in a large number of cases by various observers, but at present the evidence of the causal relation of either to the disease is not sufficiently conclusive.

Friedländer's pneumonococcus or, more correctly, bacillus, was the earliest discovered. He found it in the lung-tissue, especially in the exudation in the air-cells, and in the lymphatics of the affected lung, in very numerous cases, and it has also been very frequently found in the sputa. These bacilli were cultivated by Friedländer in various ways. His observations have been repeated by many others, and their substantial accuracy cannot be questioned, so far as the frequent presence and general characters of the organism are concerned. The writer has frequently cultivated them from sputa, and also from fluid aspirated from the lung and from the pleura in cases of acute pneumonia.

Their characters may be briefly described. As seen in sputa, sections of the lung, or cultivations, they consist of short oval or oblong cells, arranged singly, in pairs, or short rows. They approach so nearly to a spherical shape that they were described by Friedländer as micrococci.

Within the body and in sputa, many of them appear to be surrounded by a hyaline capsule or clearer space, which may include single cells or short rows, and may be specially stained. This character, which was regarded by Friedländer as distinctive, is now known to be present in many other bacteria, and is simply due to gelatinous softening of the cell-wall, as already described.

The organism may readily be cultivated on peptone-gelatine, at normal temperatures, though it grows better at 35° C. It grows especially well on the surface, producing an elevated rounded mass, which, with the growth along the needle-track, causes an appearance which may be likened to a nail or pin, a character regarded as peculiar by Friedländer. It does not liquefy the jelly. It grows also on potatoes and on blood-serum.

Inoculation with these cultivations Friedländer found to produce pneumonia and pleurisy in mice, with reproduction of the organism in the pleural fluid, the lung, and the blood. The spleen was greatly enlarged and indurated. In guinea-pigs and even in dogs similar results were produced, though exceptionally. Rabbits were unaffected.

It has been objected to Friedländer's experiments that the method adopted, by injection into the lung, was faulty, and only showed the production of septicæmia with local inflammation. Nor does the fact that in a small number of cases inhalation of the organism produced a similar effect remove this objection. It can only be said that this organism is poisonous to mice and causes intense local inflammation and septicæmia in them, but this in nowise suffices to prove its special relation to pneumonia. Moreover, an apparently identical bacterium, similarly virulent, has been cultivated from the secretions of the mouth of healthy persons, and appears to be commonly present there.

It was pointed out by Afanassiew that another bacterium, differing from the preceding in size and shape, was also often present in the lungs and the sputum in pneumonia. This, which has been more fully studied by A. Fraenkel and G. Weichselbaum, and is known as the Fraenkel or Fraenkel-Weichselbaum pneumonia bacillus, has been found to be very commonly present in the lungs and in the rusty sputum in cases of pneumonia, especially during the earlier stages. From its shape it has also been called the Diplococcus lanceolatus, and is also known as the Diplococcus Pasteuri. It is in reality a bacillus. In shape it is like a short spindle partially divided into two halves, each of which is lancet-shaped. The double cells may form short chains. Like Friedländer's, this bacillus shows a capsule when within the body, but not in cultivations. It can be cultivated on nutrient jelly, agar, or blood-serum, and still better in broth. It grows best at about 35-37° C., but can be grown on jelly at 24° C. or a little higher, forming small, rounded, translucent, whitish points. It does not grow at ordinary temperatures; and this fact, along with its comparatively slow rate of growth, makes its cultivation more difficult than Friedländer's organism. When grown outside the body it rapidly loses its virulence, and also its vitality, unless fresh cultivations are made.

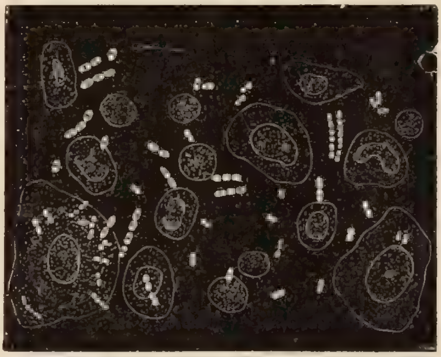

Fig. 81.—Acute Pneumonia.—Dried sputa from a case of pneumonia, showing the Streptococcus lanceolatus, and some other Strepto- and Diplococci. × 950 diam.

Inoculations with these cultivations cause septicæmia in mice, guinea-pigs, and rabbits, the latter animals being highly susceptible. Great swelling with induration of the spleen occurs, and rapid death, often in twenty-four to forty-eight hours. But no pneumonia occurs, nor pleurisy, unless the cultures are injected into the pleural cavity. Great development of bacilli takes place, and they are found in the blood and all the organs. In the human subject, these bacilli have been found in large numbers in the vegetations in septic endocarditis accompanying pneumonia.

These observations, which have been confirmed by numerous competent experimenters, would not suffice to prove absolutely any causal connexion with pneumonia. More suggestive, however, is the fact that when cultivations of the bacillus are weakened by exposure to a temperature exceeding 40° C. for several hours, and then injected subcutaneously into rabbits, some of them become very ill and some die after several days, and that in these there is found intense inflammation of the pleura and sometimes of the lung, with pneumonic consolidation. Moreover, according to Gamaleïa,[1] successive cultivations in rabbits greatly intensify the virulence, and large doses of the intensified cultures will kill sheep, or, if injected into the lungs of sheep or dogs (which are highly resistant), set up intense pneumonia.

Even these facts do not remove the bacterium from the category of septicæmia-producing bacteria; and the experiments of Monti, who produced pneumonia by injection into the trachea, have not been confirmed. Moreover, a similar bacillus has been found in many cases of pleurisy, peritonitis, peri- and endocarditis; and, according to Foà and Bordone-Uffreduzzi, it is almost constant in epidemic cerebro-spinal meningitis. And, according to Netter, it is common in healthy oral and nasal secretions.

Further investigation is necessary to prove their specific relation to the disease.

Group II.—*Diseases due to Infection of Wounds by Bacteria which are common in the Soil, &c.*

7. **Malignant Œdema.**—Space allows us to state only a few facts regarding the bacillus of malignant œdema—an organism discovered by Koch (*Arbeit. aus d. Kais. Gesundh.* 1881, Bd. 1). In its morphological characters it presents certain points of similarity to the bacillus anthracis, but in its conditions of life and manner of growth it is widely different. It is a large bacillus, though somewhat less, especially in thickness, than the anthrax bacillus. The rods are found growing separately and also in chains, the latter condition being seen especially in cultivations. They have distinctly rounded ends, and the spores, which are formed under certain conditions, are larger than the diameter of the bacillus, so that a slight bulging is formed either in the centre or towards the end. Spores are not formed in the living body. The rods are motile, and recently lateral cilia have been demonstrated.

This bacillus grows readily on the ordinary media, both at the body-temperature and also at lower temperatures, but only under strictly anaërobic conditions. If liquid gelatine-medium be inoculated (better with glucose added), and then allowed to solidify, growth occurs only in the deeper parts of the medium. The colonies produce little opalescent spheres of liquefaction, and small bubbles of gas appear in connexion with them. The growth has a peculiar heavy but not putrid odour.

The bacillus occurs very widely in nature, being found in garden earth, in fæces, in decomposing fluids, &c. It is pathogenic to most animals, though cattle are said to be immune. In rabbits and guinea-pigs, for example, its inoculation is followed by the occurrence of a spreading subcutaneous œdema, with the formation of small bubbles of gas, and death generally occurs in about two days. Until after the death of the animal, the organisms are not as a rule present in the blood. When other putrefactive bacteria are introduced along with it, as in inoculation with garden earth, &c., the development of gas is more marked, and the infiltrated tissues become very putrid.

In several cases of progressive gangrenous emphysema in the human subject this organism has been found to be present in large numbers, and is probably the chief causal agent, though its effects are aided by the concomitant growth of other bacteria, the condition generally arising from a wound into which soil or other septic matter has entered.

This bacillus is one of the organisms against which immunity can be produced by the injection of its soluble products.

8. **Tetanus.**—Until recently, tetanus was usually regarded as a disease of the nervous system, due to peripheral irritation. But many facts, and especially its analogies with hydrophobia, have long suggested its infective origin. Recent discoveries have not only established this, but have greatly advanced our general knowledge of bacteriology by the light thrown on other diseases.

The first demonstration of the transmissibility of tetanus by inoculation was given by Carle and Rattone of Turin in 1884. Their experiments were made on rabbits, by injecting an emulsion of the wounded tissues from a patient who died of tetanus. In the same year A. Nicolaier of Göttingen succeeded in producing tetanus in mice, rabbits, and guinea-pigs by subcutaneous inoculation of earth. In the pus from the wound

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[1] *Ann. de l'Inst. Pasteur*, 1888, p. 400.

Nicolaier found a bacillus which presented peculiar characters, together with others commonly found in suppurating wounds. Inoculation of other animals with pus from the wounds gave rise to tetanus in them, with reproduction of the same bacillus, but not in a state of purity. Attempts to cultivate the bacillus proved unsuccessful. In 1886 Rosenbach found the same bacillus in the wound in a fatal case of tetanus in man, and produced tetanus by inoculation from the wound, and from impure cultivations from the bacillus at the fourth generation. And although Rosenbach did not succeed in cultivating the special bacillus in a pure condition, he was able to exclude the other forms present in the cultivations as causes of tetanus, by cultivating them apart and inoculating in other animals.

The first successful attempts to isolate and cultivate the tetanus bacillus were published by Kitasato in 1889 (*Zeitschr. f. Hygiene*, Bd. vii. p. 225). Cultivations of pus from a case of tetanus were allowed to grow for forty-eight hours at the temperature of 38° C. They were then exposed to the temperature of 80° C. for three-quarters of an hour to one hour. This had the effect of killing all except the tetanus bacillus (or its spores). Cultivations made from the residue in an atmosphere of hydrogen succeeded in peptonised broth, gelatine, or agar.

The bacillus thus obtained appears to correspond with that previously described by Nicolaier. It grows freely only in an atmosphere devoid of oxygen, and is therefore strictly anaërobic. That it can develop in the presence of other aërobic bacteria may possibly be due to their action in absorbing the oxygen. It grows best at a temperature of 36-38° C., the spores appearing at the end of thirty hours. Below 14° C. its growth ceases; between 20° and 25° C. it is very slow, and spores do not appear for seven or eight days. The spores show great resistance to heat and drying; a moist heat of 80° C. for an hour does not kill them, and the spores can be kept in a dry condition for some months, still retaining their activity. Water or steam of 100° C. kills them in five to fifteen minutes; steam at 115° in five minutes with certainty. Cultivations made in the manner described retain their virulence during successive generations.

When grown in gelatine-medium the colonies usually commence as slightly cloudy points, from which radiate very fine thread-like branches. Liquefaction occurs, but somewhat slowly. If any oxygen is present, the growth occurs most readily in the deeper parts of the cultivation.

The bacillus itself is very minute, and may be seen in rods from 3–5 μ in length, growing to filaments. The diameter averages about ·4 μ. The bacillus is slightly motile. In cultivations it forms spores which are nearly spherical or ovoid in shape, and exceed the rods in diameter, being sometimes more than four times as wide. Hence, when division occurs between the spores, as is frequently the case, the bacillus resembles a pin or tambour in shape, a point which has been regarded as characteristic. But whilst this fact may aid in its distinction amongst the bacteria from wounds, it cannot be considered as in reality distinctive from other bacteria in general; though there are other peculiar characters, as seen in the woodcut, not described in other bacteria, and new to the writer. The bacillus is readily stained by any of the ordinary methods with various aniline dyes.

The remarkable resistance of the spores has already been mentioned. Putrefaction of the tissues containing them does not affect them. Their degree of resistance to antiseptics appears also to be great. Carbolic acid (5 per cent.) applied for ten hours has failed to kill them, and corrosive sublimate, 1 in 1000, requires more than three hours (Sanchez Toledo and Veillon).

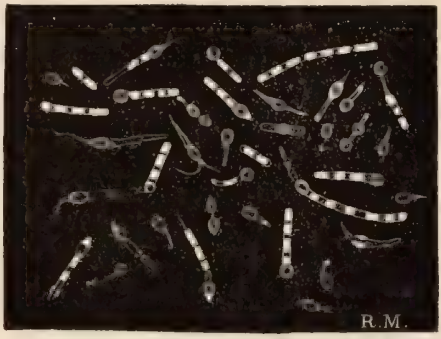

Fig. 82.—Tetanus Bacilli.—From a culture, stained by Löffler's method for showing flagella. From a specimen obtained from the Berlin Health Laboratory. Magnified 2,000 diameters. In addition to the peculiar shape, due to the large terminal spore, other peculiar morphological features will be observed: the character of the flagella, the apparent flagellation of the spores, and their relation to the bacilli.

General relations to the disease.—Up to the present time there is some conflict of opinion as to the exact distribution of the tetanus bacillus within the body; but from a general summary, and especially from a valuable series of experiments by Sanchez Toledo and Veillon (*Arch. de méd. exp.*, tom. ii. p. 709, 1890), the following would appear to be the probable condition.

The bacillus when inoculated multiplies in the wound, especially in the deeper parts, producing some little irritation, but no suppuration, although this may occur from the presence of other organisms. It does not pass into the blood, or only in a very small degree, until a somewhat later period, and especially during the later hours of life. Hence it may not be found in the internal organs; and the brain, spinal cord, liver, or spleen of animals which have died of tetanus may be inoculated into other animals without result. This is, however, only the case if the material for inoculation is taken shortly after the death of the animal; for multiplication of the bacillus takes place after death, and the organs thus become more virulent.

It appears also that the multiplication of the bacillus in the tissues near the wound is often very scanty—so scanty that some observers have alleged that it only takes place for a short time after inoculation. Indeed, Vaillard and Vincent find that if pure cultivations be injected into animals, practically no multiplication of the organism takes place, and that the tetanic symptoms produced are really due to the poisonous products of the bacillus already present in solution in the culture.

In inoculated animals the earliest tetanic symptoms commence in the muscles adjacent to the wound, and later become generalised. They may commence within a few (eight to thirty) hours, and death may occur in twenty-four hours to three days in mice, white rats, rabbits, and guinea-pigs; but in some animals (dogs, fowls) they may be delayed for six days or even longer.

It would appear that this bacillus is widely diffused in the soil; and, according to Sanchez Toledo and Veillon, it is commonly found in the fæces of healthy horses and oxen. They believe that it can readily develop there, owing to the relative deficiency of oxygen in the intestines. There can be little doubt that it must, if this is the case, have a saprophytic *rôle* in nature, in addition to its pathogenic effects.

Lastly, it has been found that animals which have recovered from inoculation of the tetanus bacillus have not acquired an immunity to subsequent inoculations.

Dr. Sormani of Pavia (*Inter. Med. Congress*, 1890, *Trans.*, vol. v. p. 150) has recorded an extensive series of observations which, in the main, confirm these results. But he found that the Clostridium fœtidum of Liborius, which very commonly accompanies the tetanus bacillus in fæcal matter, cannot be killed by the exposure to 80° C., as its resistance to heat is nearly as great as that of the latter. It withstands even 100° C. for an hour. Hence it is difficult to obtain pure cultivations of the tetanus bacillus from fæces. But since this clostridium has a powerful reducing action whilst growing, its presence facilitates to a remarkable extent the growth of the tetanus bacillus, by removing the oxygen. His experiments also showed that inhalation of the tetanus bacillus does not produce the disease, and that when swallowed in large quantities it does not affect the animal; although by its multiplication in the intestine the fæces become very virulent. He was able also to implant subcutaneously a minute tube containing cultivations of the bacillus, in such a way that the toxic matter could filter out without the bacilli, and found that tetanus was nevertheless produced. This confirms the results of other observers, that the direct action of the bacillus on the system is by means of a diffusible poison, which is generated in the wound and thence absorbed.

During the last two years a large number of investigations on the poisonous products of the tetanus bacillus have been carried on, in a manner similar to that described later in the case of diphtheria. Such investigations have been conducted in Italy, France, and Germany, and there is a considerable agreement amongst the most important results independently obtained. It is found that virulent cultures made free from bacilli by filtration produce all the symptoms of the disease with great readiness when injected into animals. Brieger and Fraenkel affirmed the poisonous substance to be a toxi-albumen; but Tizzoni and Cattani on the one hand, and Vaillard and Vincent on the other, came to the conclusion that it is of the nature of a soluble enzyme or ferment. Tizzoni and Cattani (*Centralb. f. Bakt.* 1890, ii. 69), by dialysis of the filtrate of a virulent culture, and subsequent evaporation to dryness, obtained a yellowish crystalline-looking powder, which at least contained the active substance, though not in a pure form. This poison possesses extremely active properties, half a cubic centimetre of a filtered virulent culture being sufficient to kill a rabbit, and ·05 milligramme of the organic matter precipitated from such a filtrate by calcium phosphate causing marked symptoms (Vaillard and Vincent, *Ann. de l'Instit. Past.* 1891, p. 1). The poisonous properties are, however, very easily destroyed by heat, by chemical agents, and in other ways. Exposure to a temperature of 60° C. completely deprives filtered cultures of their virulence, and exposure to sunlight for eighteen hours has a similar effect (Kitasato). The poisonous effects follow when it is injected, either into the blood or subcutaneously; but when injected into the stomach, or when swallowed, it has no effect. These results, and many others, show that the tetanus poison is a very unstable substance. The tetanus bacillus also produces a peptonising ferment, which is destroyed at the same temperature as the poison, but the identity of the two substances has not yet been established. The poison is present in the blood of animals which have died of tetanus, and when the blood or its serum is injected in sufficient quantities into a susceptible animal, such as a mouse, tetanic symptoms result. Guinea-pigs are the most susceptible animals, whilst in dogs the symptoms are much later in appearance and less marked.

Important advances have also been made towards producing immunity against this poison, and probably also towards curing the disease in certain cases. Tizzoni and Cattani (*Centralb. f. Bakt.* 1891, i. 189) found that by injecting small doses of the tetanus poison into dogs repeatedly for a time, an immunity against large doses of the poison was produced in them. They found that the serum of such animals had a directly antagonistic action to the tetanus poison, and when added to filtered tetanus-cultures deprived them of their virulence. Also the serum of immune dogs, when injected into mice, conferred a similar immunity on them. Later, by a somewhat more complicated method, they succeeded in making guinea-pigs and rabbits immune. They have also conducted an extensive series of researches on the nature of the substance in the serum which produces the immunity, and have found it to correspond in its chemical relations with a globulin having the properties of an enzyme. This substance they have called 'tetanus antitoxin.' Behring and Kitasato (*Deutsch. med. Woch.* 1890, No. 49), a short time before, succeeded in producing immunity in rabbits against the poison, and found that ·2 c.c. of the serum of an immune rabbit injected into a mouse conferred immunity on it. As an example, a rabbit rendered immune could withstand the injection of 10 c.c. of a virulent tetanus culture, of which ·5 c.c. was quite sufficient to kill with certainty an unprotected animal. They also obtained the same result as Tizzoni and Cattani, with regard to the antagonistic action of the serum of immune animals to the tetanus poison outside the body. All these observers also found that in the case of mice in which tetanic symptoms had set in, a cure could be produced by the injection of the serum of immune animals, if the dose of the poison were not excessive, and if the disease had not advanced too far. The immunity artificially produced in these animals disappears after a time.

Special interest attaches to the application of these results to the treatment of the disease in the human subject. The first case treated successfully was by Gagliardi; the second by Schwarz, of which a full account is given in *Centralb. f. Bakter.* 1891, ii. p. 785. The latter employed tetanus antitoxin prepared by precipitation by alcohol from the serum of an immune dog, and subsequent evaporation to dryness *in vacuo*. The case was one in which all the symptoms of tetanus were well-marked. Injections of the antitoxin were made on three occasions in doses of 15, 25, and 25 c.g. respectively. Little result followed after the first injection, but marked improvement occurred after the second; and after the third the symptoms quite disappeared, and complete cure resulted. Several similar cases have occurred since, the number in which favourable results have been obtained being seven at the present date (September 1892). Still more extended observations are necessary before a definite statement can be given regarding this method of treatment in general.

As practical conclusions, it is evident that the main cause of tetanus is the introduction into a partially closed wound of material containing this bacillus or its spores, and that this is especially liable to occur where fæcal matter is abundant.

Its life-history also indicates the great importance of freely opening wounds in which foreign bodies have become fixed, in order to avoid the anaërobic condition; and it explains the fact that, even after the onset of tetanic symptoms, free excision of the wound has occasionally proved of service.

The great resistance to ordinary disinfectants and antiseptics necessitates the use of the strongest possible, and an acid solution of corrosive sublimate of 1 in 500 strength is needed. The use of iodoform has also occasionally been found of service in experiments, but only when in the presence of other bacteria which can decompose it.

It may be added that experiment seems to prove that the so-called 'idiopathic' or 'rheumatic' tetanus, 'head tetanus,' and also 'trismus neonatorum,' are due to the same organism.

Group III.—*Specific Infective Diseases, usually transmissible by inoculation, attended by inflammatory changes which frequently become chronic, and usually associated with the formation of specialised granulation-tissue growth* ('*infective granulomata*') *throughout the body.*

9. **Tubercle.**—Before anything was definitely known regarding bacteria as the causal agents in the production of tubercle, it had been proved by experiment that it was a directly inoculable disease. Villemin produced general tuberculosis by the introduction of caseous material into the subcutaneous tissue of animals; and Cohnheim and Salomonsen inoculated the anterior chamber of the eye of the rabbit, and produced in this way a tubercular affection of the iris, characterised by the growth of small grey nodules—a condition which does not occur spontaneously in these animals. (Béhier and Liouville had previously made similar observations.) They found also that this condition might be followed by a general tuberculosis. These experiments showed that in tubercular material there is some virus capable of propagating itself and giving rise to the characteristic lesions. To Koch belongs the credit of first discovering the nature of the virus, by demonstrating the constant

presence of bacilli in tubercular affections, by isolating and cultivating these organisms, and lastly by inoculating with them and producing the disease. His work in this discovery is an excellent practical example of the canons laid down by himself for proving the bacterial nature of any disease.

The announcement of the discovery of the bacillus of tubercle was made by Koch in 1882, and a full account of his work appeared in the following year in the *Mittheil. a. d. Kaiser. Gesundheitsamte.*

For a time Koch's endeavours to demonstrate the presence of organisms in tubercle, by means of the methods of examination and staining then in use, were unsuccessful. But he ultimately found that by subjecting the tissues for a long time to the action of a solution of methyl blue, rendered alkaline by the addition of caustic potash, which increases its penetrating power, the presence of bacilli could be revealed. This original method was replaced by a better one, namely, the staining of the tissues for twenty-four hours with gentian-violet solution in aniline-oil water. He found that when stained in this way the bacilli retained the stain even if treated with strong mineral acids. By the employment of dilute nitric acid (one part in two of water) he could remove the stain from the tissues and other organisms, leaving these bacilli coloured. One exception he found, namely, the bacilli of leprosy, which react to the stain in the same way, though they hold it with rather less tenacity. He then coloured the tissues by a contrast stain, such as Bismarck brown. All other methods of staining subsequently devised depend upon the same principle, namely, that these bacilli can only be stained by a solution of strong staining power (generally a solution of fuchsin or gentian violet, with a suitable mordant), and when thus stained they can be subjected to powerful decolorising agents without losing their colour.

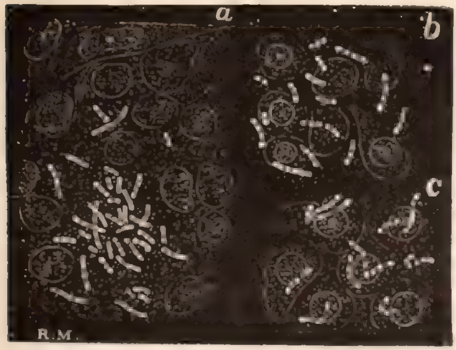

Fig. 83.—Tubercle Bacilli.—*a*. From section of lung. *b*. From sputum. *c*. From section of tubercular ulcer of intestine. × 850 diam.

Characters of the tubercle bacillus.—The organism thus discovered by Koch, and now known as the *Bacillus tuberculosis* or *tubercle bacillus*, is of comparatively small size, measuring as a rule 2·5 4·5 μ in length, and about ·3 μ in thickness, so that relatively to its length it is a thin bacillus. The rods are straight or slightly curved. They are generally found singly; often two are joined in a straight line or at an obtuse angle; but in the tissues they rarely form longer rows, though these are common in cultivations. Occasionally in the tissues, very frequently in phthisical sputum, and also in old cultures, an appearance may be seen in the bacilli which suggests the occurrence of spore-formation. This consists in the presence of clear globular unstained spaces in the bacilli, there being sometimes three or four such in a single rod, and arranged so regularly as to give the appearance of a row of cocci (*see* fig. 83). These uncoloured portions refract the light highly, and microscopically many of them have certainly the appearance of spores, though this cannot be held to be definitely proved.

The bacilli may be found wherever the growth of tubercle is going on, though in varying numbers, according to the rapidity and character of the growth. As a rule, it may be said that the more acute the tubercular process, the more numerous are the bacilli. In recently formed, rapidly growing tubercles, they are generally present in large numbers, even in the central parts which are showing signs of degeneration; whereas in chronic fibroid tubercles they may be very few in number; and in old caseous material, as a rule, their presence cannot be demonstrated. Sometimes in the nodules in which caseation is going on there can be seen in the degenerating parts bacilli which stain imperfectly, and have lost their distinct form; or only a few granular remains may be seen, some of which may be spores. This is the more likely, as caseous material has been found capable of producing tubercle on inoculation, though no tubercle bacilli could be demonstrated in it. The bacilli, as seen in the tissues, are sometimes scattered fairly uniformly, sometimes closely gathered in little clusters, and may occur partly within cells, partly lying free. Frequently in bovine tuberculosis, more rarely in the disease in the human subject, they may be seen to have a special relation to the giant-cells. In these cells the bacilli often form a sort of ring or zone towards the periphery, and are sometimes arranged in a radiate manner (*see* fig. 84). They are generally found apart from the nuclei, and the protoplasm of the giant-cell often shows a granular and partially degenerated appearance. In acute caseous catarrhal changes in the lungs, they may often be found in very large numbers in the contents of the air-cells, especially where the process is spreading. In some very acute forms of the disease they may sometimes be seen in parts in which no distinct tubercles have yet formed; the writer has seen this very well in the spleen in acute tuberculosis. In the sputum of phthisical patients their presence can generally be revealed with comparative ease, and for this purpose Neelsen's carbol-fuchsin method is probably the most suitable. In order to find them, one of the small yellow caseous-looking masses in the sputum ought to be selected, broken down between cover-glasses, and treated as above described (*vide* Modes of Staining). They are generally found in little groups, sometimes in very large numbers, and occasionally so closely massed together as to make the recognition of individual bacilli difficult. They may also, of course, occur singly here and there. They may also be demonstrated in the urine in cases of renal phthisis, in the dejecta in tubercular ulceration of the intestine, and in the milk of cows with tubercular udders.

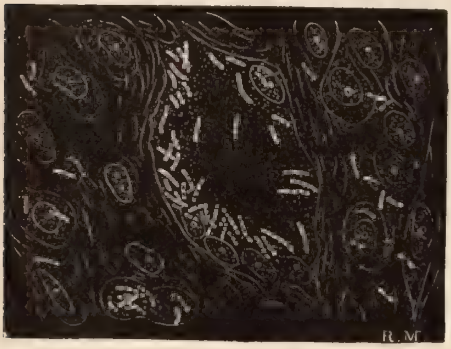

FIG. 84.—Tubercle Bacilli in section of a cow's udder. Showing relations of bacilli to a giant-cell. × 850 diam.

Cultivation.—Koch's first attempts at cultivation on the media then in use were unsuccessful, but he ultimately succeeded on blood-serum prepared by an ingenious method. He sterilised it by heating to 55° C. on successive days—sterilisation by steam being inadmissible, on account of its coagulating the albumen, and rendering the medium opaque; and subsequently inspissated it at a temperature of 65° C. The medium thus obtained is transparent, semi-solid, and sterile. As the presence of other organisms requires to be rigorously excluded, he first employed for inoculation portions of tubercular material from animals, which of course could be obtained from them in a perfectly fresh condition. The skin of the animal having been previously purified by washing with an antiseptic, and all the scissors, knives, &c., used in the operation having been sterilised by heat, he dissected out portions of the nodules, and made inoculations on the serum. For the first few days no signs of growth were observed, but generally on the tenth to the fourteenth day the growth made its appearance. It first appears as a small whitish point, which gradually spreads on the surface of the medium, becoming more distinctly white or yellowish-white; and ultimately forms a small scale-like film of wrinkled appearance. The growth progresses slowly throughout, and after a week or two comes to a standstill. It never penetrates into the surface of the medium, and causes no liquefaction. In meat-broth growth is very imperfect, and occurs only when the liquid is in a thin layer, as the organism is strictly aërobic; but on glycerine-agar, as Nocard and Roux first pointed out (*Annal. de l'Inst. Past.* 1887, p. 19), the growth both appears at an earlier date, and is more rapid and abundant than on blood-serum. But the successive cultures tend to diminish in vitality and virulence. The young colonies on solid media, when examined with a low power, show characteristic appearances which, so far as is known, are quite peculiar to the tubercle bacillus. The margins of the growth have the appearance of wavy bundles of hair running in a sinuous manner, whilst those bundles in the central portion give the appearance of a number of laminæ intertwined. The bundles, or laminæ, are composed of bacilli arranged in a parallel manner. It was for a long time believed that the bacillus could grow only on animal media, but Pawlowsky (*Annal. de l'Inst. Past.* 1888, p. 303) has since found that growth takes place also on potatoes kept at a suitable temperature, if the tubercular material be well rubbed in, and the surface of the potato kept moist. When examined in fluids, tubercle bacilli exhibit no power of independent movement.

The cultivation of tubercle bacilli directly from *post-mortem* material, from sputum, &c., where many other organisms are present, is very difficult, on account of their slow rate of growth. But it has been effected by one or two very ingenious expedients, which it is needless to detail. Cultivations may, however, be made with comparative ease indirectly, by inoculating animals with the tubercular material, and then using some of the nodules produced for inoculation on the culture-media.

Tubercle bacilli flourish best at a temperature near that of the normal body. Koch found that on blood-serum growth took place readily between 30° and 40° C., that about 37° C. is the most suitable temperature, and that below 28° C. and above 42° C. growth does not take place. On glycerine-agar the temperature limits are rather more extended.

Relation to the disease.—That this organism is really the cause of tubercle was proved by Koch by a very extensive series of experiments on animals, by inoculation both of tubercular material containing the bacilli, and of pure cultures. His results have been amply confirmed by a very large number of subsequent workers. Its pathogenic properties were tested by Koch in a great many ways: by injecting the bacilli into the subcutaneous tissue, into the anterior chamber of the eye, into the peritoneum, into the veins; by feeding animals with material containing the bacilli; by distributing the organisms in the air to be respired by the animals. In many cases the bacilli used were from cultures which had been carried through more than twenty generations. By all these various methods tubercle was produced, differing of course in its anatomical characters and distribution in the different methods. The result depends somewhat on the number of bacilli introduced; thus, a small number introduced into the anterior chamber of the eye produces a growth of small grey tubercles, while a larger number causes a general caseous infiltration. Tubercle bacilli of the same culture also produce somewhat different tubercular lesions in different kinds of animals. A single example may be given of Koch's many experiments. Tubercle bacilli taken from a culture of the twenty-third generation were mixed with sterile water, and 50 c.c. of the mixture were distributed on three successive days by a spray apparatus in a box containing a number of rabbits, guinea-pigs, rats, and mice. Some of the animals died, the others were killed twenty-eight days after the last inhalation, and in all of them tubercular lesions were found in the lungs.

From the above statements with regard to the temperatures at which tubercle bacilli grow, it is evident that their growth in natural conditions is practically limited to the bodies of warm-blooded animals. But while this is so, they can retain their vitality for a considerable length of time at ordinary temperatures, whether in the dry or in the moist condition. It has been proved that phthisical sputum kept in the dry state for more than two months still contains living tubercle bacilli, and that when kept in sterilised water the bacilli are still alive at the end of two months. The process of putrefaction which kills many pathogenic bacilli appears in many cases to have little effect upon tubercle bacilli, and tuberculous sputum allowed to putrefy for several weeks has been shown by inoculation to contain living tubercle bacilli (Fraenkel, Baumgarten). Many experiments have been performed on their resistance to heat and chemical reagents by Koch, Schill and Fischer, Baumgarten, Voelsch, and others. Only one or two facts can be mentioned. Sputum containing a large number of bacilli loses its infective properties by being thoroughly exposed to the action of carbolic acid (2-3 per cent.) for a few minutes (Schill and Fischer, Baumgarten). They are, however, much more easily killed, whether apparently spore-containing or not, when in pure cultivations (Yersin). Other antiseptics act in a similar way; but some, such as corrosive sublimate, are unsuitable on account of the coagulum they form on the surface of the sputum. They show a comparatively high resisting power to the action of the gastric juice, experiments having been made, both with natural and artificial gastric juice, on tubercular sputum, and other materials, and on cultures (by Falk and Wesener). It has been found that tubercle bacilli from pure cultures, after being acted upon by the gastric juice of a dog for six hours, are still virulent when injected into animals. It is therefore evident that bacilli in meat, milk, and the like, if not killed before being swallowed, will probably pass into the intestine in a living state. Moist heat at a temperature of 100° C. kills the bacilli in any condition in a few minutes; the bacilli in moist sputum are killed more quickly than when the sputum has been thoroughly dried. In cultivations, at least, much lower temperatures are sufficient—70° C. (Yersin). For disinfecting purposes, however, the higher temperature should be used. Dried sputum requires to be exposed to dry heat at a temperature of 100° C. for sixty minutes in order to kill all the bacilli with certainty.

Statements disagree regarding the comparative resistance of tubercle bacilli with apparent spores, and of those in the supposed spore-free condition. Some have found a considerable difference, whilst others have failed to find any. The important practical point, however, is to know the greatest resisting power of the organism in any condition, and the above statements have been given with this end in view.

As is well known, tubercle bacilli may gain entrance to the body by the respiratory passages, by the alimentary tract, and by external wounds. Direct experiment would appear to prove that in the case of the air-cells of the lung, and the intestinal mucous membrane, they can produce tubercular lesions without the presence of previous catarrh or any other abnormal condition. Numerous examples of direct inoculation of mucous surfaces in the human subject are afforded by *post-mortem* examinations.

Speaking generally, we may say that in experiments on animals the result of direct inoculation with tubercle bacilli (*e.g.* by injecting subcutaneously or into the anterior chamber of the eye) is to produce first local tubercular growth, and later a generalised affection. When introduced into the circulation in sufficient numbers, the bacilli produce an acute tuberculosis, though sometimes the animal may succumb before tubercles visible to the naked eye have been formed. As examples of the means of rapid extension from a tubercular focus in the human subject, may be mentioned the distribution of caseous material containing bacilli by means of the air-passages to other parts of the lung, the rapid tubercular affection of serous cavities when the bacilli gain an entrance to them, and the general tuberculosis produced by the entrance of the bacilli into the circulating blood.

A few words may be said regarding the action of the bacilli on the tissues, and the mode of formation of tubercles. Careful experimental work on this subject has been done by Baumgarten, Cornil, and others, most of the results of which can be readily followed on specimens from the human subject. The first change produced by a local growth of the bacilli is a proliferation of the connective-tissue cells. The cells, by the irritation of the bacilli or their products, multiply by karyokinesis, and become 'epithelioid' in character, whilst a little later evidence of irritation is shown by emigration of leucocytes, which accumulate at the periphery. A little cellular nodule is thus produced around the bacilli. Soon an important change occurs in the centre of the nodule. The cells become swollen and translucent, their nuclei lose the power of staining, and the cells show a tendency to fuse together. This change, known as 'coagulation necrosis,' is soon followed by a granular disintegration, which often terminates in caseation. The giant-cells, which are specially seen in chronic tubercles, appear generally to be formed by the enlargement of the epithelioid cells, though there may be other methods of formation. The bacilli therefore act in two ways—first, by causing reactionary changes in the cells, evidenced by their proliferation; and, secondly, by producing degeneration in the cellular elements. The greatly different appearances of tubercular growths depend chiefly upon the rapidity and intensity of the proliferative and degenerative changes.

Practical conclusions.—The facts established by the bacteriological work done on this subject ought to have important practical results. That the sputum from cases of phthisis contains numerous bacilli, and that in many cases on its becoming dry the bacilli are disseminated in the atmosphere whilst still in a living and virulent condition, are facts beyond dispute. They have been demonstrated in the atmosphere, and in the dust of apartments containing phthisical patients, and have been proved by direct inoculation to be still capable of producing the disease. The danger arising from treating phthisical patients in the same rooms or wards with other patients is at once apparent, and there are numerous actual examples of infection in this way. By the isolation of cases of phthisis as far as this is practicable, and by the treatment of the sputum as infective material, much more than has as yet been attempted might be done to lessen the spread of the disease.

10. Leprosy (Elephantiasis Græcorum).—Until within a recent period this formidable disease had excited but little interest in this country, since its practical disappearance from our shores in the middle ages. Yet its wide prevalence and serious results in various countries under the rule of Great Britain might have led to more research as to its causes and cure. It will suffice here to deal with those aspects which most especially relate to its bacteriology.

The essential uniformity and identity of leprosy in its various manifestations are now generally admitted; and whether it is studied in the temperate or cold climates in Northern Europe, as in Norway, Finland, and North Russia, or in Newfoundland, or in Italy, Spain, India, Egypt, Syria, or in the islands of the Pacific, it is found to be the same in its morbid anatomy and clinical features.

The old view that it was a highly contagious disease has in more recent times given place to the notion that it is not contagious. But the evidence which is accumulating on all hands of its possible direct transmission, and of the spread of the disease in localities where it has been introduced (as into the Sandwich Islands in 1865), confirms the older view, which is in accordance with the results of bacteriological investigation. It is especially on this account that the study of its relation to micro-organisms is of such extreme importance.

The *morbid anatomy* of leprosy can only be touched upon so far as is necessary to explain what follows.

The various clinical forms, 'tubercular,' 'anæsthetic,' and so on, have a common anatomical basis. The nodular or diffused thickenings of the skin, the anæsthetic areas, the parchment-like, shrivelled skin, the ophthalmia, the paralysis of nerve-trunks, the atrophy of the cartilages and bones, and the wasting and shrivelling of the extremities, are all the direct result either of a chronic inflammatory or proliferative process in which granulation-tissue is formed and subsequently cicatrises, or of the chronic inflammatory changes in nerves and nerve-trunks.

Microscopic study of the morbid changes in leprosy before the discovery of the bacillus lepræ showed little to distinguish them from other chronic inflammatory changes, such as those of syphilis. The affected parts show diffuse infiltration with granulation-tissue, sometimes taking a nodular form, whilst the proper tissue-elements are being atrophied and absorbed. The only special feature observed was the presence of a rather unusual number of large cells, epithelioid in type, often with so-called vacuolation and vesicular swelling of the nuclei. These cells differ from the giant-cells of tubercle in their smaller size, absence of multiple nuclei, and irregular arrangement. From their peculiar abundance and character they are distinguished as 'lepra cells.' Absence of caseation was also noted as a character in which the new-growths of granulation-tissue differed from those of tubercle and syphilis.

In 1874 (*Norsk Magazin f. Lægevidenskab*, 1874, Heft 9; Virchow's *Archiv*. Band 79, p. 32) Dr. Armauer Hansen of Bergen discovered that the parts more especially affected by growths of leprosy, and particularly those in most active development, contained large numbers of bacilli. Further researches, first by Neisser in 1879, and since by many observers in all parts of the world, have established the constancy of their presence, and of their peculiar characters and relations to the diseased parts, and have confirmed the accuracy of Hansen's observations. As there has been much dispute as to their exact relations to the tissues, and as our knowledge on many points is yet very incomplete, it will be well only to state those facts which are best ascertained, most of which the writer can confirm from his own observations, and to leave the disputed points for further investigation.

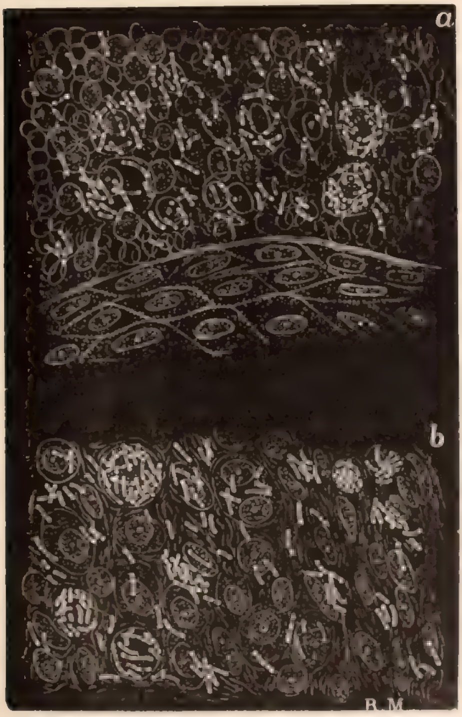

FIG. 85.—Leprosy.—Section of skin, showing superficial and deep parts of the same section. *a*. Exudation on surface of skin, showing numerous red blood-corpuscles and leucocytes, together with large cells. The bacilli are for the most part contained in these large cells. *b*. From deeper part of the same section, showing the relations of the bacilli to the cells and tissues. × 850 diam.

The *bacillus lepræ*, or *leprosy bacillus*, as seen in the tissues, very closely resembles the tubercle bacillus. It may be studied either in the juice expressed from one of the nodules (especially those in the skin), or in sections prepared and stained. In the first condition they are motionless (although some have stated that they may have a slow movement, this appears to be an error). They can be far more readily stained with ordinary aniline dyes than tubercle bacilli, and if stained in the same way as tubercle, they are rather more readily decolorised. They stain well with carbol-fuchsin, safranin, or gentian violet. Fuchsin with a contrast stain of methylene blue does well. It has been observed that some stains give a most definite appearance of bacilli. Others show a row of spore-like bodies (coccothrix), due to the fact that some parts of the bacilli are much more readily stained than the rest.[1]

The bacilli are usually straight, or very slightly curved, of nearly uniform thickness, rounded or slightly pointed at the ends. They always show the peculiar beaded or spore-like character of dots at fairly regular intervals, which have a different refraction, and different reaction to staining from the rest of the protoplasm. *See* fig. 85.

The tenacity of life of these bacilli when placed in a suitable position is very remarkable. In the numerous attempts which have been made to inoculate leprosy in animals, it has been found that even where no proliferation had, so far as could be judged, taken place, the bacilli remained in an apparently living condition in the subcutaneous tissue for several weeks or months.

These organisms are generally found in leprosy in large numbers, and have a special relation to the histological changes—*i.e.* they are present wherever the growth of the granulation-tissue is going on. A considerable amount of discussion has taken place with regard to the exact site of the bacilli in the tissues; but it is now generally admitted, as Neisser, Cornil, and Suchard described, that they are for the most part contained within the large globular 'lepra-cells.' In the leprous nodules of the skin, it can be seen that they are present in large numbers in the cells of the infiltration of the dermis and of the subcutaneous tissue, whilst the epithelium is generally quite free from them. So also in the glandular structures of the skin they are generally absent, though they may occasionally be present in the sebaceous glands, in the hair-sheaths, &c. A few may also be found lying free in the lymphatic spaces. The number of bacilli may be enormous, especially in the nodules which are chiefly cellular, each cell in the field of the microscope sometimes containing a considerable number (*see* fig. 85). In all the parts affected by the lesions the bacilli are found to be present, and to have a similar relation to the tissue-elements—in the nerves, in the lymphatic glands, in the cornea and other parts of the eye, and in the viscera when affected. As a rule, they are absent from the general circulation, though Cornil and Babes state that they may be present before death, especially if there be fever. When ulcers form on the skin, bacilli may be found in great number in the discharge, and the secretions of mucous surfaces also contain them when these are similarly affected.

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[1] See Neisser, *Verhandl. d. Deutsch. Dermatolog. Gesell.* Congress-Burg. 1889, and *Cent. f. Allgem. Path.* 1890, p. 166.

Numerous attempts have been made to cultivate the leprosy bacillus, but up to the present without success. Various observers have at different times announced that they have succeeded in obtaining pure cultivations, but their results have not been confirmed. That the leprosy bacillus does not grow outside the body under the same conditions as other known bacilli (*e.g.* of tubercle) seems abundantly proved by the numerous attempts at cultivation. This, however, on the other hand, serves to mark it off more distinctly as a separate species.

Nearly all the attempts to produce the disease in animals by inoculation of material containing the bacilli have completely failed. An exception is, however, afforded by the experiments of Melcher and Orthmann, who in one or two instances, by inoculation of leprous material into the anterior chamber of the eye of rabbits, produced an extensive growth of nodules in the lungs and other organs, which they affirmed contained leprosy bacilli. Though some authorities, who have seen the specimens (*e.g.* Fraenkel), are inclined to believe that the organisms in the nodules are really leprosy and not tubercle bacilli, subsequent experimenters have entirely failed to obtain a similar result. Inoculation experiments have also been made on the human subject, in some cases without result. The most important, perhaps, of these experiments is that by Arning, who, in 1884, inoculated a criminal in the Sandwich Islands who had been sentenced to death. Inoculations were made at several places, and at one a nodular swelling formed, in the juice of which leprosy bacilli were found for more than a year afterwards. Later, in 1887, there developed well-marked tubercular leprosy. The experiment is, however, somewhat invalidated by the fact that before the inoculations the individual had been frequently in contact with lepers.

The absolute proof, therefore, that the bacillus of leprosy is the cause of the disease is still wanting, owing to failure in the attempts to isolate and cultivate it. Yet, if we take the facts established regarding it, together with those of other diseases in which bacilli have been proved to be the causal agents, very little doubt can remain on the subject. The invariable presence of the bacillus in large numbers, its special relation to the tissue-changes, and its absence in all other known pathological conditions, may, in the meantime, be taken as practically conclusive evidence.

11. **Glanders.**—This disease, on account of its resembling tubercle in many particulars, may be conveniently considered here; and although it is of minor importance, on account of its comparative rarity in the human subject, the bacterial nature of the infective virus has been proved with equal completeness, and its properties have been very fully investigated. Only the more important facts can be given. The bacillus of glanders (Rotz-bacillus; *Bacille de la Morve*; *Bacillus mallei*) was discovered by Löffler and Schutz in 1882, the announcement being made shortly after Koch's first publication on the tubercle bacillus. These observers not only demonstrated the presence of the organism in the tissues in glanders, but isolated it, and by inoculation produced the disease in various animals. Babes claims to have observed the same organism at an earlier date (his observations being published in 1881), but he made no cultivations.

This bacillus is of small size, and is generally described as being rather shorter and slightly thicker than the tubercle bacillus. The rods are generally straight, with rounded ends, and when stained often show lighter or unstained spots, some of which at least are generally regarded as being spores; and Rosenthal has succeeded in staining some of them with the carbol-fuchsin solution. In the glanders nodules the rods generally occur singly, scattered, or in little groups, and never form long filaments; they are found both within and outside the cells. In their behaviour to stains they present certain peculiarities, which make their satisfactory staining in the tissues a matter of considerable difficulty. They stain with watery solutions of methyl blue, and other agents, with comparative readiness, though not very deeply (better when an alkali is added), but lose the colour very easily when treated with a decolorising agent. They are accordingly decolorised by Gram's method. The most suitable stain is one which does not readily overstain the tissues, so that little decolorisation is necessary. A great many different methods have been given; the following is one which Löffler has found to be specially suitable: The tissues are stained for five minutes in alkaline methyl-blue solution. They are then placed for five seconds in a decolorising solution—namely, water 10 c.c., to which are added two drops of concentrated solution of sulphurous acid, and one drop of a 5 per cent. solution of oxalic acid. They are then dehydrated in alcohol, cleared in xylol, and mounted in Canada balsam.

The glanders bacillus grows with comparative readiness on nearly all the ordinary media; but a somewhat high temperature is necessary, 35°–39° C. being most suitable, though growth still proceeds as low as 22° C., and to a small extent even lower. Its growth on potatoes has striking characteristics, which are of aid in the recognition of the organism. First evidence of its growth on potatoes is seen about two days after inoculation, and it spreads on the surface, giving an appearance like a layer of yellow honey. Later, the colour becomes deeper, assuming a brownish tint, which has been compared to cuprous oxide, and it also becomes duller and more opaque in appearance. The characters are well seen about the eighth to the tenth day. (One or two other organisms give a somewhat similar appearance, but these are readily distinguished by their morphological characters.) In stroke-cultivations on agar a whitish line appears on each side of the needle-track, and spreads for a short distance, assuming a yellowish tint with a moist appearance; on blood-serum it appears first in the form of little transparent drops of yellowish tint. In gelatine-peptone it also grows, but the medium of course becomes liquefied at the temperature suitable, and accordingly the growth is not characteristic. In inoculating from glanders nodules, &c., potatoes are found to be the most suitable medium for starting the growth, and they have also the advantage of giving a characteristic appearance.

The bacillus can be dried without being killed, but in the dry condition it retains its vitality for a much shorter period of time than the tubercle bacillus. Löffler found that in most cases the bacilli were dead after being in the dry state for a week, though sometimes they lived much longer. Pure cultivations generally die off after a month. To heat and chemical reagents it offers a comparatively low degree of resistance. It is very rapidly killed by steam at 100° C., and pure cultures are killed by an exposure to 55° C. for ten minutes. Carbolic acid 2–5 per cent., chlorine water, and other agents, are all effective in a few minutes. Accordingly, any of these agents may be employed for disinfecting purposes.

Löffler and Schutz, after demonstrating this organism in the tissues, succeeded in obtaining pure cultivations on the serum of the horse and sheep, and, after growing it through several generations, tested the effects of inoculations on various animals. Some animals they found to be refractory, whilst others were very susceptible. Amongst the latter are field-mice and guinea-pigs. On rabbits the effects are somewhat uncertain; sometimes only a local lesion developing, sometimes a general attack of glanders resulting, with nodules in the lungs, &c. Cats and young dogs are readily susceptible to inoculation, whilst white mice enjoy immunity. Field-mice generally die in about eight days after inoculation, and show an extensive growth of minute nodules in the liver, spleen, &c. Inoculation is rapidly fatal to guinea-pigs also, and they show all the characteristic features of acute glanders. Great interest naturally attaches to its effects upon horses; and Löffler and Schutz, after one doubtful experiment, obtained satisfactory results with two horses. They made several injections at various parts of the body, and at the seats of inoculation boggy swellings formed in a few days, and later many of them broke down into unhealthy-looking ulcers. The lymphatics became swollen so as to form hard cords, and the glands became enlarged to the size of pigeons' eggs and indurated, a discharge took place from the nostrils, and the animals had all the symptoms of an ordinary attack of glanders. One animal died, the other with symptoms of failing health was killed. On *post-mortem* examination both presented lesions characteristic of glanders—not only ulcers on various parts of the surface with implication of the lymphatics in connexion, but also deposits in the nasal mucous membrane, with irregular ulcerations, and nodules in the lungs. Experiments on animals have been repeated by a great number of observers with confirmatory results. The glanders bacillus is one which in cultivations shows great variation in virulence.

The same bacillus is found in the lesions when the disease occurs in the human subject, and cultivations having the same characteristics have been made. Weichselbaum at a comparatively early date (*Wien. med. Woch.* 1885) succeeded in obtaining pure cultivations from the pustules in a case of acute glanders in a woman, and by inoculations on various animals obtained similar results to those of Löffler and Schutz. One of the writers cultivated the bacillus from a farcy bud on the arm in 1880, but failed to produce characteristic effects in animals. Unfortunately, also, workers at this subject have been accidentally inoculated with cultures of this bacillus, with fatal results.

Regarding the presence and characters of this organism, its manner of growth on potatoes, &c., and its effects on animals, there is practical unanimity amongst all who have investigated the subject. The results of the experiments of Bouchard, Capitan, and Charrin about the same time as those of Löffler and Schutz are now generally regarded as fallacious. These observers found in the glanders nodules, &c., organisms in the form of cocci, often growing in chains, which they were able to cultivate through several generations, and by means of which they produced the disease. Probably there were also glanders bacilli present in the cultivations in small quantities, and to them the results were due.

In its mode of action and in its effect upon the tissues, this organism presents a certain resemblance to the tubercle bacillus. Its growth may remain for a long time local, or it may rapidly produce a general infection; but in all situations its action on the tissues is the same. By its growth it causes irritation, which produces cell proliferation and leucocyte infiltration, so that a small focus or nodule results, which may enlarge to various dimensions. If at any place the bacilli are present in large numbers (*e.g.* after a local inoculation), the area which shows the reaction is correspondingly large. Along the lines of the lymphatic vessels and in the lymphatic glands a similar action takes place, giving rise to the well-known thickening and induration. The nodules in glanders, owing doubtless to the nature of the chemical products of the organism, have a great tendency to undergo softening and to break down. Hence the formation of ulcers in various parts which is so important a feature in glanders. The action of the organism is for the most part confined to the lymphatic system; but that it also enters the blood, and is thus distributed, is proved both from the anatomical disposition of the lesions and also by the actual demonstration of its presence in, and its cultivation from, the blood, though in most cases this is a matter of great difficulty. The bacilli are found in greatest numbers in the small nodules of recent formation. In old nodules, especially when ulceration has taken place, their detection is a matter of great difficulty, or may be quite impossible.

The spread of the disease takes place for the most part by direct inoculation of material containing the bacilli—nasal secretion from a case of glanders, &c.—on a wound of the skin or on a mucous membrane. In horses and asses, at least, the disease is probably also transmitted by inhalation of the organisms suspended in the air. That this is not a rare occurrence is likely from the fact that the lungs may contain numerous nodules without evidence of the disease in any other part of the body. Babes (*Arch. d. Méd. Expér.* 1891, iii.) found that the disease could readily be set up in susceptible animals by exposing them to an atmosphere in which cultures of the organism had been pulverised. He also found that inunction of the skin with vaseline containing the bacilli might produce the disease, their entrance being in this case along the hair-follicles. As a means of diagnosis in doubtful cases of the disease, as has frequently been pointed out, the method of inoculation is of much greater service than microscopical examination; and for this purpose guinea-pigs are the most suitable of the animals generally available. Strauss states that after inoculating the peritoneal cavity of a male guinea-pig with glanders secretion, a swelling of the testicles rapidly takes place, and the growth of small nodules can be found in the tunica vaginalis as early as two days after the inoculation. Within recent years a substance ('*mallein*') has been introduced, which is said to afford a certain means of diagnosis. It was prepared by Kalming as a watery extract, and by Preusse as a glycerine extract, of cultures of the glanders bacillus. This substance when injected in certain doses is said to produce a febrile reaction in glandered animals, but none in others. The method is still under trial.

A. Babes (*Arch. de Méd. Expér.* July 1892) has isolated a substance which he calls '*morveine*,' and which from its chemical characters he thinks to be of the nature of an enzyme. He prepares it by precipitating filtered cultures of the bacillus with equal parts of alcohol and ether, and finds it to be exceedingly powerful in its action, and that it causes a reaction especially in glandered horses. He also states that he has been able to produce by repeated small injections of it an immunity against glanders, and in one case of the disease he succeeded in effecting a cure. All these statements still require confirmation.

12. **Actinomycosis.**—*See* special article.

13. **Rhinoscleroma.**—This disease, which is characterised by a chronic induration and thickening of the skin and of the mucous membranes of the nose, pharynx, and other adjacent parts, has the features of a chronic inflammatory process produced by a specific irritant, and this is probably a bacillus. The presence of organisms in the affected tissues was first observed by Frisch in 1882 (*Wien. med. Woch.*), and his observations have been confirmed. In fact, there is practical agreement amongst those who have had an opportunity of studying the disease, regarding the invariable presence of a bacillus with definite characters. This organism is very similar in form to the 'pneumococcus' of Friedländer, occurring in the form of short rods, often several in a row, which are surrounded by a hyaline capsule. They generally measure 1·5–3 μ in length, and about ·7 μ in thickness. As described by Cornil, Alvarez, Payne, and others, they are found, often in considerable numbers, within the large spherical cells which are present in large numbers in the thickened dermis, and also lying free in the connective-tissue spaces and in the dilated lymphatics. The rods are readily coloured by Gram's method, and the capsules may thereafter be stained red by safranin. Cultivations of the organism have been made, first by Paltauf and v. Eiselsberg in 1886, and since then by many others. On peptone-gelatine the growth has a remarkable similarity to Friedländer's pneumococcus, being in the form of a rounded knob on the surface, with a thin line along the

needle-track. The only difference observed is that it is rather more yellowish in tint, and more opaque in appearance. The rods also tend to be of greater length, and, as already stated, they differ in staining with Gram's method.

Organisms have, however, been found in other situations by various observers, which in their characters are said to be similar to the bacillus of rhinoscleroma, and some of them have been cultivated from healthy nasal secretion; and it has been held that in rhinoscleroma some of these organisms have simply passed into the tissue already diseased. Yet the invariable presence of the organism, and its special relation to the tissue-changes, are strongly in favour of its standing in causal relationship to the disease.

Unfortunately, experiments on animals are not conclusive, and different results have been obtained by different observers. Paltauf and v. Eiselsberg failed to produce any change like rhinoscleroma; whilst Pawlowsky, by injections into the anterior chamber of the eye, produced a chronic inflammatory overgrowth with large epithelioid cells, some of which contained hyaline globules such as are found in rhinoscleroma. From what we know of other diseases, it is scarcely likely that a true rhinoscleroma can be produced in animals.

Bandler has found the same organism in a chronic inflammatory thickening of the vocal cords—*chorditis vocalis inferior hypertrophica*—and has made pure cultivations from the diseased tissue; and accordingly believes that the affection is the same as rhinoscleroma.

14. Syphilis.—Although many observations had been made on this disease, with a view to finding characteristic micro-organisms, and such had been described by various observers at an earlier date, the work which is probably of most importance, and which has certainly attracted most attention, is that of Lustgarten, who in 1884 announced the discovery of a bacillus with special properties. He found in the affected tissues thin bacilli, generally 3·5 to 4·5 μ in length, often bent or slightly irregular, with small swellings at the extremities, and sometimes showing two to four spores in their interior. They occurred chiefly within the larger cells, especially at the periphery of the syphilitic infiltration, though some were also found lying free in the lymphatic spaces. He was able to demonstrate these organisms in all of sixteen cases which he examined, using a special method as follows: The sections were stained for twenty-four to forty-eight hours in an aniline-water solution of gentian violet; and after being washed in alcohol, were placed for ten seconds in a 1·5 per cent. solution of permanganate of potassium. They were then treated with sulphurous acid, which removes the brown precipitate which has formed and decolorises the sections; washed in water; dehydrated, and mounted. Tubercle and leprosy bacilli can be coloured in the same way; but, unlike these, the 'syphilis bacilli' are easily decolorised by mineral acids. Subsequent observations would appear to show that these organisms are not always present in the syphilitic lesions, and several competent observers have altogether failed to find them. Moreover, it has been asserted that a similar organism may be normally present on the surface of the genital organs (the *smegma bacillus* of Alvarez and Tafel), and that in syphilis it enters the affected tissues secondarily. This, however, would not explain its presence in the lesions in the internal organs in syphilis. Since the publication of Lustgarten's work, other organisms, supposed to be characteristic, have been described by various observers as being present in the tissues, and even in the blood, in syphilis. The whole question is at present in a very doubtful state, and we cannot say that any particular organism is even probably the cause of the disease.

GROUP IV.—*Diseases associated with Spirilla.*

15. Cholera, Asiatic.—Although many attempts had been made to discover the cause of cholera, and various fungoid and allied organisms had been found in the discharges, and had been supposed to be the specific agent, none had any sufficient scientific support until the discoveries of Koch in 1884. But it cannot be doubted that antecedent observations, erroneous though they may have been, paved the way for the acceptance of the view that cholera may be due to a micro-organism.

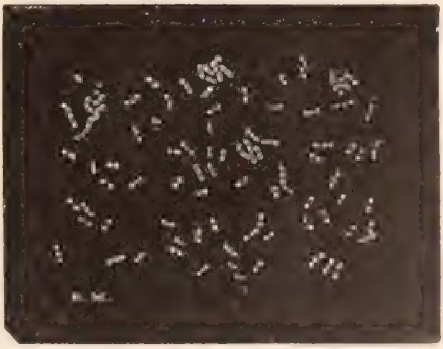

FIG. 86.—Koch's 'Comma Bacillus,' or Spirillum of Asiatic Cholera.—From a dried culture, stained with fuchsin. From the Berlin Health Laboratory. × 900 diam.

It might be well to state at the outset that, although the observations of Koch may be regarded as practically beyond dispute, and although the organism discovered by him affords in its reactions a striking explanation of many of the phenomena of cholera, yet we lack absolute scientific proof of its causal relation to the disease. Enough is known, however, to make its provisional inclusion justifiable. Moreover, Koch's results have been confirmed by the vast majority of competent observers in all parts of the world.

The 'comma bacillus' of Koch, or 'Spirillum choleræ Asiaticæ,' is a very minute organism, each cell being about 1·5 to 2 μ in length, and ·5 to ·6 μ in thickness, curved in varying degree, and therefore resembling a comma. Each cell is flagellated at one or both ends, commonly only at one end, the flagella being either single or double, from one to five times the length of the cell, and not more than ·05 μ in thickness. As in other spirilla, the flagella may be present only at some periods of life; and we may find the cells when they are grown under various conditions, in pairs, S-shaped, or in longer filaments of corkscrew form, and even as straight rods. (This will be best understood from a comparison with the drawing of spirillum undula, fig. 69.)

The cells are actively motile, especially in warm temperatures. When stained, the individual cells may show darker parts at the ends or centre, suggesting possible spore-formation. But although much attention has been devoted to this question, no spores have yet been proved to exist.

The microscopical characters are seen in the accompanying figures, one of which (fig. 86) is drawn from a specimen stained with fuchsin, the other (fig. 87) from one stained by Löffler's method for showing flagella.

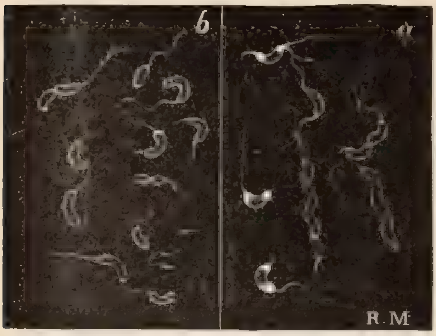

FIG. 87.—Finkler's Spirillum and Koch's Cholera Spirillum, both prepared in the same manner, stained by Löffler's method, to show flagella; and placed side by side for comparison.—*a.* Finkler's Spirillum. From a culture made in the Pathological Laboratory, Univ. Edin. *b.* Koch's Cholera Spirillum. From a specimen from the Berlin Health Laboratory. × 2,000 diam.

Side by side with the latter is a drawing from a cultivation of Finkler's comma bacillus, stained by the same method. The relations of Finkler's bacillus or spirillum will be subsequently referred to.

To stain the spirillum, after drying the intestinal contents on a cover-slip, a watery solution of fuchsin may be used, best with heating for about ten minutes. But Löffler's method gives far better results, though it is much more tedious and uncertain. Specimens stained in this way usually appear larger than when simply stained. For partial staining, a very dilute solution of methyl violet may be mixed with the intestinal contents on the slide.

Sections of the intestine may be stained for twenty-four hours in fuchsin or alkaline methylene-blue solution.

Growth and Cultivation of the Spirillum. These organisms grow best in alkaline media, and with free access of oxygen; indeed, it is said that some of the movements appear to be actively directed to the search for oxygen when a 'hanging drop' is studied. But they must be capable of growth with a deficient supply of free oxygen, as in the intestine, deriving it from the blood and lymph, or from compounds which contain it.

The presence of acids is generally prejudicial to their growth, yet they grow on potatoes of which the reaction is slightly acid.

For active growth a temperature of 30° to 40° C. (85° to 104° F.) is best suited, and growth is arrested below 15° C. or above 42° C. Growth also ceases in an atmosphere of H or CO_2, but revives on readmission of oxygen. A temperature of $-10°$ C., or vacuum, does not destroy the spirilla; but drying for two to three hours, or a temperature over 50° C., soon kills them. They grow readily in meat-broth, even when exceedingly dilute, in milk—producing little or no perceptible change in it, on blood-serum, nutrient gelatine or agar, and on potatoes.

The growth on nutrient gelatine and on potatoes is especially employed for diagnostic purposes.

In gelatine-plate-cultivations, made in the manner already described, minute whitish points appear, and around them the gelatine liquefies, the minute colony, not larger than 1 mm. in diameter, sinking into a funnel-shaped depression. By the end of the second or third day (if the plate is kept at about 20° C.) it is covered with these small funnel- or bubble-shaped depressions. The liquefaction spreads peripherally, and the entire surface becomes liquefied, the rapidity of course depending on the number of points of growth.

The appearances on examining the plate microscopically in the usual way, with a low power, are also peculiar. The individual colonies are very irregular in shape, and as they enlarge they appear highly granular, resembling, as Koch remarked, a mass of particles of ground glass, and having a peculiar glistening appearance, the colour being white or faintly yellowish. As liquefaction occurs, a clearer zone, with crenated edges, surrounds the colony, and later the mass sinks into the funnel-shaped hollow caused by the liquefaction. At this period a faint roseate hue may sometimes be observed in the colony, which is regarded as absolutely peculiar to the cholera spirillum, and has not been observed in any other similar growth.

If grown in such a way that higher powers can be used for observation, each droplet is found to swarm with actively moving spirilla.

The mode of growth in puncture-cultivations in nutrient gelatine is also peculiar. The growth along the needle-track is most active near the surface, and as liquefaction occurs the colony grown at the surface sinks into the jelly. The funnel-shaped area of liquefaction enlarges beneath the surface, and thus acquires a bubble-like appearance. Later, the liquefaction advances more deeply along the needle-track, and an elongated funnel- or finger-shaped zone of liquefaction occurs. This spreads until it reaches the sides of the tube, and from this time spreads deeper in the tube. But the process of liquefaction is slow, and with jelly of sufficient strength (10 to 15 per cent. gelatine) may take some weeks. At the bottom of the liquefied area are whitish masses of spirilla, whilst at the surface is a scum or pellicle of them, mostly in various stages of degeneration.

The cultivations thus made are liable to rapid degeneration and death, so that after five or six weeks it may be difficult to make secondary cultivations from them.

On agar jelly, the surface-growth is in moist-looking, whitish streaks, which do not tend to spread much, and are not specially characteristic. When older, the cultivations tend to become of brownish colour. The agar is not liquefied. The duration of life in agar-cultivations is much greater than in nutrient gelatine, successful recultivations having been made after some months.

On potatoes, especially when kept at a temperature of 20°–30° C., the growth spreads as a thin translucent layer of somewhat brownish-yellow or greyish-brown colour, the exact shade probably depending on the different kinds of potato or the temperature and moisture.

In broth the growth is rapid, and the spirilla tend to accumulate in a scum upon the surface, some masses falling to the bottom, leaving the greater part of the broth clear.

The methods of cultivation thus described are of practical importance, since the characters presented by the cultures are, when taken together, almost peculiar to the cholera spirillum. It is true that some closely allied forms, *e.g.* Finkler's spirillum, which has been found in cases of summer diarrhœa in the intestinal evacuations, and perhaps some others, give reactions which are very similar. But the liquefaction of the jelly is more rapid, and does not in tubes assume the same peculiar form. If the cultivations are studied side by side, one can easily see these differences, but they are not to be readily perceived by those who have not carefully worked with the true cholera spirillum. As may be seen from fig. 87, the differences in the microscopic characters of the two would not be readily perceptible.

Hence the importance of discovering some further diagnostic characters. One which has been suggested is found in the fact that, if a cultivation in peptonised broth is treated with dilute sulphuric acid, which must be absolutely pure, a reddish violet or even purple colour is produced. This reaction, which is said also to occur with the so-called vibrio-Metchnikoff, but not with Finkler's spirillum, is stated by Salkowski to be due to the presence of indol. It is therefore only reliable if extreme care is taken to prevent the formation of indol in other ways by reduction, and to use only pure sulphuric acid. And it is best to cultivate in extremely dilute broth.

But, by the careful study of the various modes of growth and reactions, the practised observer can distinguish with almost absolute certainty the 'comma bacillus' of Koch; and important practical results in the early detection of cases of cholera have been attained in this way.

The study of this organism leaves no doubt that it is capable, under favourable conditions, of propagating itself outside the human body. or, as some would put it, that it has a sapro phytic *rôle* in nature. The favourable conditions can only be attained where there are a suitable temperature and site and soil for its continuous propagation. Experiment has shown that it can live in pure water for some time, but that in water containing organic matter and other bacteria it is said to flourish only a short time, and is then killed by the growth of the other bacteria. In what way it succeeds in persisting in localities where the disease is endemic, as in the delta of the Ganges, and along the Yang-tze-Kiang valley, is not yet fully explained. Some recent observations throw doubt upon its absolute incapacity to withstand drying, and suggest also that, whilst it is readily destroyed by drying when grown in the intestinal canal, it has a greater degree of vitality in conditions of free growth outside the body. Nor can we overlook the fact that many bacteria, which are readily suppressed by others when grown with them in artificial cultivations, do not entirely perish, but some frequently survive, and may be recultivated, though with difficulty.

Relations to the disease.—Briefly stated, this peculiar bacterium was found by Koch in the intestinal discharges and contents in all cases of true Asiatic cholera, reaching the maximum degree of abundance at the height of the disease, and then almost entirely replacing the common bacteria of the intestinal canal. On the other hand, it was not found in the excreta of healthy persons, or under any other conditions than where cholera was present, disappearing with the epidemic. This constant association with the disease has been confirmed by many observers in different parts of the world. Moreover, the conditions under which cholera occurs and disappears correspond with what might be expected from our knowledge of the life-history of the spirillum. For details on these points other works must be consulted.

The organism is not only found especially in the intestine and its contents, but is practically limited to them, not invading either the blood or other organs. In the intestine it penetrates into the crypts of Lieberkühn, and may be found beneath the epithelium, but rarely makes its way more deeply. The intestinal contents, especially when examined immediately after death in rapidly fatal cases, resemble cultivations of the spirillum.

Attempts to produce the disease in lower animals by inoculating or injecting the organism are open to the difficulty that cholera never affects the lower animals. But since in other diseases peculiar to man success has been attained by inoculation of the cultivated specific organisms, this barrier is not necessarily insuperable.

After numerous experiments by various observers, many of them of doubtful value, the result has been attained by Koch and confirmed by others, notably by Macleod and Woodhead, that, if the contents of the alimentary canal in guinea-pigs are rendered alkaline, and the peristaltic movements partially arrested by means of opium or in other ways, the injection of cultivations of cholera spirillum into the stomach is followed by a condition closely resembling cholera. Diarrhœa is absent, but the intestines are found after death to be distended with fluid containing enormous quantities of the organism, and the changes in the structure of the intestine resemble those in human cholera.

An unintentional experiment on the human subject is also recorded by C. Fraenkel.[1] A doctor, working in the 'cholera course' in Koch's laboratory, and in no other way exposed to the disease, had a severe attack of typical cholera, with the usual presence of the 'comma bacillus' in the stools.

Mode of action in the disease.—We have seen that the spirilla are positively limited to the intestines within the human body, and that they do not even here penetrate more deeply than just beneath the epithelium. Careful research has failed to discover them in the blood or any of the other organs. Their action would therefore appear to be entirely local, and to produce an intense and peculiar irritation of the intestinal mucous membrane, which constitutes the chief *post-mortem* appearance. How far the other symptoms of cholera are explained by this intestinal lesion, and by the rapid withdrawal of water, has been disputed. That they may be due to these alone is suggested by the phenomena of some other poisons which cause severe diarrhœa. But it is probable that there is in addition some poison produced in the bowel, which is absorbed into the blood.

Various attempts have been made to isolate this poison, but of the numerous substances which have been separated from cultivations it is at present uncertain whether any one of them is the special cholera toxine or tox-albumen.

The general facts as to the spread of cholera, its conveyance mainly or solely through the excreta, its rapid development and spread by infected water or milk supply, its relations to temperature, and so on, accord very closely with what has been discovered with regard to the 'comma bacillus.' And whilst there are some points which need explanation, the researches of Koch may safely be followed as practically true for the treatment of epidemics, with the sole exception of a doubt whether drying is a sufficient means of disinfection.

Reference has been made to Finkler and Prior's comma bacillus, and to the vibrio of Metchnikoff. These organisms, and some others which have been carefully studied, *e.g.* Deneke's comma bacillus and Emmerich's bacillus, have in some ways close resemblances to Koch's spirillum, and much has been said and written about them. It is at present questionable whether any of them can be regarded as the specific agents of any disease. The alleged results of their cultivation and inoculation in animals have not been sufficiently confirmed to make it worth while here to detail them. All that may be said is that, whilst unquestionably there are other species of spirilla found in nature, and even in the human body, which bear a close resemblance to the 'cholera spirillum' of Koch, they show, when carefully investigated, marked differences in their conditions of life, mode of growth, and still more in their peculiar relations to disease. Their study has tended to confirm the view that Koch's organism has, amongst the closely allied minute spirilla, a peculiar and special relation to cholera.

Within recent years several methods of producing immunity against the effects of the cholera spirillum have been announced. Of these probably most importance attaches to that of Haffkine, who states that he has produced immunity even against the virus in intensified form. This *virus exalté* is produced by growing the organism in the peritoneal cavities of a series of guinea-pigs in succession—generally about twenty—when it is found that it has acquired a greatly increased degree of virulence, and is rapidly fatal to guinea-pigs if injected into the blood or alimentary canal. Subcutaneous injection, however, causes merely a local necrosis; but if the animal has previously been injected by an attenuated form of the virus—the attenuated form being produced by growing in a current of air—the necrosis does not occur, but merely a local œdema. (The entire method of attenuation is merely an exact repetition of the mode adopted by Pasteur in his well-known researches on 'fowl-cholera,' a form of septicæmia which has no relation to Asiatic cholera.) After the animals have been thus treated by subcutaneous injection, first with the attenuated virus, and then with the *virus exalté*, they are found to be quite immune against the organism introduced in any way whatever. Haffkine inoculated Hankin and several others by this method, and, so far as the local changes are concerned, produced the same effects as in guinea-pigs, *i.e.* after injecting with the attenuated virus he injected with the intensified form, with no further result than a local œdema and some fever. It thus appears that the human subject may be inoculated with safety by this method, and it remains to be seen whether any immunity is conferred against the natural disease, and, if so, how long it lasts. Of other methods of conferring immunity which have been described, space does not permit us to give an account.

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[1] *Grundriss der Bakterienkunde*, 3rd edit. p. 365.

16. **Relapsing Fever.**—At a time when practically nothing was known regarding the part played by bacteria in the causation of disease, a spirillum was discovered in the blood of patients suffering from relapsing fever, and found to have a definite relation to the phenomena of the disease. This organism was discovered by Obermeier in 1873 (*Centralb. f. med. Wis.* 1873, p. 145), and is generally known as the *Spirillum* or *Spirochæte Obermeieri*. He found it in the blood of patients suffering from this disease during the time of the fever, but observed that it began to disappear shortly before the crisis, and that after the crisis it was absent; also he failed to find it in any other condition. In every respect his observations have been confirmed.

Description of the organism.—The spirillum is of considerable length, measuring '1½ to 6 times the diameter of a red blood-corpuscle,' but is exceedingly thin. It shows several regular somewhat abrupt curves, and is of uniform thickness, except at the extremities, where it is pointed. It is possessed of very active motility, having both a wavy and spiral motion, and being also capable of rapid locomotion. At the onset of and during the fever the spirilla may be present in the blood in enormous numbers. The organisms always occur free, being never found either within the red corpuscles or the leucocytes. In dried films of blood they can be stained by any of the simple stains, though they do not take the colour very deeply; but in sections of the tissues their demonstration is a matter of considerable difficulty, and one of the methods for avoiding decolorisation requires to be used, methyl blue being a suitable dye. They are decolorised by Gram's method. Koch succeeded in staining in the tissues with Bismarck brown.

In blood outside the body the spirillum has considerable vitality, sometimes showing active movements after several days. It is killed by a temperature of 60° C., but it can be exposed to 0° C. without being killed.

Relations to the disease.—All attempts to cultivate the organism outside the body have hitherto failed. Koch observed that in certain conditions a growth of the organism in length took place, but no actual multiplication. Soon after its discovery, however, Münch, by injecting blood containing the organism, produced the disease in the human subject (*Centralb. f. med. Wis.* 1876); and a little later Vandyke Carter and Koch produced the disease in apes by a similar procedure. In such cases there is an incubation-period usually of three to six days before symptoms appear. In all cases, along with the onset of the fever, the spirilla appear in the blood in enormous numbers. As a result of these observations and experiments it may be considered as practically proved, even in the absence of pure cultivations outside the body, that this organism is the cause of the disease.

As already mentioned, the organisms disappear from the blood about the time of the crisis, and are absent during the 'interval.' Metchnikoff (Virchow's *Archiv.* 1887, Bd. 109, p. 175), by producing the disease in apes and killing them at various stages of the fever, found that during the period of defervescence the spirilla on disappearing from the blood accumulated in the spleen, and alleged that they were incorporated within leucocytes in that organ. Within these cells he observed spirilla in various stages of disintegration. This process of 'phagocytosis' never occurs, according to him, in the blood, and after the spirilla have disappeared from the blood they are not present in any other organ than the spleen. Soudakewitch (*Ann. de l'Inst. Past.* 1891) has performed similar experiments, and obtained practically the same results. It is, however, still unexplained why the disappearance of the organisms from the blood should start at a particular time, and should then take place so rapidly.

It is not known whether spores are formed or not, nor where and in what condition the organism exists in the body between the attacks of the fever. As to possible existence and life-history outside the human body we are still in ignorance.

Group V.—Not coming into any of the previous classes.

17. Anthrax.—The Bacillus anthracis is one of the best known and most fully investigated of all pathogenic bacteria, and was the first to be conclusively proved to be the cause of a definite disease in man, and in some of the lower animals. It was first observed in the blood of animals affected with the disease by Pollender in 1849, and was afterwards the subject of important investigations by Delafond, Davaine, Brauell, Koch, and later by Pasteur. By the experiments of these workers its causal relation to the disease had been almost conclusively proved, but the final proof was given by Koch in 1876. He was the first to succeed in obtaining pure cultivations of the bacillus outside the body, and was thus able to test the effects of its inoculation on animals without risk of fallacy. Owing to its comparatively large size, this organism has been the subject of much study, which has yielded valuable information on the morphology of bacteria, the origin and mode of formation of spores, as well as their vital properties and powers of resistance. Furthermore, discoveries regarding modification of its virulence, and the possibility of preventive inoculation, have proved of great value in relation to the whole subject of acquired immunity, and have been of much practical utility. It also serves as an excellent example of a micro-organism causing rapidly fatal results by its multiplication in the blood throughout the body.

The Bacillus anthracis (*bactéridie du charbon*; *Milzbrandbacillus*), as seen in the blood of an animal affected with the disease, occurs in the form of comparatively large rods, whose thickness is about 1·5 μ, and whose length is generally about the diameter of a red corpuscle, though both shorter and much longer forms are seen. The rods may be present in enormous numbers, sometimes appearing to equal the red corpuscles in number. In the blood and in the spleen the rods occur singly, or two or three may be joined end to end, but long chains are not usually found. In the pleural exudate and in similar fluids, as well as in cultivations outside the body, the organism grows into long filaments, which may be shown to be made up of a large number of individual bacilli. The rods have slightly rounded or nearly square extremities, and their protoplasm has a homogeneous or slightly granular appearance, but spores are not usually found in the bacilli within the living body. When the organism is grown outside the body in a suitable soil, at a sufficiently high temperature (not below 18° C.) and in the presence of oxygen, spore-formation occurs, which in its chief features agrees with what has previously been described under 'Spore-formation.' The various appearances are well seen in the accompanying woodcut (fig. 89).

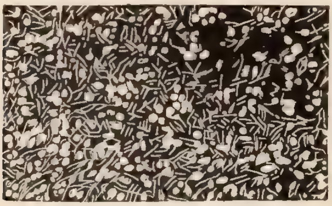

Fig. 88.—Part of the Spleen of a Guinea-pig which died of anthrax, showing the relative proportion of bacilli and leucocytes. × 100 diam. From a photomicrograph.

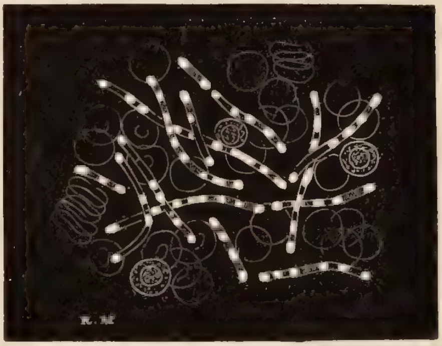

Fig. 89.—Bacillus Anthracis in a Blood-vessel in the Heart of a Cow. × 950 diam.

Cultivation, &c.—The anthrax bacillus can readily be cultivated outside the body on all the ordinary media. It grows at ordinary temperatures, but much better about 35° C., the limits of growth being generally given at 12–45° C. On certain media its growth has a characteristic appearance.

In puncture-cultivations in peptone-gelatine the growth appears along the needle-track as a somewhat whitish line from which fine lateral offshoots spread out horizontally in the medium, these also in their turn giving off lines of growth, so as to produce an appearance which has been compared to bunches of fine bristles. The lateral stems are longest near the surface of the gelatine. Later, liquefaction begins at the surface and spreads downwards, so that the characteristic features are lost, and the growth appears as a white flocculent mass at the junction of the fluid and solid portions. In plate-cultivations minute white colonies appear, which, on reaching the surface of the gelatine, cause a little area of liquefaction around them. If these superficial colonies are examined with a low-power lens, the periphery is found to have an appearance like masses of curly locks of hair, the centre of the colony being denser and of a slightly greenish tint. The appearance is due to the growth of the organism in wavy bundles of long parallel filaments, which in the centre of the colony are interwoven and massed together. On potatoes the growth is abundant, and appears as a thick cream like mass, which remains chiefly localised and has little tendency to spread on the surface. The growth on other media presents nothing characteristic. The bacillus also flourishes well in broth and other liquid media.

Growth takes place only in the presence of oxygen, and best on a neutral or slightly alkaline medium. In all conditions the bacilli are found to be devoid of the power of independent movement. They can be coloured readily by Gram's method, and by the various simple aniline stains.

Anthrax bacilli in the spore-free condition have comparatively little resisting power to chemical antiseptics, &c. When dried they are generally found to be dead after a few days, and they soon die in fluids in the presence of putrefactive bacteria. They are very rapidly killed by moist heat at 65° C., and by a 1 per cent. solution of carbolic acid; the action of the gastric juice is also rapidly fatal to them, and they are therefore generally killed in their passage through the stomachs of animals. The spores, on the other hand, show a remarkable tenacity of life, regarding which some of the chief facts have already been given. As is well known, they can be kept in the dry state for an almost indefinite period of time, and still be capable of growth when placed in suitable conditions. Dry heat at 140° C. must be applied for several hours in order to kill the spores with certainty, and they may be placed in a 5 per cent. solution of carbolic acid for a considerable time without being killed. Unlike the bacilli in the spore-free condition, they can pass through the stomach unaltered, and thus reach the intestine in a virulent condition. The facts stated with regard to the conditions of formation of spores, and their powers of resistance, are of the greatest importance in relation to the life-history of the organism, and the mode of spread of the disease.

Relations to the disease.—When inoculated into susceptible animals (such as mice, rabbits, guinea-pigs, &c.) even in the minutest quantities, this organism causes a rapidly fatal disease. The bacilli generally soon reach the blood, and rapidly multiply, so that they may be present in enormous numbers; in the spleen also they are very numerous in some animals, and this organ in most animals shows marked enlargement. Death generally takes place in one or two days. The other *post-mortem* changes are chiefly those of a severe septicæmia—congestion and cloudy swelling of organs, and often small hæmorrhages, which are in many cases associated with plugging of the capillaries with small masses of the bacilli. At the seat of inoculation there may be inflammatory œdema, with extravasation of blood; or there may be little change. In sections of the tissues the bacilli are found in enormous numbers in the capillaries (in comparatively small numbers in the larger vessels); in fact, so numerous are they in the capillaries of the kidneys, liver, intestines, peritoneum, and lungs, that in stained specimens these may appear as if injected with a coloured material. Animals may be infected by inhalation either of the bacilli or their spores, the former generally producing a pneumonic condition, whereas the latter may be rapidly absorbed, and produce a general infection with comparatively little local change. Infection by the spores may also take place by the intestinal tract, and this is probably the common mode in the natural disease in sheep and cattle. The modes of infection in the human subject, and the lesions produced, are described under PUSTULE, MALIGNANT. Certain animals enjoy a natural immunity against the action of the anthrax bacillus, for example, adult dogs, white rats, many birds, and frogs; though the susceptibility may be modified by altered conditions of temperature.

In view of the enormous numbers of bacilli which may be present in the blood, it was formerly thought that their effects were produced partly mechanically, and partly by their using up the oxygen of the blood. And though they do act in both of these ways, it is now known that, in common with other pathogenic bacteria, the anthrax bacilli produce specific chemical poisons. A so-called toxalbumen was separated by Brieger and Fraenkel, whilst Sidney Martin has separated albumoses and a poisonous alkaloid. Sidney Martin finds that the action of the bacillus on the proteids of the body is very similar to that of the tryptic ferment, an alkaloid being one of the products of the breaking up of the peptones. This alkaloid is a local irritant, producing inflammatory œdema, and it also causes fever, whilst the albumoses produce coma in animals. He was able to separate these substances both from anthrax cultures, and from the blood and spleen of animals which had died of the disease. Hankin also isolated an albumose which was fatal to guinea-pigs and mice in very minute doses.

So numerous and various are the experiments on the subject of the production of artificial immunity against anthrax, that only one or two of the most important results can be stated. In the various methods employed there are two chief principles involved—first, that one attack of the disease protects from subsequent attacks for a considerable period of time; and, secondly, that the virulence of the organism may be so modified by the conditions of its growth, &c., that when inoculated it produces a much milder form of the disease, but one which is still capable of producing immunity for a time. At the outset, to correct a common misconception on this subject, it may be definitely stated that the earliest successful results were obtained by English workers. Duguid and Burdon-Sanderson found that if bovine animals were directly inoculated from guinea-pigs suffering from anthrax, the disease produced was not a fatal one. Greenfield confirmed this discovery, and also found that the bacilli obtained from guinea-pigs retained their properties in cultivations, and could therefore be used as a protective vaccine for cattle. He also found that when grown through successive generations in aqueous humour, their virulence became greatly attenuated. These facts were published before the work of the French observers. Toussaint very shortly afterwards stated that if the blood taken from an affected animal and containing the bacilli were exposed to a temperature of 55° C. for a certain time, it acted as a protective agent when injected into animals. Pasteur somewhat later published his method of attenuation and preventive inoculation, regarding which the following are his chief statements. Anthrax bacilli grown at 42·5° C. do not form spores, and after twenty-four days are so modified that they do not kill rabbits or sheep, though they are still fatal to mice. A cultivation thus prepared is employed as the *premier vaccin*. Cultivations kept under the same conditions for twelve days have their virulence less diminished, and constitute the *deuxième vaccin*. Sheep injected with the *premier vaccin*, and fifteen days later with the *deuxième vaccin*, enjoy an immunity against the most virulent cultures. Pasteur's results have been utilised in France and elsewhere for the protection of cattle and sheep, apparently with success, but great care is requisite in the preparation of the vaccine in order to obtain safe and effective inoculation. The immunity produced in this way is not permanent. Pasteur's method has been criticised by Koch and other German workers. These have acknowledged the efficacy of the method as a means of conferring immunity, but have called in question its applicability as a means of general vaccination against the disease. Other methods of modifying the virulence of the anthrax bacillus have been discovered; for example, Chamberland and Roux found that this was effected by adding a small quantity of carbolic acid to the medium (1 to 600), and Chauveau obtained a similar result by growing it in compressed air.

Recently Hankin has found that the albumose which he has separated from cultures of the bacillus, when injected in very small quantities, is capable of producing immunity, even in mice, which are the most susceptible of the animals commonly used. In the case of anthrax, therefore, one of the poisonous products of the bacillus acts as the protecting agent against subsequent attacks. It is also interesting to note that he found that the bacilli of the *premier vaccin* produce much less albumose than is found in virulent cultures, and therefore Pasteur's method would appear to be a gradual acclimatising of the organism to the albumose poison. The soluble products of a micro-organism had in several instances been proved to be capable of conferring immunity against its action, but this is the first case in which a definite chemical substance possessing this property has been isolated. R. M.

18. **Diphtheria.**—The presence of bacteria and other organisms of various kinds in the false membranes in diphtheria has long been recognised. Within a comparatively recent period the most careful research had only established the almost constant presence of micrococci, masses of which can be readily observed, not only in the false membranes, but also in the deeper tissues, in the swollen lymphatic glands of the neck, in the kidneys, and sometimes in other organs. Their constancy and association with the parts most especially attacked by the disease were strong arguments in favour of their specific relation.

But further research has shown that, although almost constantly present, the micrococci cannot be regarded as the peculiar and specific agent of the diphtheritic virus, but only as associated with, and possibly concerned in, some of the secondary phenomena. The true agent of diphtheritic infection is almost conclusively proved to be the diphtheria bacillus. Klebs had described and studied bacilli of special characters in the false membranes in 1875, but the most complete description of the bacillus and working out of the subject are due to Löffler. Hence the bacillus is commonly known as Löffler's diphtheria bacillus, or less commonly as the Klebs-Löffler bacillus. Löffler's original observations (*Mitth. aus d. K. Gesundh.*, 1884) have been in the main confirmed and largely extended by many subsequent observers. Some of them are referred to below. Of the highly interesting and important observations only a brief summary of the best-established facts can here be given. The bacillus is constantly present, not only in epidemic, but also in sporadic diphtheria, and in membranous croup. The proportion of cases in which it has been discovered microscopically, cultivated, studied by inoculation, &c., by every observer who has investigated any series of cases, is so large that the exceptions are readily accounted for by accidental conditions or defects in method. Speaking generally, its special habitat is in the false membranes; and it produces the peculiar toxic phenomena by means of a poison which is there generated and absorbed into the system.

At first the bacilli are found in small numbers upon and in the superficial layers of the epithelium of the mucous membrane, especially where excoriated; and as the false membrane is formed they multiply, especially in its older and therefore more superficial parts. (That the part in which it is found may not *always* be actually the most superficial is due to the fact that in some positions layers of fibrinous exudation may be superposed at a later period, though this is not the common mode of occurrence. A detailed account of the various modes of formation of the false membrane would here be out of place.) Where the epithelium has been entirely detached, some bacilli may be found penetrating it, especially in those parts infiltrated with serum or sero-fibrinous exudation. But, with rare exceptions, they do not appear to penetrate more deeply, or to become diffused throughout the organism.

In those parts where the diphtheria bacilli are found they may be scattered, or in lines or patches, or, not uncommonly, in spheroidal masses, which may, if the preparation is defectively stained or insufficiently magnified, be readily mistaken for masses of micrococci (*see* fig. 90).

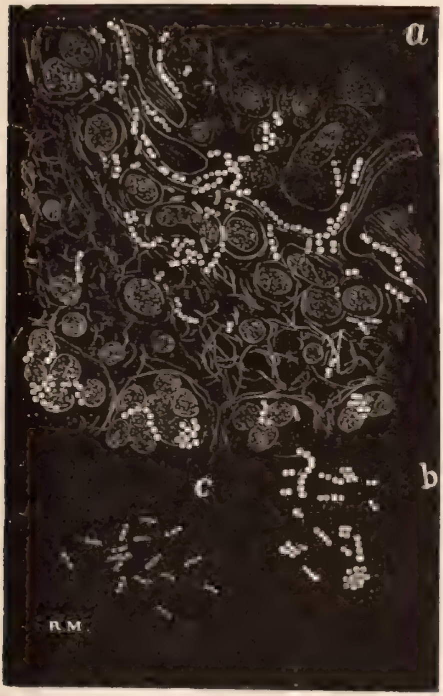

FIG. 90.—Diphtheria.—*a*. Part of false membrane from a case of diphtheria, containing both streptococci and bacilli. *b*. Streptococci; *c*. Bacilli, viewed separately. × 950 diam.

The diphtheria bacillus is minute, of very variable length, the rods not usually exceeding 6 to 8 μ in length, the individual elements 1·5 to 2·5 μ.[1] Both in the fresh condition and in sections it may be straight or slightly curved, often somewhat swollen, and showing either at the ends or centre of the rods more deeply stained portions, the relations of which to spores will be discussed later.

More important are the facts as to the cultivation and pathogenic reactions of the bacillus.

Cultivation.—Löffler first succeeded in obtaining pure cultures of the diphtheria bacillus on a mixture of serum and gelatinised meat-infusion. His medium is composed of three parts of calf or sheep blood-serum mixed with one part of neutral gelatinised veal-broth, to which have been added 1 per cent. of peptone, 1 per cent. of grape sugar, and ·5 per cent. NaCl. It can also be grown on blood-serum alone, on glycerine-agar, and in slightly alkaline meat-broth (veal-broth to be preferred).

Growth proceeds almost solely above a temperature of 20° C., and well at 37° C. (roughly speaking, 70° to 99° F.) A moist temperature of 60° C. kills diphtheria bacilli, whether in the cultivations or false membranes; but when dried they may resist a temperature of 98° C. for nearly an hour. When grown on Löffler's serum they form greyish-white colonies, which extend rapidly on the surface, and become visible to the naked eye in twenty-four to thirty-six hours. It is found that the growth of the first cultivation from false membrane is slower than that of the subsequent generations, probably owing to the more complete acclimatisation.

On agar the growth has a brownish colour, and the edges are more irregular. In broth the bacilli form small whitish clumps, which fall to the bottom or adhere to the sides of the vessel. They can also be readily grown in milk. Liquefaction of semi-solid media is never produced.

The diphtheria bacillus is one which grows best in the presence of oxygen, although in liquids it appears to be capable of some growth in the absence of free oxygen ('capably anaërobic').

The vitality of the bacilli appears to be very great. It has been already mentioned that in fluids they are readily killed by a temperature of 60° C. But at ordinary temperatures their duration of life is remarkable, and still more their power of resistance to drying, which is commonly soon fatal to spore-free bacilli.

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[1] In this we have an illustration of the great variety of statements by different observers, due to modes of preparation and examination. Löffler said they were about the length of tubercle bacilli, but twice as thick. Others say: average 6 μ long, ·16 μ diameter; Zarniko, 1·5 to 2·5 μ long, ·3 μ broad. The latter is approximately correct for the fresh cultivated bacilli, but in hardened and mounted specimens the diameter appears much smaller

Serum cultivations kept under ordinary conditions were found by Roux and Yersin to be living and active for five months (*Ann. de l'Instit. Past.* 1890), by Spronck (*Centr. f. allgem. Path.* April 1, 1890, p. 217) for three months. If air and light were excluded a similar result was observed after thirteen months (Roux and Yersin). Even in broth the vitality may be retained for three months (Spronck).

Still more remarkable is the result of *drying*. Thus, bacilli dried on threads have been recultivated after four months (Roux and Yersin), or even after six months by Spronck (*loc. cit.*), and showed no diminution in vitality or alteration in character. Portions of false membrane carefully dried and kept in the dark have been found to contain living and active bacilli after four months.

The bearing of these facts on the persistence of infection is of extreme importance. They have also great interest in relation to the question of the presence or absence of spores in diphtheria bacilli, and constitute a strong argument against the commonly accepted view that they are devoid of spores.

Modes of Staining.—The bacilli can be readily stained in the fresh condition either in the false membrane or in cultivations. Minute fragments or scrapings are squeezed between two cover-slips in the usual manner, and then dried. They may then be stained with alcoholic methylene-blue solution. They can also be stained with gentian violet, with or without Gram's method. Various other methods may also be employed, such as dahlia and methyl green in watery solutions.

When thus stained, these bacilli, like many others of analogous structure, show deeply coloured portions at the ends or centre of the rods, which are by many regarded as aggregations of protoplasm which take on a deeper stain, and as having no relation to spore-formation, especially as these so-called polar granules (*Polkörner*) do not stain with the special spore-staining methods. It would lead us too far to discuss this subject fully, but it appears to the writer that this conclusion is not warranted, for similar conditions are observed in many other bacilli in which these 'granules' almost undoubtedly have the relation of spores. The fact of possible variety in the character and formation of spores appears to have been lost sight of by many observers.

In addition to these granules, other granules, highly refracting and sometimes staining deeply, may be seen, especially in old cultivations, and the rods may show bulbous swelling of the ends or centre. These are doubtless degenerative changes or 'involution forms.'

In hardened and preserved sections the discovery of the bacilli is often a matter of far greater difficulty: they may sometimes be successfully stained with gentian or methyl violet, or with magenta. But, as with most preserved specimens, it is found that the number of bacilli is apparently far less than in freshly cut sections or scrapings.

Virulence and mode of action of diphtheria bacilli.—When cultivated under suitable conditions their virulence may be maintained through a long series of generations (150, Spronck). But the intensity of the virulence has been found by several careful observers to be subject to considerable modifications, and to vary much under conditions not yet explained. Some of these variations may be dependent on the different modes of cultivation; for example, when grown on glycerine-agar they appear to lose virulence sooner than on serum or on broth. Some definite observations indicate that this loss of virulence may depend on too long intervals between the generations, and on exposure to light and to excess of air. Indeed, Roux and Yersin state that if cultures made at 40° C. have a stream of air driven constantly through them for several days, the virulence may be almost entirely abolished.

On the other hand, it is found that old cultivations are highly toxic—*i.e.* when minute doses are injected they may produce the serious or fatal results of diphtheria, namely, general blood-poisoning, paralyses, or albuminuria, without the production of local lesions.

These facts are explained by a remarkable series of researches, especially those of Roux and Yersin, confirmed by others, which show that a poison is generated by the growth of the bacilli, which can be isolated, and to which the general symptoms of diphtheria are due. These researches are not only of great importance in relation to diphtheria itself, but throw a most valuable light on the general history of contagious diseases. They may, therefore, be selected as an illustration of the mode of investigation, and of the kind of evidence we have upon this important subject.

If a cultivation made in weakly alkaline broth is kept at a regular temperature, it is found after a time to become acid, and later again alkaline to a greater degree than before. At this period it becomes more highly toxic—that is, smaller quantities injected into the blood cause paralysis or death. If such a cultivation is filtered by a Chamberland filter, the resulting fluid which has thus been freed from the bacilli is found to retain its toxic properties. The filtrate contains at least two separable proteid substances, one of which has the special toxic properties, and is soluble in water but insoluble in alcohol. On concentrating the filtrate to one-third of its bulk by evaporation *in vacuo* at 40° C. and pouring it into absolute alcohol, to which a small quantity of acetic acid has been added, a greyish-white flaky precipitate occurs, which gradually sinks to the bottom.

By redissolving in water, and repeated precipitation in alcohol, with subsequent filtration and dialysis, this substance may be obtained in an almost pure condition, and may be dried *in vacuo* at a temperature of 30° C.

The material thus separated is a whitish amorphous powder, readily soluble in water, and easily decomposed by a temperature over 55° C. From its characters it appears to belong to the group of organic substances allied to ferments, which have been called enzymes. In solution it dialyses with some difficulty through animal membranes, a fact which may explain its slow absorption in some cases. It can be kept unaltered for five months in vessels from which light and air are excluded, but deteriorates if air has free access to it.

The animals which have been found to be especially susceptible, both to inoculated diphtheria bacilli and to the action of the separated poison, are rabbits, guinea-pigs, and pigeons; but even dogs can be affected by the poison. Mice and rats appear to be insusceptible.

When the poison or its solution is injected subcutaneously, or into the veins, it causes, if in sufficient dose, rapid prostration and death. If, however, the animal survives long enough, *paralytic phenomena* are observed, the parts usually first affected being the hind limbs, followed later by an irregularly distributed general paralysis, from which recovery sometimes, but rarely, occurs. *Albuminuria* also frequently occurs; this usually in the case of rabbits begins about the third to the fifth day (Spronck).

Anatomically there are found hæmorrhagic exudations in the peritoneum; scattered minute hæmorrhages, acute nephritis or extensive degeneration of the renal epithelium; and fatty degeneration of the liver. But no false membrane is observed, either at the point of inoculation or on the mucous membranes.

Similar results may be produced by injections of the culture-fluid itself, but the special reactions of the bacilli may then also occur.

Amongst the more striking facts known about the diphtheria poison is the neutralising effect of acids upon it. If a highly toxic alkaline culture is strongly acidulated even with lactic or acetic acid, the toxic property disappears, but on neutralising the fluid it reappears. Other vegetable acids also appear to hinder the growth of the bacillus, salicylic acid 1 in 2,000, or citric acid 5 per cent., having this property (d'Espine and de Marignac).

From these and other observations, the important conclusion appears warranted that the toxic effects of the diphtheritic virus are due to a poison which is generated by the growth of the bacillus; that it is formed locally in, and in the vicinity of, the false membrane, and is absorbed thence into the general system. The absence of the bacillus in the internal organs, a fact confirmed by all observers, is thus of no importance as an argument against its causal relation.

Brieger and Fraenkel have confirmed the results of Roux and Yersin in great part, but believe the poison of diphtheria not to be an enzyme, but a substance closely allied to serum-albumen, and which they call a tox-albumen.

Very important work on this subject has recently been done by Sidney Martin (*Goulstonian Lectures*, 1892)—important not only on account of the results already obtained by him, but also on account of the extensive field of inquiry thereby opened up. He has separated from the tissues of patients who have died of diphtheria two kinds of chemical substances, namely, albumoses (proto- and deutero-), and an organic acid, both of which have poisonous properties of the same nature, but those of the former are much more powerful. When injected into rabbits in certain doses certain symptoms follow—fever, diarrhœa, paresis, and loss of weight. The paresis generally begins in the posterior limbs, but the rest of the body becomes involved, the heart and the respiratory muscles also becoming affected. He finds that the paralysis is due to certain well-marked changes in the nerves, affecting first the myelin sheath, which breaks up into fragments and disintegrates; the axis-cylinder becomes thin, and may ultimately break across, so that in a motor nerve a degeneration spreads along the part beyond. These changes occur regularly in patches, and affect sensory as well as motor nerves, whilst the central nervous system is unaffected. Fatty changes are found in the associated muscle-fibres, and the heart also shows signs of fatty degeneration. The extract of the proteids of the diphtheritic membrane, prepared in the same way, has the same action, but is much more powerful; and he considers this to be due to the presence of a ferment (enzyme) in the membrane, which when introduced into the body is capable of producing more albumoses with the same properties. The chain of events is thus the following: The bacillus by its growth in the membrane produces a ferment, which by its local action produces albumoses in the membrane, and is also absorbed into the circulation, forming from the proteids of the blood, especially in the spleen, similar albumoses, which have certain definite poisonous actions, the most important being on the nervous system. He finds that these products are similar, both chemically and in their physiological action, to the substances produced by the organism when grown in meat-broth with alkali-albumen added.

As a general result of the experiments of several observers, it has been found that when the diphtheria bacillus is introduced into the fauces or trachea of an animal, it has no effect unless the mucous membrane has been abraded, but if previously abraded it causes local spreading inflammation with the formation of false membrane. The false membrane is soft and pultaceous in many cases, and spreads rapidly. It contains the bacillus in great quantity, and otherwise corresponds generally with the human disease. In some cases. if injected into the trachea by puncture, the diphtheritic process may start in the small wound made. Subcutaneous or intravenous injections are without effect, unless the quantity of the poison present is sufficient to be harmful, or unless some local reaction occurs superficially at the site of puncture, as the bacillus cannot grow in the blood or viscera.

Although there are undoubted gaps in our knowledge, the conclusion from the facts here briefly summarised seems almost inevitable that the virus of diphtheria is the Klebs-Löffler bacillus. One or two objections may be briefly mentioned. It is alleged that a bacillus, indistinguishable from the diphtheria bacillus, is present commonly in the secretions of the mouth of healthy children; and in a few cases of sore-throat of doubtful nature this 'pseudo-diphtheritic bacillus' has also been found. Attempts have been made to establish precise morphological distinctions between the 'pseudo-diphtheritic' and the true diphtheria bacillus, but these distinctions of form and mode of growth are not highly characteristic.

Roux and Yersin, who carefully examined the secretions of the mouth of fifty-nine healthy children in a district remote from diphtheria, found these pseudo-diphtheritic bacilli in twenty-six cases; and they further state that cultivations of these differed hardly perceptibly from those of the true diphtheria bacilli, which had been partially rendered innocuous by the air-stream method above described.

But they found that the virulence of the diphtheria bacilli could be restored if they were inoculated, together with Fehleisen's erysipelas micrococcus, into guinea-pigs, regaining entirely their original vigour after a few transmissions from animal to animal. No such result has been attained with the pseudo-diphtheritic bacillus.

In reality there is very little ground in the objection that, because a bacillus closely resembling the diphtheria bacillus is innocuous, the latter is only a common innocuous bacillus, which has acquired accidental toxic properties. Our means of distinguishing the different species are as yet very imperfect, and the pseudo-diphtheritic bacillus may be as injurious to some animals as the diphtheritic to others, the latter itself being innocuous to mice. The essential specific distinction is the poison it generates, and the peculiar effects which it produces. Many of its other characters are common to bacteria which are widely distributed in nature.

It may be asked what part is played by the micrococci which are so frequently present, in the false membrane, in the tissues of the throat, and in the swollen glands, and with less constancy in the other organs. It is highly probable that they aid in exciting inflammation and subsequent suppuration. The experiments of Roux and Yersin already referred to will, if confirmed, tend to support the suggestion that they may aid in the preparation of a suitable nidus for the otherwise insufficiently active diphtheritic virus.

From the facts thus related some practical inferences may be drawn. The diphtheritic virus has a high degree of tenacity of life, and can remain long dormant when dry. Hence the great importance of very thorough disinfection of all infected rooms, houses, fomites, &c., and especially those which may have been in contact with the secretions of the mouth or throat. The recurrence of diphtheria in dwellings is readily explained by the known bacteriological facts.

The diphtheria bacilli are found to remain in the oral secretions of patients for some days after apparent convalescence. Hence all cases should be kept isolated, and the mouth disinfected, for at least a week or two after apparent cure.

The fact that the poison is secreted in and around the false membranes suggests their removal where possible, or constant disinfection, and points to the probable value of lactic or acetic acid as local agents for neutralising the poison; though it must be remembered that this action is only temporary. Early local disinfectant treatment should be adopted in all suspicious cases, especially during epidemics, as the bacillus multiplies with great rapidity in the mouth and fauces.

Prophylactic inoculation has not been found possible. Clinical experience shows that diphtheria is not one of the diseases which affords protection against a second attack. Very recently it has been alleged that one of the proteid substances obtained from cultivations of the bacillus renders animals insusceptible after the lapse of a certain time; but further confirmatory evidence as to this statement is required.

19. **Typhoid Fever.**—Enteric or typhoid fever is one of the diseases in which the apparently constant presence of a bacterium possessing peculiar characters in the parts especially affected by the disease, has led to the belief in its pathogenic nature. The organism is now generally known as the *typhoid bacillus*. As yet we lack complete experimental evidence of its causal connexion with the disease. But its peculiar characters, and its definite association with the special lesions in the intestines, mesenteric glands, and spleen, particularly in the earlier

stages of the disease, render its provisional inclusion amongst pathogenic bacteria justifiable. It is true that the entrance of bacteria into diseased parts of the intestine is easy, and that the characters which this bacillus presents may be proved later to be not distinctive; but the early and special association with the diseased parts, and the absence of other common bacteria at the same period, add weight to its claims.

The first definite discovery was announced by Eberth in 1880 (Virchow's *Arch.* 83, p. 486); and the more accurate study and cultivation of it by Gaffky (*Mitth. a. d. K. Gesundheitsamte*, ii.) in 1884. Their work has to a large extent been subsequently confirmed by numerous observers.

Site.—The typhoid bacillus is found in the swollen Peyer's patches and solitary glands during the early stages of the fever, and also in the mesenteric glands, spleen, and liver. It is usually in colonies or clusters, formed of bacilli closely massed together (but the colonies widely scattered), and around them there is active proliferation and degeneration of the tissue-elements. The bacilli are usually short, somewhat thick, with slightly rounded ends, measuring about ·4 to ·6 μ in diameter, and 2 to 6 μ in length. In some situations their length may be greater. They frequently show spore-like bodies at the ends and centre, whose relations have been discussed above (*see* Diphtheria). They may be brought into view by various aniline dyes, especially by methylene blue, but often require special methods and careful search. They are usually decolorised by Gram's method, unless the sections have been previously treated with corrosive-sublimate solution: even then they may be difficult to stain. As the disease advances, they appear to diminish in number, or are much more difficult to detect. Their presence has also been demonstrated in the dejecta of typhoid patients (Pfeiffer).

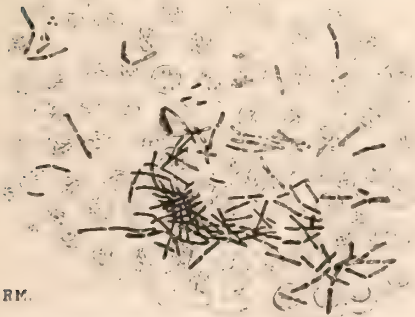

Fig. 91.—Typhoid Bacilli in section of a swollen Peyer's patch. Showing the usual appearance in stained sections. × 950.

Gaffky succeeded in cultivating typhoid bacilli on nutrient jelly. They appear as somewhat rounded colonies on the surface of the jelly, which coalesce and spread upon the surface, forming a thin layer which acquires a slightly brownish tinge. They do not liquefy the jelly. In puncture-cultivations growth appears as a whitish line along the needle-track, but spreads specially on the surface as a flat whitish layer with a shining appearance, which may reach the wall of the test-tube. From the mode of growth they are evidently highly aërobic, but are said also to be capably anaërobic. In fluids they grow freely, as in broth or milk, causing but little change in the latter. Some growth occurs even in water. They are found to be motile when examined in fluids, and show a peculiar wavy or serpent-like motion, which is seen best in the longer threads. When grown upon potatoes they produce a delicate transparent layer, which is almost invisible if the potatoes have an acid reaction, slightly yellowish or grey if alkaline. The surface becomes covered in about two days at a warm temperature (38° C.), in three to four days at ordinary temperature. Longer filaments are formed in cultures than in the tissues.

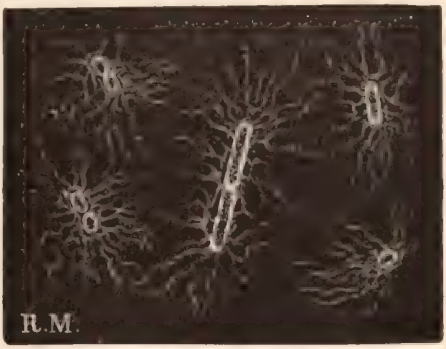

Fig. 92.—Typhoid Bacilli.—Stained to show cilia × 2,000 diam. From a specimen prepared in the Berlin Health Laboratory.

A recent discovery of considerable importance is that of the peculiar characters of the cilia of typhoid bacilli, seen, by means of Löffler's method, best in young cultivations (six to eight hours) on serum. Each bacillus appears to be surrounded by a hyaline sheath, from which a large number of irregularly arranged cilia run outwards in all directions, most being lateral. Their appearance is well seen in fig. 92. This character was at first believed to be unique, but some other bacilli have since been found to possess cilia arranged in the same way. Besides, we cannot with our present means determine the constant presence of these cilia under all conditions in fluids or in sections, and their value as a diagnostic aid would be limited by this fact, even if they were peculiar to this bacillus. Nor are any of the other complex and delicate methods which have been proposed of distinguishing by cultivating under different conditions, &c., sufficiently certain to afford a foundation for absolute diagnosis.

It has also been alleged that the typhoid bacilli possess a greater power of resistance to heat than some others which are closely allied to them, and that they can develop in the presence of carbolic acid in the proportion of 2 to 1,000. This fact, first stated by Chantemesse and Widal to be characteristic, has proved to be common to them with some other bacilli. Moreover, some observers have failed to cultivate in this way some bacilli which had all the other common characters of typhoid bacilli (Martinotti and Barbacci).

Very numerous experiments have been made by inoculations of cultivations of the typhoid bacillus in animals. Injections have been made subcutaneously, into the blood, into the peritoneum, directly into the duodenum, &c., but in no case with results which are at all conclusive. Many animals die in a day or two with symptoms of septicæmia, sometimes with emaciation and diarrhœa, whilst swelling of the spleen and of the lymphoid patches in the intestine has been found in certain cases; but similar conditions have been produced by sterilised cultures, and the results appear to be of the nature of an 'intoxication' rather than a disease with specific localised lesions. Moreover, similar results have been produced by the injection of the products of other organisms, and therefore they are not characteristic of the typhoid bacillus. A disease essentially similar in its characters and lesions to typhoid has not been, and possibly cannot be, produced in the lower animals.

In the absence, therefore, of direct experimental proof, our knowledge must be chiefly guided by the presence of the organism in cases of typhoid, its relations to the spread of the disease, &c. Here, however, there arises the difficulty of definitely distinguishing this bacillus from others which have been found to resemble it closely. For example, Cassedebat found in Marseilles water 'three pseudo-typhoid' bacilli, which resembled the typhoid bacillus in all the chief particulars, and could only be separated from it by the change produced by their growth in gelatine coloured with aniline dyes, by the degree of turbidity produced in broth, and by some minor differences observed when they were grown side by side. Accordingly, various peculiarities of the typhoid bacillus have been described as an aid in diagnosis, such as the growth in media containing a small quantity of carbolic acid (Chantemesse and Widal), the negative indol reaction (Kitasato), the growth in acid peptone gelatine coloured with gentian violet (Uffelmann). The method of growing it in the presence of carbolic acid, introduced by the writers mentioned, and since modified in various ways, though not sufficient to distinguish the typhoid bacillus from all other bacteria, has been found in the hands of many to aid in its separation when many putrefactive organisms are present. Vincent, for example, found that, by adding ·7 per cent. of carbolic acid to the medium and incubating at 42° C., most organisms are killed; and by this method, followed by plate-cultivations, he succeeded in cultivating the typhoid bacillus from the Seine water in Paris. Thoinot, Loir, and others also cultivated it from the same source. None of the methods mentioned have yet been accepted as giving results which are quite characteristic of this organism, though by taking all the characters together it may be found possible to separate it from all other organisms.

Statements regarding the discovery of the bacillus in earth, water, &c., must therefore be received with a certain degree of caution, though the results in some cases, ascertained with great care, may be perfectly reliable. The bacilli have been found to remain alive in water for a considerable length of time, and cultivations have been made from fæces which had been kept in a sterilised tube for fifteen days. The facts known therefore with regard to their conditions of growth, &c., make it probable that in sewage-water they can live for a considerable length of time, and even multiply to some extent. Gaffky found that at a suitable temperature typhoid bacilli formed terminal spores, and that the spore-bearing bacilli could withstand drying for three months at least. The conditions of life and of growth of the typhoid bacillus are such as to make a saprophytic existence outside the body very probable.

The large number of cases of typhoid in which the bacillus has been found, the definite relations to the lesions, and its vital properties, make it very probable that it is causally related to the disease, but complete proof is still wanting. Moreover, much work still remains to be done in the direction of separating and distinguishing the members of what appears to be a group of bacilli, closely allied to the typhoid bacillus. According to Babes (and apparently Klebs holds a like opinion), considerable varieties also exist in the precise characters of the bacilli cultivated from different forms of typhoid.

It does not appear to the writer that there are as yet sufficient means of distinction of typhoid from other bacilli by form of growth or modes of cultivation. A study of specimens of cultures from various laboratories has shown them that the organisms which are being studied in different places as 'typhoid bacilli,' whilst closely similar in appearance and mode of growth, do not present the same kind of ciliation when studied by Löffler's method. A revision of the entire subject appears to be necessary, before we can arrive at definite conclusions as to the relations of the bacillus to the disease.

20. Influenza.—During the recent epidemics of this disease a vast amount of bacteriological work has been done with a view to discovering the specific virus, and a great many micro-organisms have been isolated from the bronchial secretion, blood, &c. Of these the most commonly mentioned are diplococci, very similar to the 'diplococcus lanceolatus' of pneumonia, as described by Babes, Kirchner, Weichselbaum, and others. Recent observations have, however, shown that these are probably not peculiar to the disease, and that the influenza microbe is an exceedingly minute bacillus with definite character. An account of this organism was published simultaneously in January 1892 by Pfeiffer, Kitasato, and Canon (*Deutsch. med. Woch.*), though the bacillus may be one of the many organisms previously observed by others. The two first-mentioned observers found it in the bronchial secretion, and succeeded in obtaining pure cultivations. Canon observed the same bacillus in the blood of influenza patients, especially during the fever, and later succeeded in cultivating it from the blood. The bacilli are exceedingly thin and relatively short, and are found in the sputum in enormous numbers, occurring singly, in pairs, or in short rows. In the blood they are generally very few in number. (One of the writers observed similar bacilli in the blood during the high fever in influenza in February 1891.) They are stained with some difficulty, a dilute Ziehl's carbol-fuchsin solution or warm methyl-blue solution (Löffler's) being very suitable. On glycerine-agar, growth appears as minute colourless drops, for some time almost invisible to the naked eye, which generally remain separate, having little tendency to run together. Kitasato examined the sputum in a large number of other diseases, and never found this organism. Pfuhl (*Centralb. f. Bakter.* 1892, i. p. 397) has found the same organism in the sputum in influenza, and obtained pure cultivations from nine cases, but has found it only exceptionally in the blood. It is the opinion of some that the common site of the organism is the mucous membrane of the respiratory passages, and that it enters the blood only at certain stages.

Much more extensive observations are necessary, and a full account of the action of the bacillus on animals is still wanting. It is, however, evident from what we now know of this affection, that if a bacillus with peculiar characters can be cultivated both from the bronchial secretion and from the blood in influenza, there is a very strong probability that it is causally related to the disease.

GROUP VI.—*Other Diseases in which a Bacterial Virus has been assumed or alleged, but is at present doubtful.*

21. Other Diseases.—In addition to the above diseases, whose relation to micro-organisms has been more or less satisfactorily established, there are a number of others which, from their analogous characters, we should expect to be due to a somewhat similar cause. Such are, for example, scarlet fever, measles, yellow fever, &c. From time to time discoveries have been announced of bacteria as the specific agents, but as yet it cannot be said that any sufficient proof has been given of their causal relation. With regard to yellow fever, specific micro-organisms are asserted to have been found by various observers, and even a method of preventive inoculation has been announced; but since the work has not yet been accepted as possessing scientific accuracy, it appears unnecessary to give details. In dysentery, also, various organisms have been discovered, and some observers are in favour of the view that dysentery is not due to a bacterium but to the amœba coli, which has been found in the intestine, and also in the secondary abscesses in the liver in this disease. But whether its presence is only accidental, or has any causal relation, is yet uncertain.

Malarial Fever.—An article of this kind would be incomplete if no reference were made to the discoveries of organisms in the blood in malarial fevers, which are now accepted by nearly all competent authorities as causally related to the disease.

The early observations of Tommasi-Crudeli and Klebs, on the presence of a characteristic bacillus in malaria, have not been confirmed, and there is now a general consensus of opinion that the specific organisms present are not bacteria, but belong to the group of protozoa. These organisms were discovered by Laveran in Algeria, and described in November 1880, and his observations have been substantially confirmed by numerous observers in various parts of the world—by Marchiafava, Celli, and Golgi in Italy; by Osler, Councilman, and James in America; by Vandyke Carter in India; and by many others. Some of these, notably Marchiafava and Celli, made the discovery independently, although at a later date than Laveran.

The organisms occur in several forms, in the numerous descriptions of which there is considerable uniformity, though the appearances have been variously interpreted. Laveran arranges them into four classes, as follows:—

(1) *Spherical bodies*, which measure from 1 to 9 μ in diameter, and occur within the red corpuscles, and also free in the serum. They are small masses of hyaline protoplasm, and possess active amœboid movements,

which can be studied by means of a warm stage. With the exception of the smallest, they contain dark pigment-granules, which are evidently formed from the hæmoglobin, which is destroyed as they grow within the red corpuscles, the largest of the bodies, as a rule, containing most pigment. As many as four may be found within a red corpuscle, though they generally occur singly. The spherical bodies are those most commonly seen.

(2) *Flagella and flagellated organisms.*—The flagella appear to form by an outgrowth from certain of the larger spherical bodies, which have become free, and there may be one to four flagella attached to one organism. They have a very rapid lashing movement, which is best seen when becoming slow owing to cold or coagulation. The length of the flagella measures three to four times the diameter of a red corpuscle, and they are of extreme tenuity. They may become detached, and then possess an independent movement of their own in the serum. The flagellated organisms are frequently observed, but less often than the spherical bodies.

(3) *Crescentic bodies.*—These are found free in the serum, are non-amœboid, and measure 8–9 μ in length. They are generally crescentic in shape, sometimes sausage-shaped, and a fine curved line is occasionally seen joining the extremities, which has been regarded by some as indicating the remains of a red corpuscle, whose hæmoglobin has been absorbed by the parasite. They are colourless and transparent, and generally show a small collection of dark pigment about their middle. Some of them afterwards become round or oval. They are most commonly found in malarial cachexia (Laveran), or in the irregular types of fever (Golgi and others).

(4) *Rosette-shaped or segmented bodies.*—These are somewhat spherical bodies, generally a little larger than a red corpuscle, presenting a central mass of pigment-granules, sometimes surrounded by a hyaline envelope. From the centre radiating lines pass to the periphery, indicating a regular segmentation of the protoplasm, and they appear to split into smaller ovoid or elongated bodies. This form is rarer than the others, and is seen especially in the quartan type. They are generally regarded as formed by a segmentation of the intra-cellular spherical bodies.

Methods of examination. — All these varieties are best studied in the fresh blood on a warm stage. Dried films of the blood, after being fixed by heating, may be stained for thirty seconds in a saturated watery solution of methyl blue, and then washed in water. They may be mounted dry, or in Canada balsam. These preparations show all the forms except the flagella.

Regarding the relations of these different forms to one another, there has been, and still is, much dispute. That the spherical bodies gradually enlarge within the red corpuscles, destroying the hæmoglobin, and may afterwards undergo segmentation, producing in some cases the rosette-shaped bodies, all observers are practically agreed. According to Golgi, Celli, and other Italian observers, the crescents and flagellated organisms represent sterile vegetation forms, which have become free before segmentation has occurred, and are incapable of further development; whereas Laveran considers the flagellated body, at least, to represent the stage of full development, which is extracellular. Laveran also considers that all the different forms are merely stages of the same organism, and that, although some of these are more commonly present in certain varieties of fever, yet they are not strictly related to the clinical types, *e.g.* though the rosettes are most commonly found in the quartan type, they are not peculiar to it. Most of the Italian observers, on the other hand, hold that there are distinct kinds of parasite, corresponding to the types of malarial fever, some considering that there are three varieties of parasite, others that there are only two. They consider that the different varieties of parasite have different periods, during which they pass through the whole cycle of their development, and that these periods determine the type of the fever. This view of distinct varieties of parasites, however, as Laveran points out, is not fully supported by the appearances found in the blood, and is difficult to harmonise with clinical facts.

The evidence that these organisms are causally related to the disease may be briefly summed up thus. Their presence in the blood in malarial fever has been observed in widely distant parts of the world, and practically all are agreed regarding the microscopic appearances; and they have been found in the human subject in no other conditions. They are present in the blood during the paroxysms of fever, and almost completely disappear when the fever subsides. They also disappear from the blood under the influence of quinine, an exception being formed by the crescents, which may persist for some time. They account for the destruction of red corpuscles with consequent anæmia, and also for the pigmentation consequent on what was formerly called melanæmia, the pigment-granules being taken up chiefly by leucocytes, and deposited in various parts of the body. And, lastly, although cultivations of the organisms outside the body have not been obtained, inoculation with blood containing them has reproduced the disease in man, with their multiplication in the blood (Celli and others), and it is also stated that a similar result has been obtained in apes. It is still quite unknown where and in what form they exist outside the human body, how they gain entrance into the body, and by what means they produce the fever.

It is also interesting to note that a somewhat similar, though quite distinct, variety of organism has been found in the blood of birds, in which they cause a certain disease. Here, again, they are situated within the red corpuscles, the hæmoglobin of which they destroy. Papers on this subject have been published by Danilewsky and others, and the work which is being done is certain to throw light on many points which are yet obscure in connexion with malaria.

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MICROSCOPE in MEDICINE.—It must at the outset be recognised that the microscope is but an aid to one of our senses. It merely extends our means of observation, of seeing what is. The range of our vision being limited, this optical arrangement permits a wider field, a greater depth of perception. Of itself the microscope allows the hitherto hidden, only because too minute, to be seen, whilst it discloses nothing that does not already exist; it renders, in short, the eye for the time being and in one direction more perfect.

The formation of a diagnosis, which may be regarded as the first aim of practical medicine, is the result of a judgment founded upon observation of the case, guided by experience and with due regard to external circumstances. Any agent that extends the means of observation, or renders such more accurate, is obviously a great gain; and on this ground the microscope ranks with the stethoscope, the thermometer, the ophthalmoscope, and the probe, which permit a wider application of the senses of hearing, sight, and touch. But whilst perhaps it may be conceded that the microscope for daily practice is not of such necessity as either of those instruments, it has a further and greater claim on the consideration of the medical man, for what it has done and is doing in laying the foundation of the science on which his practice depends.

That which characterises the theories of pathology at the present day, and which markedly distinguishes them from any and all hitherto taught, is the recognition of the association and dependence of function upon structure, with the subsequent corollary that disease is but altered function due to altered structure. Whilst the knowledge of the structure of the body (anatomy) was, previous to the present century, of the coarsest character, the theories of disease were limited only by fancy and empiricism. But as the great truth which established the connexion of physiology, and hence of pathology, with anatomy came more and more to be recognised, the principles of morbid action, the explanation of symptoms, and the suggestion of rational treatment followed on truly scientific grounds. It was in establishing, and is now in maintaining and following this truth, that the microscope ranks highest among our instruments of research.

The Instrument.—In face of the many and excellent instruments that are offered, it would be invidious to recommend any particular one; but the following remarks are intended to be a guide as to the kind of microscope that is sufficient for the ordinary requirements of the practitioner, it being assumed that the optical principles of a compound microscope are understood, and that its various parts are known by name, and that the workmanship of the instrument shall be of the best. The ordinary work of a microscope may be said to consist of examining various secretions, histological specimens, &c., for which powers not greater than one-quarter to one-sixth inch are required. But for certain kinds of work (as the examination of micro-organisms) much higher powers are necessary, and the employment of these demands corresponding changes in the stand and its accessories.

Of a microscope-stand, one of its principal merits should be steadiness, a quality derived from its shape and not from factitious weighting. The tube should be movable quickly up and down by a 'coarse' adjustment and slowly by a 'fine' adjustment. The importance of the latter can hardly be overrated, for in one sense a microscope-stand may be expressed as a fine adjustment. The tube should be capable of being inclined and of remaining steady in any position between the perpendicular and horizontal, the latter position being required for drawing with the camera lucida and for photographic purposes. The tube should be fitted with a nose-piece, an apparatus for carrying two to four objectives which are made to focus at the same level by means of 'adapters.'

Every microscope should possess a 'substage condensor,' fitted so that it may be focussed by a rackwork and accurately centred. The best form is the 'Abbe' achromatic condensor, and the amount of light may be conveniently regulated by an 'iris' diaphragm; but this may also be effected by means of a 'turnout' arm, in which are placed 'stops' of various size and shape. The 'mirror' for reflecting the light is flat on one side and concave on the other. The 'plane' surface should be used in conjunction with the condensor.

The most important part of a microscope is the optical, viz. the objectives and the eyepieces. These are constructed of different kinds of glass. Ordinary lenses made by combinations of crown and flint glass are known as 'achromatic' lenses from their quality of rendering the 'dispersion' comparatively inappreciable. There always remains, however, more or less of this dispersiveness, a condition known as the 'secondary spectrum.' Comparatively recently a new vitreous compound has been devised, and from this are made 'apochromatic' lenses by which, in combination with specially constructed eye-pieces, the secondary spectrum is quite abolished and the image is, when properly focussed and illuminated, really achromatic. These objectives are specially valuable for photomicrography and for the examination of micro-organisms.

The lens is also 'dry' or 'immersion' according as the preparation is viewed through air or some liquid medium—water or oil—placed between the cover-glass and the face of the objective, the main object of the immersion being to increase the amount of light; for as the power of the lens increases so does its face decrease in size, and consequently the amount of light admitted becomes necessarily limited. Passing through air, light is more scattered or deflected than through liquid, hence the loss is naturally lessened by the immersion lens. Cedar oil is generally used, having, when inspissated, a refractive index of 1·51. But the latest development has been to make the immersion system 'homogeneous;' in other words, to have all the media between the objective and the preparation of similar refractive and dispersive power. High-power lenses are, or should be, provided with a screw collar, in order to correct for different thicknesses of cover-glass.

The remainder of the necessary optical apparatus consists of eye-pieces or oculars. These are 'positive' or 'negative' according as they focus within or without the ocular when used as a simple microscope. They are made of various strength, and this is inversely as their length—*i.e.* the longer they are the weaker they are. The weaker eye-pieces have less magnifying power; but much more light and better definition are obtained with them than with the short oculars with their greater magnification. For apochromatics the eye-pieces are of special construction, and in order to 'compensate' for the lens they are 'over corrected.' They are of two classes, the 'working' eye-piece and the 'projection' eye-piece, the latter being chiefly employed for photographic purposes.

For artificial illumination—which is often preferable to daylight—a common mineral oil lamp, with a flat half-inch wick, is all that is necessary even for the best work; but a lamp which is provided with a black metal chimney, can be placed in any position, and can be fed without being moved, is of great advantage to the worker. The edge of the flame gives better illumination than the side when the light passes through a condenser.

We have now touched upon the microscope and its indispensable accessories as it affects the requirements of the medical student and practitioner in prosecuting ordinary histological work, the examination of urine, of various secretions, &c., for which purposes an inch and one-sixth inch are the only objectives absolutely necessary. But now, from the almost hourly need of examining tissues and secretions for micro-organisms, it is obvious that the instrument must be more expensive, because additional apparatus is required, which in turn necessitates greater costliness in the stand and its accessories. Ten years ago ten pounds was enough to spend on a microscope, which fulfilled all professional needs. To-day twice that sum is barely sufficient.

In selecting an instrument suitable for working purposes, we should advise a medium-sized stand, having a roomy stage, fitted with double or triple nose-piece, an Abbe condenser, an iris diaphragm, three objectives—viz. 1-inch, $\frac{1}{6}$, and $\frac{1}{12}$ oil-immersion, and two oculars.

With regard to the apochromatics, it may be admitted that their price renders them microscopical luxuries; and yet the dry $\frac{1}{6}$ apochromatic, having a magnification equal to that of an ordinary $\frac{1}{12}$ oil-immersion, possesses inestimable advantages for the examination of fresh fluids, and especially for observations on the blood.

On the border-line between indispensable and dispensable comes the 'mechanical stage,' an arrangement whereby the preparation can be moved up and down and to and fro by rackwork. But a small amount of practice with the fingers, and the fixation of the slide with a couple of spring clips, will enable most persons to move a slide about with equal smoothness and precision to the mechanical stage. Indeed, the presence of the milled heads, which project to one side of the stage, are to be regarded as an encumbrance. But the advantages of both conditions may be combined by having a 'movable stage.'

Another accessory is the 'finder,' of which there are several varieties, the most convenient being that where the vertical and horizontal stage-plates are graduated. By noting the numbers on the scales, the situation of any given spot on a preparation can be recorded, and the slide can thus be placed in the same position at any future time.

Measuring.—This is effected by either the stage or eye-piece micrometer. The former is merely a slide on which are a series of parallel lines ruled according to the English or to the decimal scale; say that the lines are $\frac{1}{100}$ or $\frac{1}{1000}$ of an inch apart.

One form of eye-piece micrometer is a simple and inexpensive apparatus, in which case it consists of a glass plate to be slipped into the eye-piece, and on it are marked a series of parallel lines. Now since the value of the marks in the stage micrometer are fixed and known quantities, it follows that for any given tube-length the value of the distance between the marks in the ocular micrometer is obtained. Except for low and medium powers this is not a very accurate method, and for minute objects the 'screw micrometer eye-piece' is required.

Drawing.—It is frequently necessary that an accurate drawing should be made of the object seen; and this may be done by means of the camera lucida, an apparatus which is fitted on to the eye-piece. According to its construction, the camera is used with the microscope in the horizontal and in the vertical position, and also at an angle of 45°. The simplest and cheapest is the neutral-tint reflector. In using this it is necessary to keep the paper and instrument in exactly the same position, and to 'balance' the lights. This means that the light of the room and the illumination of the specimen must be so arranged or balanced that both the outline of the image and the pencil-point are well seen. The distance between the slide and the eye-piece and that between the eye-piece and the paper (the microscope being horizontal) must be the same, for if the latter be greater than the former then the paper-image will be greater than the object-image, and *vice versa.*

It is an easy inference from the use of the stage micrometer and of the camera that a combination of the two may be used for ascertaining the magnifying power of a lens; thus, if the lines on the stage micrometer $\frac{1}{100}$ inch apart are, when thrown on the paper, measured to be equal to 1 inch, then its power is represented as '× 100,' and so on.

APPARATUS AND REAGENTS.—Bearing in mind that it is for the clinical use of the instrument, rather than as a means of histological research, that the microscope is here considered, the actual reagents and apparatus required are very few. The following are requisites: A pair of small curved scissors, a pair of fine pointed forceps, a pair of 'cover-glass' forceps, for which epilation forceps are admirably adapted, a few sharp needles, mounted in handles, those with cutting edge being preferable, slides and cover-glasses, which latter cannot be too thin, several camel's hair brushes, one or two glass rods, lifter, bibulous paper, and pipettes. The slides and cover-glasses, used as well as new, are best cleaned by immersing them for several hours in strong nitric or sulphuric acid, and then washing them in running water to completely remove the acid. They should be kept in covered jars containing strong methylated spirit.

Except for the examination of tumours and new-growths, which may require hardening and staining, the medical man chiefly wants a microscope to ascertain the nature of various secretions and discharges, which are mostly of a fluid nature, and do not require the addition of any medium; but should any such be needed, it is desirable that it should be inert, and as nearly as possible of the density of the blood-serum with which the tissues are normally moistened. For this purpose a ¾ per cent. solution of chloride of sodium, or a 3 per cent. solution of glycerine in distilled water, to which a few crystals of carbolic acid have been added to prevent the growth of fungi, is most convenient.

For fixing and hardening portions of tissue the safest method is to immerse pieces in Müller's fluid (bichromate of potassium 2½, sulphate of sodium 1, water 100) or in 2 per cent. bichromate of ammonium solution. The fluid must be constantly changed until it remains clear. According to the size of the pieces, the preparation will be sufficiently fixed in a few days to a few weeks. When required for examination the pieces should be further hardened by immersing them for one to several days in strong methylated spirit. The spirit is then extracted in water and the pieces soaked in mucilage of acacia (B.P.) for twenty-four hours, after which they are sectioned by means of an ether freezing microtome, the best form of which is the 'Williams.' In using this instrument it is only necessary to be careful that the knife-edge is perfectly parallel to the plate. The gum having been dissolved out in lukewarm and afterwards distilled water, the sections are stained. This is best done with one of the numerous logwood solutions, and afterwards with some red or red and yellow dye such as picrocarmine or acid-rubin, or the latter in combination with acid-orange. The sections are then mounted either in an aqueous or a resinous medium. If the former, then after having been 'cleared up' in ½–⅓ glycerine solution, they are best permanently preserved in Farrant's medium. If the latter, then, after having been dehydrated in alcohol, they are cleared up in oil of cloves and mounted in balsam or dammar dissolved in xylol, benzol, turpentine, &c.

The foregoing is a very brief sketch of a practicable procedure, attainable by any one in a comparatively short time and at a very moderate cost.

Space does not permit more than merely to mention the more elaborate processes of the paraffin and celloidin methods. These not only require more time, but are more costly than the method just outlined. Nor can we allude to the numberless methods of staining requisite for demonstrating particular elements, but we append a few formulæ which are in general use for staining sections and cover-glass preparations.

1. Ehrlich hæmatoxylin solution.—Dissolve hæmatoxylin crystals 1·5–2 grammes in 100 c.c. absolute alcohol; add distilled water and glycerine āā 100 c.c., glacial acetic 5 c.c., and as much potash alum as the mixture will take up. Do not filter and expose to the light until the solution is of a port-wine hue. When

'ripe,' add a few drops of this solution to a watchglassful of distilled water. The sections stained red are transferred to tap water, wherein they become a beautiful blue.

2. Picrocarmine, to be used as a contrast stain, is better purchased than made; one of the most efficient formulæ is that invented by Ranvier.

3. Acid rubin.—The solid pigment is dissolved in distilled water. A few drops of the strong solution to a watchglassful of distilled water.

4. Alkaline methylene-blue solution.—Saturated alcoholic solution of methylene blue, 1 vol., KHO (1-10,000 $H^{2}O$) 3 vols.

5. Acid methylene-blue solution.—Saturated alcoholic solution of methylene blue, 1 vol., acetic acid (0·3 per cent.), 3 vols.

Both these methylene-blue solutions are very useful for micro-organisms, either in sections or in cover-glasses. If the alkaline be not successful, the acid often is.

6. Gram's method.—Saturated alcoholic solution of gentian violet, 10 c.c., anilin oil water, 100 c.c. After staining, the preparations are treated with the following until they turn black: Iodine 1, iodide of potassium 2, water 300; then with alcohol; the after-treatment being the same as for other section or cover-glass preparations.

7. Stain for tubercle bacillus and leprosy bacillus, &c:—

(*a*) Saturated alcoholic solution of fuchsin 10 c.c.; carbolic acid in 5 per cent. solution 100 c.c.

(*b*) Sulphuric acid 20 c.c.; alcohol 30 c.c.; water 100 c.c.; methylene blue to saturation; filter.

Cover-glass preparations are made by allowing a thin stratum of fluid to dry on a cover-glass, or if viscid—*e.g.* sputum—by squeezing a small quantity flat between two glasses, and by drawing, not pulling, them apart. The layer should be thin and even, a mere film. The 'cover' is next dried in air and 'fixed' by waving it two or three times through the flame of a spirit-lamp. The covers may then be stained by floating them on any appropriate solution, or by the method for staining tubercle bacilli as described below. *See* Section D, Sputum.

CLINICAL USES.—The microscope may be applied to the investigation of the various discharges and secretions from the body, with the result of obtaining information, which, though often of but imperfect value, may on other occasions be of the most positive and precise character, determining a diagnosis which without it would be uncertain.

(A) **Urine.**—It may be taken as a fundamental principle that perfectly healthy, fresh urine should have no visible deposits. A small quantity of flocculent mucus, entangling a few epithelial cells, is, however, of such frequent occurrence and of such trifling importance as practically to come within the limits of health. More than that is abnormal, and demands investigation. It may be that they are only the result of changes in the urine after it is passed, or, on the contrary, they may have been voided as such. Occasionally absolutely clear-looking urine may contain tube-casts, which the microscope only can detect.

It is important, therefore, to know the age of any sample of urine that is examined, and, when possible, a portion of the whole twenty-four hours' quantity should be taken. Where this cannot be done, what is passed in the morning on rising should be chosen, since it is in such a specimen that certain objects are most likely to be present. Frequently an examination for several successive days may be necessary, for there are some conditions of kidney-disease in which but very few casts are passed, and would most probably escape one examination of a haphazard specimen. The urine should be collected in conical glasses, holding about four ounces, which must be scrupulously clean, and, if in frequent use, are best kept in a closed vessel of water, since thereby dust is prevented from accumulating at the bottom; and it is well to pour a little strong nitric acid into such glasses occasionally, to effectually remove all dust and deposits, subsequently, of course, thoroughly washing them in cold water. The urine should be allowed to stand six or eight hours at least in a cool place, and be covered by a plate of glass or a paper cap, to prevent the entrance of dust. With a clean glass pipette a few drops of the lowest portion of the fluid may be removed. A collecting-glass has been invented whereby the lower strata of urine may be drawn off from the bottom by a tap; but a pipette answers all ordinary purposes. It is convenient to have the glass slide to which the drops are transferred provided with a cell, made by a very thin circle of gold size, since not infrequently large casts are crushed by the pressure of the cover-glass. The cell also answers the purpose of confining the fluid, any excess of which can be removed with blotting-paper. Such an arrangement is not suitable when it is required to add any reagents to the specimen.

The following objects may occur, the clinical significance of which is treated of elsewhere:—

1. *Adventitious matter, dust, &c.*—Even with the greatest care in collecting and preparation, foreign bodies are extremely apt to be met with, the commonest of which are hairs, wool, cotton and flax fibres, minute particles of feathers or wood, starch-granules, sand, and oil-globules. Besides these, a number of extraneous substances may occur, such as sputum and fæces, the source of which is obvious, whilst occasionally substances are purposely added by malingerers

or by others for the purpose of deceit. It is absolutely essential that an acquaintance with the microscopic appearance of such objects should be possessed by the medical man.

2. *Mucus.*—This material presents itself as finely granular streaks and smears of every variety of size and shape, often mistaken for casts, and occasionally simulated by scratches on the slide or cover-glass.

3. *Epithelial cells.*—These may be derived from all parts of the urinary tract; and they include glandular spheroidal or polyhedral cells, from the kidney, especially the convoluted tubules; columnar cells from the ureter and the greater portion of the urethra; and flattened tesselated scales from the pelvis of the kidneys, and the orifice of the urethra. Very large polygonal cells of the same variety come from the vagina. The vesical epithelium is very variable in appearance, but is generally either flattened or pyriform, of large size, and not always to be distinguished from the scales from other parts.

4. *Spermatozoa.* Spermatozoa occasionally occur in the urine, without being of serious importance. Their characteristic appearance is not easily recognised under a magnifying power of less than 300 diameters.

5. *Blood.*—Blood-corpuscles in the urine differ considerably from their normal biconcave disc shape, and may shrink into irregularly shaped particles, but usually they swell up and become globular in appearance, these changes being due to alterations in the density of the fluid. Under such circumstances the corpuscles are not very easy of detection, appearing as very faint yellowish rings, and if but very few in number may not always be recognised with certainty, especially as there are many other objects, such as spores of fungi, which closely resemble them. If the blood be present in moderate quantity, it gives a characteristic colour to the urine, which suggests the presence of corpuscles. The discs more rapidly disappear in alkaline than acid urine, remaining in the latter for a considerable time.

6. *Leucocytes.*—Bodies identical with white blood-corpuscles are sometimes seen entangled in the shreds of mucus (mucous corpuscles), or may be derived from the inflamed epithelial surface; and, if present in large amount, constitute pus-corpuscles, originating from pyelitis, cystitis, urethritis, leucorrhœa, rupture of an abscess into the urinary tract, and other conditions.

7. *Portions of new-growths.*—Cells, fibres, and other elements, from cancerous and other neoplasms of the urinary organs or adjacent structures, such as the uterus and the rectum, may be detected in the urine; but it is very seldom that the diagnosis of the existence of these new-growths rests upon their recognition under such circumstances.

8. *Renal tube-casts.*—The appearances, nature, and origin of these bodies have been fully treated of in the article Casts.

9. *Living organisms.*—Perfectly fresh, healthy urine should be quite free from living organisms, but very shortly after being passed various forms are liable to be met with, to some of which the alkaline decomposition of the fluid is due. Among the species which gain entrance to the urine after it is voided, and are to be found in almost all specimens after a few hours unless special precautions be taken to exclude them, are various cocci, of which Micrococcus ureæ (the determining cause of the ammoniacal fermentation of the urea) and Sarcina ureæ are the most abundant, together with numerous bacteria and bacilli, all belonging to the Schizomycetes or fission fungi. In saccharine urine yeast fungi (Saccharomyces or Torula cerevisiæ) are very quickly and abundantly developed; and in stale diabetic urine after the alcoholic fermentation has ceased members of the group of Hyphomycetes or Moulds are to be found—*e.g.* Pœnicillium glaucum and species of Mucor. Certain animal forms, infusoria and amœbæ similar to those occurring in the fæces, have been exceptionally found in urine which has become alkaline after being some time passed.

Micro-organisms and other parasites which are seen in urine as it comes from the bladder are usually of serious import. They may have been introduced *ab extra*, as by a catheter causing the urine to decompose in the bladder, or may have escaped into the urinary passages as the sequence of specific affections of the organs, and of these the tubercle bacillus is the most characteristic. Other forms have been reported as occurring in the urine in nephritis, ulcerative endocarditis, and typhoid fever. Certain entozoa are occasionally found in the urine, the most important of which are the Filaria sanguinis hominis and the eggs of Bilharzia hæmotobia. Hooklets and fragments of echinococci from rupture of hydatid cysts into the urinary passages may sometimes be detected in the urine.

10. *Fat.*—In the condition known as chyluria, large quantities of fat in a state of fine molecules and minute globules, with a few leucocytes, red blood-corpuscles, and frequently embryos of the filaria, are seen by the aid of the microscope. In extreme fatty degeneration of the kidney, as from phosphorus poisoning, fat-granules may be detected in the urine. The possible presence of oil-globules in the urine after the passage of a catheter should be remembered.

11. *Salts.*—The solid constituents of the urine, which are normally held in solution, are apt to be deposited as the result of definite disease, or may occur in association with states on the border-land between it and health, or may be entirely due to fermentative

changes in the secretion after it has been voided.

These various precipitates may be grouped as amorphous, colloidal, and crystalline, either separately or mixed, and for the most part are sufficiently abundant to be recognised by the naked eye, requiring, however, the microscope for their complete recognition.

(i) *Amorphous.*—As a concentrated acid urine cools after being passed there will probably be thrown down a granular deposit, ranging in tint from a faint pink or cream colour to a deep red, the well-known 'brick-dust' precipitate of *urates*—quadrurates of Bence-Jones and Roberts—of sodium, potassium, and ammonium, and occasionally of calcium and magnesium. The coloration of these substances is owing to their association with the urinary pigments. Later, during the 'alkaline fermentation' a white deposit falls of *tribasic calcic phosphate*, which may also be thrown down in acid urine. Under the microscope, these bodies appear as shapeless granules in masses, with no distinctive appearances except as regards colour—not always absolute—and the solubility of the urates on applying heat, which does not dissolve the phosphates.

(ii) *Colloidal.*—Under certain as yet unascertained physical conditions—but of which some degree of viscidity appears to be one—the urinary solids tend to deposit in spheroidal, ovoid, or dumb-bell form, which, falling short of the definite regularity of crystals, are known as submorphous or colloidal. The most frequent salt thus to occur is the calcic oxalate as well-marked dumb-bells in acid urine; much less commonly the calcic sulphate; also in acid urine, and the calcic carbonate, both as dumb-bells and spheres, in an alkaline fluid. Mere microscopic examinations may be insufficient to distinguish these substances from one another; and their behaviour to reagents, such as the solubility of the first mentioned and the insolubility of the second in strong hydrochloric acid, the solubility of the carbonate and the insolubility of the oxalate in acetic acid, must be ascertained. Sodium and ammonium urates may occur in alkaline urine as spheres or ovoids, rarely as dumb-bells, and sometimes as spiny spheroids, the so-called 'hedgehog crystals.'

(iii) *Crystalline.* — *Uric acid*, which in excess forms cayenne-pepper-like grains, or gravel, is remarkably variable in the crystalline shapes it assumes when deposited from acid urine; typically occurring as hexagonal plates and four-sided rhombs, but often ovoid, lozenge, barrel, or comb shaped, singly or aggregated into irregular or rosette-like masses, and of the greatest diversity in size. Owing to the affinity of the urinary pigments for uric acid and its salts, such crystals are always slightly tinted—straw-colour to pale brown, but are colourless when chemically pure. Further characteristics of these crystals are their solubility in liquor potassæ, and the purple colour which they give on the addition of ammonia after evaporating with nitric acid (the murexide test).

Calcic oxalate, found also in acid urine, especially after the ingestion of rhubarb, tomatoes, and certain other articles of food, occurs as octahedra composed of two four-sided pyramids placed base to base, appearing when seen in the short diameter as a square marked by two bright cross lines; they are soluble in mineral acids, but unaffected by heat, acetic acid, or liquor potassæ.

Ammonio-magnesium or *triple phosphates* are deposited in alkaline or very faintly acid urine as triangular prisms with bevelled ends, of varying lengths; when very short simulating the oxalate of lime octahedra, and when long known as the 'coffin lid' or 'knife rest' form. Stellate feathery crystals of the same substance have been seen.

Neutral calcic phosphate occurs as prismatic or wedge-shaped crystals arranged in very characteristic rosettes. Rhombic tablets of basic magnesium phosphate are very occasionally met with.

Calcium sulphate, of very rare occurrence, appears as long needles.

Hippuric acid, also of very exceptional occurrence in human urine, assumes the form of four-sided prisms.

12. *Exceptional substances.* — *Cystin* forms regular hexagonal tablets of various size, which are usually laid one on the other; much less often it appears as square prisms.

Leucin as it occurs in the urine is impure, and appears as yellowish highly refracting spheres, almost like oil-globules and tending to aggregate. *See* LEUCIN.

Tyrosin, which usually accompanies the preceding, forms tufts of very fine needles.

Hæmatoidin, derived from the hæmoglobin and associated with the escape of blood into the urinary tract, has been found as minute yellow or reddish acicular crystals.

Indigo has been seen in decomposing urine, both as blue needle-shaped crystals and as amorphous granules.

For the simple detection of most of the above-mentioned objects no reagents are necessary; but the more transparent bodies, such as casts and epithelial cells, are often rendered easier of detection by slightly tinting the field with a drop of magenta solution or tincture of iodine. The crystalline deposits may be preserved by mounting in Canada balsam or Farrant's medium, subsequent to washing in spirit and turpentine; but attempts to keep for any time either casts, or epithelium, are usually very unsatisfactory, though occasionally successful in very weak carbolised glycerine solution.

(B) **Fæces.**—It is not often that the matters passed by the bowel are submitted

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to microscopic examination not so often perhaps as they should be. The greater bulk of the motions appears to consist microscopically of amorphous granular substance of no special character, consisting for the most part of dead epithelial cells shed from the mucous membrane, and masses of semi-digested proteid and other matters.

The distinctly recognisable objects are:

(*a*) Those derived from the food-constituents which have escaped digestion or are indigestible, and obviously vary considerably with the diet. Such are starch-granules and shreds of vegetable-tissue, both cells and fibres; oil-globules, elastic and muscular fibres—the latter exhibiting but faint indications of striation, and filaments of areolar tissue. An excessive proportion of any of these, making due allowance for the character of the diet, would suggest some flaw in their digestion demanding investigation. All occur to some extent in normal fæces, and, like most of the constituents, are more or less bile-stained.

(β) Certain crystalline substances are frequently to be found; some are food-derivatives, and unless in abundance are to be regarded as normal, whilst others are of pathological significance. Among the former are acicular crystals, commonly aggregated in tufts, of the higher fatty acids in combination with calcium and magnesium. Occurring in all fæces, they are specially abundant when the bile is excluded from the intestine, or when there is a large amount of fat in the food, as in a milk diet. Crystals of cholesterin are rarely seen in the stools, and leucin and tyrosin probably not at all. Calcic salts, of which the oxalate is the most frequent, but also the phosphate, and occasionally the carbonate, sulphate, and lactate, are seen, presenting the same microscopic appearance of crystalline and colloid form described in the preceding section. Their significance is uncertain, but some at least appear to be more abundant in catarrhal states of the bowel; and the same may be said in respect to crystals of the triple or ammonio-magnesian phosphate which are frequently met with in fluid stools. Hæmatoidin crystals in the fæces are to be considered of morbid import, occurring as they do in association with gastro-intestinal hæmorrhage; and the Charcot-Leyden crystals, similar to those found in sputum, are of occasional occurrence in the stools of typhoid fever and phthisis.

(γ) Among the tissue-elements derived from the gastro-intestinal tract which are found in the evacuations, epithelium cells—columnar and goblet cells—are always present, having all appearances from characteristic individual cells but slightly altered, such as are shed in catarrh, to shrunken and degenerated cells singly, or amorphous masses. They are frequently yellowish from bile-staining. Red blood-corpuscles and leucocytes are seldom seen, the former being rapidly disintegrated among the fæcal matters, and the latter only being appreciably present when there is ulceration of the bowel, or an abscess has burst into the canal. When the corpuscles cannot be recognised, blood may be detected by the hæmin crystals, which form after heating a fragment of the dried fæces, with a grain or two of chloride of sodium, in a few drops of glacial acetic acid.

(δ) The numerous living organisms, vegetable and animal, which, infesting the intestines, may be found in the fæces, are enumerated and described in the articles, INTESTINES, Diseases of: 17. Micro-organisms of; and 20. Parasites of. For the detection of the various bacilli, the film of fæcal matter dried on the cover-glass should be soaked for some time in solutions of the appropriate dyes, such as methylene blue, fuchsin, &c. *See* MICRO-ORGANISMS.

To investigate these, it is merely sufficient to flatten out, by means of slight pressure on the cover-glass, a small portion of the motion, in a drop of some indifferent medium, such as a 1 per cent. saline solution or very dilute glycerine. The micro-organisms are best examined as 'cover-glass preparations,' as described above and in Section D on the Sputum; or in some of the sediment removed by a pipette, after a small portion of the fæcal matter has been shaken up with a large excess of distilled water, and allowed to stand.

(C) **Vomit.**—This should be examined as soon as possible after expulsion, and the liability to the presence of all kinds of extraneous matter should be borne in mind. Small portions may be spread out in dilute glycerine; or it may be necessary to shake up the matter with distilled water, and take up a few drops of the mixture with a pipette.

As in the fæces, the ejected contents of the stomach consist microscopically of masses and flakes of material presenting no morphological characters, as well as food-particles in varying stages of digestive disintegration, with consequent loss of distinctive features. It is impossible to give any accurate description of these substances, but those which are to be recognised with more or less certainty are fat globules, muscular, elastic, and areolar tissue fibres, starch-granules, and shreds of vegetable tissue. Epithelial cells, both squamous and columnar, and occasional red and white blood-corpuscles, may also be detected. The micro-organisms are very variable, but on the whole are less numerous than in the intestines, the acid medium of the stomach being less favourable to their development; and it is more particularly when the food is unduly delayed in the stomach, as in gastro-ectasis, that they are to be found. Several species of yeast fungi, which cause the various fermentations of carbohydrates, producing alcohol, lactic and butyric acids, &c., are perhaps the most abundant, although micrococci, bacilli, and sarcinæ are to be met with, especially the last named. Fragments of new-growths, cancer-cells, &c., are occasionally seen.

(D) **Sputum.**—In the examination of the expectoration the microscope is often of great value, as thereby the exact nature of the morbid changes in the lungs may be determined. Small shreds of the sputum should be separated and spread out on the slide, and covered at once; sometimes a drop of a watery solution of methylene blue is required to render more evident some of the very transparent objects. It is obvious that the expectoration is liable to contain all kinds of objects that have not come from the lungs—fragments of food, epithelial scales from the tongue and mouth, hairs, &c.; but, excluding all such bodies, the sputum consists of a menstruum of viscid mucus, which is hardly recognisable under the microscope, except as a very finely granular film, entangled in which are innumerable air-bubbles of all sizes, with a few *leucocytes*, and occasionally a few squamous and more or less distinctly ciliated *epithelium cells* from the air-passages. If a drop of acetic acid be floated in beneath the cover-glass, the mucus assumes a finely striated appearance, and the nuclei of the cells are rendered very distinct. With all degrees of catarrh and inflammation of the mucous tract the number of leucocytes and epithelial cells becomes more and more abundant, with occasional *red blood-corpuscles*, which increase in proportion to the degree of pulmonary hæmorrhage, and oil-globules liberated from cells that have undergone fatty degeneration. When the lung is actually breaking down, fragments of pulmonary tissue may be readily recognised under the microscope by the characteristic elastic fibres, which frequently retain the arrangement they normally have in the walls of the air-cells. They are rendered especially distinct by the addition of acetic acid, or by previously boiling the sputum for a short time with solution of caustic soda (20 grains to the ounce), which clears up other matter, leaving the elastic tissue untouched. Vegetable fibres derived from the food, and which also resist the action of the alkali, must not be mistaken for the lung-tissue. Fibres of connective tissue, and particles of cartilage from the bronchi, may occasionally be detected in destructive lung-disease.

Besides the above-mentioned epithelium, there are occasionally to be seen flattened tesselated scales, with large nuclei, derived from the alveoli of the lungs, and more frequently spheroidal or elliptical nucleated cells, also supposed to come from the alveoli. These often contain granules of pigment, or of soot or metallic dusts which have been inhaled, or their granular protoplasm may be almost completely replaced by fat granules and globules. Their real significance is uncertain, but they are surely pathological. Microscopic fibrinous casts of the ultimate bronchioles and air-vesicles are seen in the sputa of acute pneumonia, and in the condition known as plastic bronchitis. *See* CASTS.

Apparently associated with pulmonary hæmorrhage, may be seen in the expectoration objects somewhat resembling starch-granules—*corpora amylacea*—though it is doubtful whether they are really amyloid in composition. In the sputum of asthma and capillary bronchitis, and less often of pneumonia, peculiar spiral bodies are sometimes seen even with the naked eye, and frequently of considerable length; they would seem to be composed of mucin or some similar substance, and are known as *Curschmann's spirals*. Epithelial cells are apt to be entangled among the finer fibrils which twist around the central spiral thread of which they are composed.

Various crystals may be found in the sputum in disease, and those termed Charcot-Leyden crystals are the most peculiar. Occurring in the expectoration of an asthmatic paroxysm, and also in bronchitis, they appear as colourless elongated flattened octahedra, very variable in size, and soluble in warm water, mineral and acetic acids, and alkalis, but insoluble in cold water, alcohol, and chloroform. Their exact nature and composition are unknown, but they are probably derived from the epithelial cells of the bronchioles. Crystals of hæmatoidin, indicative of previous hæmorrhage into the air-passages, with subsequent decomposition of the blood; of cholesterin and salts of the fatty acids, showing caseous degeneration of inflammatory products; also leucin and tyrosin, and occasionally oxalate of calcium, and ammonio-magnesium phosphate—all these may be seen, but are of no great diagnostic value.

The examination of the sputum for micro-organisms, especially the bacillus tuberculosis, has become a matter of routine, and affords valuable diagnostic information. Among the various methods of procedure which have been recommended, the following is here selected as a convenient example of the 'cover-glass preparation.'

Take up with forceps the cover-glass, the sputum-layer being uppermost, and drop thereon with a pipette just enough of solution *a* (*see* formula 7, p. 1350) to form a complete layer, and heat it over a spirit-lamp flame until it *begins* to boil. Then, having thrown off the staining solution, press the cover-glass lightly between two folds of filter-paper. Next immerse the red-stained cover-glass in solution *b* for a few seconds. This done, wash it in water to neutralise the acid. The sputum-layer should now be of a pale blue tint (if any red remain the process must be repeated). The cover-glass should then be dried on blotting-paper, and finally dehydrated by waving it to and fro a few times through the spirit-lamp flame. The preparation is finished by mounting it in balsam. The time required for preparing, staining, and demonstrating tubercle bacilli in sputum by this method need not be longer than three minutes.

Besides the tubercle bacillus, the diplococci of pneumonia and (though rarely) actinomycosis and species of protozoa, are to be found. Fragments of echinococcus cyst and hooklets, as well as the ova of Bilharzia hæmatobium, may be detected.

(E) **Blood.**—The microscopic examination of the blood is concerned with (*a*) the formed elements of that fluid, and (*b*) foreign bodies which may have been developed in it or have gained entrance to the stream.

(*a*) As regards the former, the red and white corpuscles and blood-plates, they may be altered in quantity or in character. The method of enumeration of the corpuscles is elsewhere described (*see* HÆMACYTOMETER); by it are detected the conditions known as polycythæmia (excess of red corpuscles) and oligocythæmia (deficiency of the same), leucocythæmia or leukæmia (permanent excess of white corpuscles) and leucocytosis (a transient excess in their number). Variations in the number of blood-plates are less easily detected, and the significance of such is imperfectly known, but an excess has been noted in pregnancy and some chronic maladies, whilst in fever they are said to be fewer; but it cannot be said that their normal proportion to the other corpuscles has been accurately determined. *See* BLOOD, Morbid Conditions of.

Much care is required for the proper interpretation of the changes observed in the appearance of the corpuscles, since these elements, especially the red, are very susceptible of alterations of form determined by an increased or diminished density of the plasma, tending to swell up and lose their biconcavity or to become crenated or even stellate. Some of these changes may take place after the blood has been drawn from the body, due to want of proper precautions in maintaining the normal conditions, or are even wholly *post-mortem* effects. Apart from these accidental alterations, very definite differences from the standard size of the corpuscles have been noted, varying from a third (*microcytes*) to double that of the normal diameter (*macrocytes*). These varieties may be of very temporary duration, and their explanation is unknown; but they are more prone to occur in such blood-states as chlorosis and pernicious anæmia, in certain toxic conditions, and in burns. More noticeable are extreme alterations in the shape of the red corpuscles; seen at the maximum in pernicious anæmia, though also met with in severe chlorosis or other cachectic states, as the cancerous. In place of the normal flattened discs the corpuscles may be oval, tailed, reniform, or of irregular contour, perhaps to be attributed to an exaggerated protoplasmic contractility: to this condition the term *poikilocytosis* is applied. Nucleated cells tinged with hæmoglobin, and representing intermediate stages between the red and white corpuscles, are to be found in such profound blood-affections as leukæmia. Structural perversions of the leucocytes recognisable by the microscope refer chiefly to the behaviour of these bodies with staining agents, particularly eosin, as well as considerable differences in their size. Attempts have been made, though of doubtful certainty, to distinguish between the various forms of leukæmia, and between these affections and Hodgkin's disease, by the differences in the extent to which the protoplasmic granules of the leucocytes take the eosin staining. Those cells which exhibit the greatest preference for the dye are termed 'eosinophile,' and are supposed to indicate in proportion to their number a true leukæmia rather than a temporary leucocytosis. But identical cells have been found in conditions quite apart from leukæmia, and their diagnostic value is very uncertain. As is well known, the red corpuscles of healthy blood after being shed tend to run into rouleaux; but in some diseases no such tendency is observed, and the cells remain entirely separate or aggregated into irregular heaps.

(*b*) Among the adventitious bodies found in the blood are pigment-granules and masses, often free but sometimes included in the white corpuscles, and constituting the condition known as *melanæmia*, as seen in severe intermittent and remittent fevers. Colourless octohedral crystals, similar to if not identical with those described in the previous section as Charcot-Leyden crystals, have been said to occur in leukæmic blood, but it is doubtful whether they are not due to *post-mortem* change.

The most important objects of this group are wholly extraneous in origin, namely, parasites, both micro-organisms and members of the class Vermes. To the former belong the bacillus of tubercle, anthrax, glanders, typhoid fever, malarial fever, the streptococci of erysipelas, and spirillum of relapsing fever—all described elsewhere. The two higher hæmatozoa, namely, Distoma hæmatobium, ova and perfect worm, and Filaria sanguinis-hominis, are also fully treated of under other headings.

To examine blood, the finger, having been carefully cleansed, should be pricked in its extensor aspect with a lancet-needle without being squeezed or constricted by ligature, &c. The cover-glass should be just touched at its centre with the blood-drop, and then pressed very lightly on the slide, so that a thin and uniform layer is obtained. It is of the greatest importance that the slide and cover-glass should be perfectly clean, for otherwise crenation sets in very rapidly. A ring of some indifferent oleaginous material, such as thin vaseline, applied round the edge of the cover-glass will prevent evaporation, and keep the blood fresh for many hours. For the examination of fresh blood this is sufficient, but for permanent preparations the following technique is advisable. Expose the cover-glasses with their thin films of blood to the vapour of 1 to 2 per cent. osmic acid for some minutes. Then dry them thoroughly by placing them in front of a good fire carefully protected (*e.g.* under a watch-glass) from dust, &c. They may then be stained by floating them in an aqueous solution of fuchsin, or of phenol-fuchsin (*see* formula 7), and then contrast stained with alkaline methylene blue (*see* formula 4). Other good second stains are phenol-methylene blue, phenol-iodine green (made up like phenol-fuchsin), anilin oil, or gentian violet. The red corpuscles pick up the red dye, and the leucocytes the blue or green. In any case the blood-plates will be stained, though they are best seen if the cover-glass be treated by Gram's method. Eosin is frequently used for staining blood films, and a convenient formula is eosin (soluble in water) 1 grm., alcohol 60 c.c., water 160 c.c. When the cover-glasses are sufficiently stained they may, after removing the superfluous fluid with bibulous paper, be dried in the flame and mounted, but it is better to pass them through absolute alcohol very quickly, then mop up on filter paper, pass through flame, and mount in balsam. A similar method of using various dyes is suitable for the demonstration of micro-organisms in the blood.

(F) **Milk.**—A drop of milk, placed on a slide and covered with a thin glass, discloses on examination fatty granules and globules of all sizes, with sharply defined outlines, and kept separate from one another by surrounding invisible films of proteid matter. In the milk secreted immediately before and immediately after delivery will be seen colostrum corpuscles, and a few leucocytes and occasional epithelial cells. Pathogenic bacilli, of which bacillus tuberculosis is the most important, have been demonstrated in milk.

(G) **Morbid Discharges.**—The microscope is frequently of value in examining discharges from surfaces—for instance, in leucorrhœa; or from abscesses which may have burst. In the latter cases, besides the pus-cells, fragments of tissue may be seen, indicating the situation of the abscess; or the existence of a new-growth may be manifested by finding small portions in the discharge. Vaginal secretions, especially in catarrhal states, in addition to numerous leucocytes, are apt to contain an infusorian, the *Trichomonas vaginalis*, an oval-tailed animalcule of about the size of a white blood-corpuscle provided with flagella and cilia; micrococci are usually abundant. The microscopic objects in the seminal fluid are the spermatozoa, which may be deficient in number, the seminal cells from which they are developed, squamous and columnar epithelial cells, and occasionally red blood-corpuscles, leucocytes, and Charcot-Leyden crystals, the last-named being probably only formed after the preparation has stood some hours.

The different morbid exudations from serous surfaces exhibit leucocytes and red blood-corpuscles, fatty granules, and crystals of hæmatoidin, cholesterin, and fats in varying abundance. Certain micro-organisms which invariably accompany suppuration, namely, micrococci, as well as bacilli of tubercle, and also actinomycosis, may be demonstrated by cover-glass preparations as above described.

(H) **Contents of Cysts.**—These are for the most part fluid or gelatinous, and leave very little for microscopic examination, besides a varying number of red and white blood-corpuscles and epithelial cells of various kinds. Exception must be made to the echinococcus hooklets of hydatid cysts, the hairs of dermoid cysts, the fatty matter of sebaceous cysts, and cholesterine crystals, so commonly met with in ovarian, and indeed in all forms of cysts.

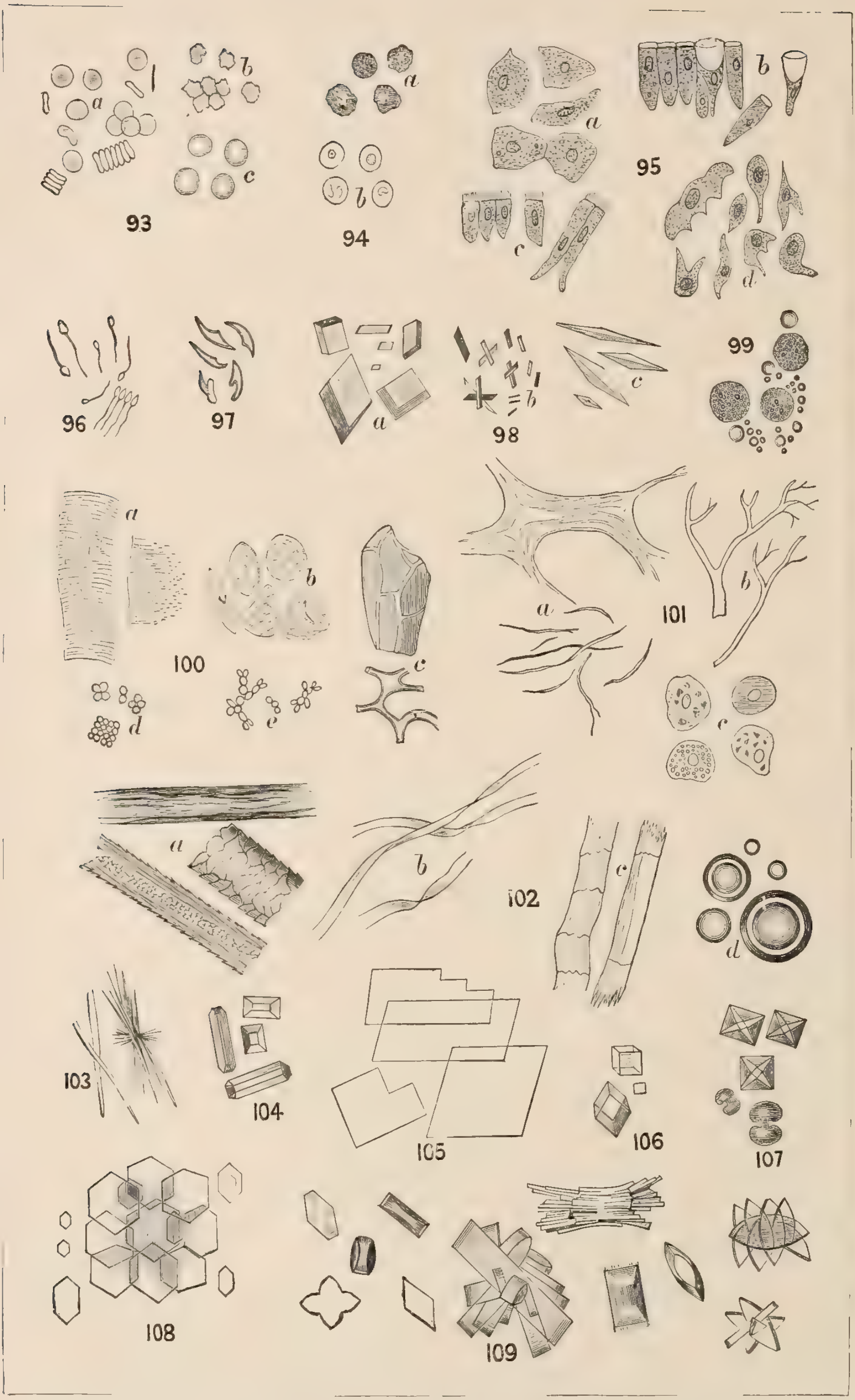
(I) **New-Growths.**—The microscopical characters of tumours are fully described under the heads of CANCER and TUMOURS.

(K) **Parasites.**—The value of the microscope for the detection of micro-organisms in the different situations in which they occur has been already referred to. Scarcely less useful is the instrument for the recognition of the various species of Tinea and Pediculi which infest the skin and hairs. *See* EPIPHYTIC SKIN-DISEASES.

(L) **Adulterations of Food, Drugs, &c.**—By means of the microscope many impurities and adulterations may be discovered, which would otherwise remain unrecognised. The following substances which are extensively used are at once detected under the microscope, and many of them in this way only—namely, starch of various kinds, improperly added to cocoa and mustard; leaves of willow or plum, substituted for tea; chicory, a root of a species of dandelion, mixed with coffee; sand with sugar; red lead with cayenne pepper; and many pigments—indigo, venetian red, umber, turmeric; as well as different salts, sulphate and carbonate of lime.

(M) **Medico-Legal Inquiries.**—Stains of blood, semen, &c. on clothing should be moistened with a few drops of distilled water or, better still, a ½ per cent. solution of chloride of sodium, and scraped with a sharp knife; and the fluid then transferred to a glass slide, and examined in the usual

MICROSCOPE IN MEDICINE



Drawings illustrating Common Objects seen with the Microscope in Medicine.

manner. The microscopical characters of spermatozoa and blood have been already referred to.

DESCRIPTION OF FIGURES.

Fig. 93.—Red blood corpuscles human.
a. Normal, singly and in rouleaux. *b.* Crenated and shrunk from drying or treatment with a concentrated fluid. *c.* Distended and globular from absorption of water.

Fig. 94.—Leucocytes. Pus, mucous or white blood-corpuscles.
a. Normal. *b.* After treatment with acetic acid; nuclei very distinct.

Fig. 95.—Epithelial cells.
a. Scaly, from mouth, vagina, &c. *b.* Columnar and goblet, from gastro-intestinal canal. *c.* Ciliated, from air-passages. *d.* Irregular and transitional forms from urinary tract.

Fig. 96.—Spermatozoa.

Fig. 97.—Hooklets of echinococcus.

Fig. 98.—Crystals.
a. Hæmatoidin. *b.* Hæmin. *c.* Charcot-Leyden crystals.

Fig. 99.—Milk.
a. Colostrum-corpuscles. *b.* Oil-globules, very variable in size, and with sharply defined outline.

Fig. 100.—Objects seen in vomited matter.
a. Muscle-fibres partially digested. *b.* Starch-granules, some showing the characteristic concentric marking, others broken up by digestion. *c.* Fragments of vegetable-tissue. *d.* Sarcinæ. *e.* Torulæ.

Fig. 101.—Objects seen in sputum.
a. Elastic fibres from the lung-tissue. *b.* Minute fibrinous coagula occurring in acute pneumonia. *c.* Alveolar epithelium.

Fig. 102.—Adventitious objects.
a. Hairs, showing cortex, epidermis, and medulla. *b.* Cotton-fibres, showing characteristic twist. *c.* Linen-fibres. *d.* Air-bubbles in varying focus.

Fig. 103.—Tyrosin; needles.

Fig. 104.—Triple or ammonio-magnesium phosphates.

Fig. 105.—Cholesterin; plates.

Fig. 106.—Chloride of sodium; cubes.

Fig. 107.—Oxalate of calcium; dumb-bells and octahedra.

Fig. 108.—Cystin.

Fig. 109.—Uric acid; various forms.

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MICROSPORON (μικρός, small; and σπόρος, a spore).—*Microsporon furfur* is the fungus of tinea versicolor, and *Microsporon minutissimum* of erythrasma. *See* EPIPHYTIC SKIN-DISEASES; and ERYTHRASMA.

MICTURITION, Disorders of.—Under this term will be considered those conditions which interfere with the normal performance of micturition, regarded as a physical act. Thus suppression of urine is not included in this category, for in the state so described no urine is secreted by the kidney, and the absence of the secretion is not due to any physical cause in the bladder or urethra. The following will be treated of as disorders of micturition:—

1. *Irritability of the bladder in the adult.*
2. *Diminished size of stream.*
3. *Retention of urine, partial* and *complete.*
4. *Urine passing by an abnormal channel.*
5. *Incontinence and overflow of urine in the adult.*
6. *Incontinence of urine in the child.*

1. *Irritability of the bladder.*—This term is never to be employed as defining any morbid condition of the bladder, since it is too vague to denote anything else than a symptom, of which the practitioner has to discover the cause. It is commonly used in widely differing senses, and conveys therefore no definite meaning to the hearer. As denoting a symptom, it may be held to imply the simple fact of unduly frequent micturition, and should never be used, either in writing or otherwise, in any other sense. Whenever, therefore, this phenomenon is present, instead of regarding it as due to some specific morbid state, indicated by the term 'irritability of the bladder,' as too frequently happens, the problem to be solved is What is the cause of the irritability? In all maladies of the bladder, and in most that affect the kidney also, unnaturally frequent micturition is present. It may vary in degree, and exist alone as a single symptom; or it may, as is much more usually the case, be accompanied by other symptoms, which aid the diagnosis. Thus it is present in all the inflammatory conditions of the bladder, and whenever calculi, foreign bodies, or tumours exist there. Also when the bladder is full, and either habitually does not empty itself, or when absolute retention is present, in either case the wants to pass water are frequent and pressing. It is often present in stricture of the urethra, and in inflammations of that passage; also in chronic pyelitis, simple or calculous, in chronic nephritis, in Bright's disease, in diabetes mellitus, as a result of the increased quantity of urine, or when urine is morbidly acid. It is present likewise during hysterical states, and under emotional excitements in many persons of either sex; and whenever the watery elements of the urine are rapidly and abundantly secreted.

2. *Diminished size of stream.*—This may occur either with or without organic obstruction in the passage. It is always present, of course, in congenital narrowing of the prepuce or of the external meatus; in organic stricture of the urethra; and mostly in enlarged prostate. It may be occasioned by inflammation of the urethra and prostate; and by impaired power in the bladder to expel its contents, from partial paralysis, atony, or other cause. Occasionally the channel is narrowed by irregular actions of the surrounding muscles, and thus 'spasmodic stricture' (an objectionable term) is spoken of as producing a diminution of the stream.

3. *Retention of urine.*—Retention of urine, partial or complete, is not to be confounded

with 'suppression,' the latter being of course defective action of the secreting organ, so that no urine is produced, and the bladder remains empty. Retention is the result in almost all cases of mechanical obstruction, such as enlarged prostate from hypertrophy, tumour, presence of blood-clots in the urethra or bladder, and occasionally from rupture of that organ. One of its most common causes is a narrow stricture of the urethra, especially when inflammation follows the use of instruments; inflammation alone may also occasion retention, as during an attack of gonorrhœa. Impacted calculus is not infrequently the cause; sometimes also, but most rarely, the spasmodic action referred to above.

Treatment.—As the cause is a purely mechanical one in the great majority of instances, the remedy which should be applied without delay is also a mechanical one, namely, a catheter of appropriate size and kind. If a suitable instrument, however, is not within reach, medicinal agents may be of service until it can be obtained. At the head of these no doubt is opium, which allays involuntary straining, and sometimes thus enables the patient to relieve himself by the natural method, at all events to some extent. It should be given in full doses, for the purpose either of relieving the patient's suffering and anxiety, or of acting favourably on the function; and the error in practice which has been most common is to give doses of 10 to 15 minims of laudanum or liquor opii, when 30 to 40 or more were necessary, and might have been highly useful. Of course the form of opiate may be varied, according to the habits of the patient or the views of the attendant. Simple opium is merely mentioned here as the type. Local bathing, as hot as it can be borne, is also a valuable adjunct; as, for example, a hip-bath, commencing at 100° F., which may with advantage be carried gradually up to 110° in these circumstances. Diuretics, often given, are for the most part injurious; that is to say, when the cause is a mechanical one; the same must be said, in such circumstances, of the tincture of the perchloride of iron, once in some repute in retention of urine. As a general principle, also, it is not to be forgotten that active purgation commonly promotes the expulsive action of the bladder, often materially so, and tends to afford relief.

4. *Urine passing by abnormal passages.*—The urine may escape by abnormal channels, passing from different parts of the urethra to the surface, most commonly by that of the perinæum, constituting urinary fistula. This condition is necessarily named as one of the 'disorders of micturition,' but its treatment belongs exclusively to the experienced practical surgeon.

5. *Incontinence and overflow of urine in the adult.*—The conditions so denoted here are among those disorders of micturition which it is very important to understand. It not infrequently happens that a man between fifty and sixty years of age finds himself gradually compelled to pass urine oftener than has been his custom hitherto, and that, the tendency still increasing, he is compelled to pass it every hour or two, both by day and night; and sometimes even, especially if not relieved by treatment, he may pass it without his will or knowledge, during sleep. During the earlier stages of the affection, it is by no means uncommon that the individual learns or believes that his experience is natural to age, and is either not amenable to treatment, or is not worthy of serious notice. Many a life has been endangered most certainly, and some have been lost, by such an estimate of these symptoms. Again, the condition described is often loosely spoken of as 'incontinence' of urine; of which, however, it is not only not an example, but indeed indicates the presence of a condition precisely contrary. It is extremely important not to confound these two opposite states when making our diagnosis. What does produce frequent micturition and so-called 'incontinence' in such a case, is a bladder unable to empty itself, always therefore partially if not completely filled, from which the surplus must be either frequently discharged, or be passed 'incontinently.' The important point, then, is never to lose sight of the fact that frequent micturition, and above all urine involuntarily passed by elderly men, in nineteen cases out of twenty indicates retention (requiring the catheter), and not incontinence.

True incontinence, which means inability to retain, on the part of the bladder, is a very rare occurrence, and is present almost invariably only in cases of disease in the nervous centres producing paralysis in other parts of the body, as well as the bladder. When the bladder-symptoms alone are present, and no signs of paralysis elsewhere exist, it may be held as almost absolutely certain that the bladder itself is not paralysed. It may be over-distended with fluid from enlarged prostate; or its coats may be thinned and atonied, and so unable to contract on their contents; but there is no true paralysis of the bladder (commonly as that term is often employed) without central lesions of the kind above referred to, and affecting other functions also besides that of micturition.

Treatment.—In these partial retentions of urine, producing its overflow and involuntary discharge, the remedy consists, in the more or less frequent use, according to circumstances, of a soft or flexible catheter, and the case is mainly surgical. There are some instances in which restoration of the power of the bladder may be attempted by medicinal agents, such as strychnine and iron, or by electricity, but their effect is little or none, apart from the habitual emptying of the organ by artificial means. In some cases perhaps they may be advantageously associated with the surgical treatment.

6. *Juvenile incontinence.*—A brief sketch of this common and well-known affection is all that our limits will admit. Nevertheless it is one relative to which much might be written, without exhausting a subject the pathology of which has wide and manifold relations.

In the earliest periods of childhood an undue frequency of passing water is often to be observed among individuals of both sexes, more commonly in boys than in girls. As age advances the infirmity usually lessens, and then disappears; whilst in exceptional instances it continues, without change, to puberty, and even for some years after that period has arrived. But the peculiarity of the case is that the urine is passed unconsciously during sleep, and this forms the most serious symptom. In spite of all precautions, a quantity of urine is discharged every night during deep sleep, an occurrence of which the child is quite unaware, and which as he advances in age he is wholly unable to control, however strong may be his disposition to do so. On the bladder becoming distended reflex action of the vesical muscular coats takes place, and the contents are discharged. The flow of urine is determined, as it would appear, not by inability on the part of the bladder to retain the ordinary quantity of urine, for the patient does so by day, but by its undue excitability or readiness to contract, so that the water is passed while consciousness is lost, during sleep. In a few instances, certain aberrations from a good standard of health seem to favour the production of these phenomena, especially sources of irritation in the rectum, which produce activity in that muscular apparatus, involving also the kindred muscles of the bladder, which are so closely associated. Thus the presence of ascarides or other foreign agents may suffice to occasion expulsive action in the bladder. During the period of infancy and early childhood the nervous system is highly impressionable, and the habit in question being accidentally set up, its persistence may result solely from repetition through the force of custom, long after the original cause has disappeared.

Sometimes slight malformations of the male organ favour the occurrence of incontinence; such as a narrow meatus, or a long prepuce which is never retracted and is consequently in an unhealthy state.

Precocious development and extreme activity of the mental faculties, producing disturbed sleep, seem to favour the occurrence of incontinence. On the other hand, it is sometimes associated with a morbid deficiency of intelligence.

Treatment. — The treatment ordinarily necessary may be to some extent inferred, when examination of the patient has determined the presence or absence of the conditions named. This done, the next indication is to subdue the activity of the expulsive function of the bladder by some agent which possesses that power. The most powerful for this purpose is undoubtedly belladonna; one of the most notable qualities of this drug is its temporary influence to produce a paralysed condition of the vesical muscles. Thus, if administered to an adult whose powers of expelling urine are feeble, such, for example, as are commonly met with in advancing years, complete retention of urine is often produced. Of this the writer has seen many marked illustrations. Now, as has already been observed, in not a few of the cases of so-called 'juvenile incontinence,' its existence is due solely to persisting habit after the original occasion of it has long ceased; and these are almost certainly and sometimes rapidly cured by administering the agent in question. The object is to induce a partial paralysis of the bladder for a period of some weeks, and if the case is obstinate, even for two, three, or four months, and by this means not only to destroy the old habit, but to develop a new one, namely, a habit of retention, and the annoyance disappears entirely and for ever. On meeting, therefore, with a case, whether in childhood or youth, the first indication is to correct any manifest deviation from the ordinary standard of general health; and, secondly, to administer belladonna persistently. Small doses, suited to the age of the patient, suffice at first, and may be given every afternoon and evening only—say from six to twelve minims of the tincture on each occasion during the first week. In the second and third weeks of treatment, the dose may be augmented one-fourth; in the fourth and fifth weeks the original dose is raised a third or half; meantime some improvement will almost certainly by this time be manifest. Since the ability to bear belladonna increases rapidly as the system becomes habituated to it, a larger dose may be given during a further term of three successive weeks, by which time the involuntary discharge of urine probably ceases. If not, a gradually increased dose must still be continued. After this the dose may be gradually diminished, and at a rate more rapid than that by which it was augmented: the habit of retention has probably been formed by this time, and when cessation from medicine takes place, no recurrence of the symptoms will be observed. Such is the writer's experience in a considerable proportion of the cases which have fallen in his way. But it must be confessed that a troublesome minority is met with in which the influence of the belladonna has not been permanent. It almost invariably produces some improvement, however, and it is worth while to be careful that the drug has been well prepared. Thus the writer has been successful with the belladonna of one chemist, after failure with that of others. Now, in regard of these obstinate and exceptional cases, what remains to be done? It may be assumed that an exhaustive observation has been made of all the functions, especially of those which perform digestion, and that it is unnecessary to insist further on this score, or to suggest the numerous details which such consideration gives rise to. All this done, there still remain modes of treatment of a local character, which ultimately almost always prove successful in these cases. These do not include blisters on the sacrum; apparatus to prevent the patient lying on his back, when asleep; arrangements to arouse him during the night once or twice to pass water voluntarily, and such measures—all of which are palliative means, and do little towards a radical cure, and which constituted the chief agencies employed some years ago.

Superior to all these in the writer's hands has been the application of a solution of nitrate of silver to the urethra, whether in the male or female. Even the use of a flexible bougie, small of course for children, passed daily, and removed in the course of a minute or so, is sometimes successful. But if this fails, the injection by means of a sufficiently long tube of the solution named to the prostatic portion of the urethra and neck of the bladder, is a remedy of no mean value. The process generally known to surgeons as 'instillation,' by means of a syringe and a flexible tube, is perhaps the best. For young women up to the age of eighteen or twenty in whom this unfortunate infirmity still exists, the writer has found it almost always, if not invariably, successful. It should be applied immediately after the bladder is emptied, in quantity, say, of a drachm, and of a minimum strength of ten grains to the ounce, up to treble that strength if necessary for subsequent applications. Enough should be employed to produce decided smarting, which shall continue for a day or two. A week or two should be permitted to elapse between each application.

It would not be right to omit the mention of other remedies besides belladonna, which may be used either alone or in combination with it. Such are the tincture of the perchloride of iron; strychnine; tincture of cantharides; and bromide of potassium. The last-mentioned, given at night only, has sometimes a manifestly beneficial effect.

Henry Thompson.

MIDDLE PARK HOT SPRINGS, in Grand County, Colorado, U.S.A.—Thermal waters. *See* Mineral Waters.

MIGRAINE.—A synonym for megrim. *See* Megrim.

MIGRATION OF CORPUSCLES. The escape of blood-corpuscles through the walls of minute vessels, and their passage into the surrounding tissues. The process is chiefly seen in inflammation. *See* Inflammation.

MILIARIA (*milium*, a millet-seed).—Synon.: Sudamina; Fr. *Miliaire*; Ger. *Friesel.*

Definition.—A vesicular eruption of the skin, generally associated with profuse sweating, and sometimes with pyrexia.

Description.—The proximate causes of miliaria are heat and sweating. The vesicles have the bulk of millet-seeds; are developed close to the pores of the skin; are generally discrete; and are dispersed irregularly over the surface. They are thin, and contain at first a pellucid fluid; in a more advanced stage they sometimes, though rarely, become inflamed, and then the serum becomes milky and opaque, and the eruption is called *miliaria alba*. When left to themselves the vesicles subside and dry up into an extremely thin scale.

Treatment.—The treatment of miliaria consists in subduing whatever feverish symptoms may be present; in lightening the clothing and coverings; in the use of tepid baths and tepid sponging; and, after the bath, dusting the skin with some absorbent powder, such as fuller's earth. Sponging with lime-water is also useful; and the use of a lotion in which oxide of zinc is suspended in lime-water, in the proportion of 40 grains to an ounce. This should be painted on the affected parts of the skin, and allowed to desiccate thereon.

Erasmus Wilson.

MILIARY ANEURYSMS.—Minute dilatations in connexion with the small blood-vessels; especially met with in the brain. *See* Brain, Vessels of, Diseases of.

MILIARY FEVER.—A febrile condition attended with the eruption of miliaria. *See* Miliaria.

MILIARY TUBERCLES. — True tubercles, which appear in the form of minute granulations. *See* Tubercle.

MILK FEVER.—Synon.: Ephemeral Fever; Sc. Weed; Fr. *Fièvre de Lait*; Ger. *Milchfieber.*

Definition.—A febrile condition produced by constitutional disturbance, accompanying the flow of milk to the breasts, on the third or fourth day after delivery.

Ætiology.—The older writers considered a febrile state to be a normal accompaniment of the establishment of the secretion of milk, but since the introduction of the clinical thermometer, and its employment by nurses as part of the daily routine after labour, it has been shown that functional disturbances in the breasts about this period, sufficient to cause a distinct milk fever, are quite of exceptional occurrence. It appears to arise chiefly in those who are in a feeble state from want of nourishment, loss of blood, or other cause; or to occur when the child has not been put to the breasts sufficiently early to free the milk tubes.

Symptoms.—The symptoms of milk fever are sometimes slight, and pass off very quickly, in which case the term 'ephemeral' is appropriate; but sometimes the fever is considerable, the temperature rising high, perhaps exceeding 102 F., and the pulse beating 120 or more in the minute, from which state the recovery is probably less rapid. The patient generally experiences slight shivering, her teeth chatter, there is a sensation of cold water running down her spine, and she calls for blankets and hot-water bottles. At this time the breasts are swollen and sensitive. This chill soon gives way to a hot stage, which may last from two to twelve hours; the head aches badly; there is pain in the limbs and restlessness, and generally thirst. The breasts now become very painful to the touch, hard, and knotty, the skin tense and shiny, and the superficial veins distended, while the axillary glands are enlarged, and the lymphatics running to them can be felt like cords. Then follows the sweating stage, from which great relief is experienced; the breasts become softer, and milk commences to flow from the nipples; the temperature falls; and all the symptoms abate.

Treatment.—During the cold stage the desire of the patient for hot-water bottles and blankets should be gratified; and care should be taken not to diminish the amount of clothing too rapidly during the hot stage. The bowels should be evacuated. A diaphoretic mixture, such as solution of acetate of ammonium with camphor water, should be administered; and the child should be put to the breasts as soon as the sweating stage sets in. In many cases flannels wrung out in hot water applied to the breasts give great relief; and sometimes *very gentle* kneading towards the nipple, using the thumb, with vaseline or warm oil, starts the milk to flow from the nipple, and hastens the subsidence of the symptoms. Clement Godson.

MIMOSIS (μιμέομαι, I imitate).—A term applied to the phenomena of a disease, which resemble or imitate those of another disease.

MIND, Disorders of.—*See* Idiocy; and Insanity.

MINERAL WATERS.—Definition. Mineral Waters is the name given to those waters which, on account of the different saline or gaseous substances which they hold in solution, or of their elevated temperature, are used in the treatment of disease, either internally or in the various forms of baths.

The science that treats of the effects of mineral waters and baths on a great number of chronic maladies is called *Balneotherapeutics*. In a wider sense this branch of medicine comprises also the use of sea baths and of common water, but these subjects are treated in separate articles. *See* Hydrotherapeutics; and Sea Air.

Courses of mineral waters and baths are to be regarded as methods of treatment analogous to courses of other remedies; but they are much more complicated, not only because many of the mineral waters are in themselves compound remedies containing several active substances in combination, but also because in most courses of waters or baths the invalid is influenced in body and mind by several other powerful agents, such as travelling; change of social conditions, occupation, scene, diet, and habits in general, mostly including increased exercise; and by change of climate. Each of these influences has in itself a powerful action, and to their combination we must often ascribe a great part of the curative effects of balneotherapeutic courses; they ought therefore to be carefully considered in every individual case as part of the plan prescribed. We are unable in this article fully to discuss these important concomitant influences, but may refer for their critical estimation to Dr. Braun's treatise *On the Curative Effects of Baths and Waters*, and other works.

As most chronic diseases are treated by other remedies as well as by balneotherapeutic courses, the physician must in every case consider whether and when mineral waters are to be used, either instead of other remedies, or in combination, or in alternation with them.

General Composition and Classification. The principal constituents of mineral waters are: Water, sodium, magnesium, calcium, and iron; combined with hydrochloric, sulphuric, carbonic, and hydrosulphuric acids, the two latter existing also in some waters 'free,' that is, uncombined with bases. Nitrogen and oxygen are likewise present in most mineral waters in various proportions; and in some there are also silica, arsenic, bromine, iodine, lithium, manganese, potassium, alum, organic matters, and several other substances in small quantities.

The substances dissolved in mineral waters are derived from the surface-soil and the rocky strata through which the water deposited from the atmosphere passes. The dissolving power of this water is much increased by the gases which it absorbs, especially carbonic acid and oxygen. The constitution of mineral waters, therefore, varies according to the nature of the strata through which they have passed.

The different mineral waters may be grouped in various ways, as, for instance, according to their chemical constituents, their temperature, their geological origin or geographical distribution, or their physiological or therapeutical actions.

The *chemical* classification, imperfect though it is, offers the advantage that it directs the attention at once to the most important constituents of the water. Some of the classes, however, are not named according to the substances contained in them in the *largest quantity*, but according to those considered most *potent*; such as the iron and sulphur waters. Another difficulty in the classification is, that some mineral waters contain several active substances in sufficiently large proportions to allow of their being placed in different classes; and, again, that some springs are so deficient in active principles as to render it doubtful where to place them. Of these latter, some appear to owe their virtues to the water alone, and its temperature, aided by the climate with which they are associated. Beginning with the latter as the most simple, we may group the mineral waters in the following principal classes:—

I. *Simple Thermal Waters*; II. *Common Salt or Muriated Saline Waters*; III. *Alkaline Waters*; IV. *Sulphated Saline Waters*; V. *Iron or Chalybeate Waters*; VI. *Sulphur Waters*; VII. *Earthy and Calcareous Waters.*

Some of the waters are chiefly used for bathing, others more for drinking, the majority for both purposes. In the consideration of the uses of the different spas, it is important to distinguish between the effects produced by the baths, and those caused by the internal use of the waters; and in larger works the plan followed by Dr. Braun, namely, to devote one section to 'bathing' and another to 'drinking courses of mineral waters,' offers advantages to the student; but in an article like the present it would be inconvenient, as frequent repetitions would be necessary.

The term 'baths' comprises not only the ordinary tub bath, but also swimming baths, or piscines; partial baths for the feet, the hands, and other parts; douches of great variety; vapour baths; carbonic acid baths; and mineral mud baths. At many places also inhalations of vapour and pulverised spray form part of the treatment.

We will now give a short account of the different classes.

I. Simple Thermal Waters.—The simple thermal waters are characterised by poverty in solid and gaseous substances, and hence low specific gravity; by perfect transparency; by great softness; and by elevated temperature—varying in the different spas from about 80° to over 150° F. Some of them contain nitrogen in larger proportions than the gases of waters usually do, others more oxygen. They are often called *indifferent* waters, on account of the absence of special mineralisation; and also *wild baths* (*Wildbäder*), on account of their being usually situated in wild mountainous regions.

Action.—The water of this class of spas when taken internally probably acts only as ordinary very pure warm water. By the drinking of warm as well as of cold water, the stomach is washed out; the secretion of bile, saliva, pancreatic juice, urine, etc., is increased; the tissue-change is augmented, and the removal of effete matters from the tissues and blood promoted; and by the acceleration of the retrogressive tissue-change, the progressive tissue-change becomes facilitated. As differences between warm water and cold water, we may mention that the latter acts more as a local excitant on the stomach, while the former is more easily absorbed, and makes less demands on the powers of the constitution, by not causing any expenditure of heat.

The simple thermal waters are much more used for *bathing* than for drinking courses; and the baths, as such, have probably the effects of ordinary warm baths, varying according to the temperature of the baths, and the time spent in them.

As the *fundamental effects of warm baths*, which effects form part of the action of all kinds of warm baths, simple as well as mineralised, we may regard—

(1) That they soften and cleanse the skin more rapidly than cold baths, and prepare it for perspiration.

(2) That they equalise and diminish the loss of heat, and, according to the temperature of the bath, lessen or prevent it altogether; and that, in the hot bath, heat is even added to the body.

(3) That the circulation in the skin is accelerated.

(4) That the organic functions and the tissue-change are slightly stimulated, or rather facilitated, without any strong reaction on the part of the organism.

(5) That the nervous system and muscular irritability are calmed.

(6) That the absorption of exudations is promoted.

These effects, as already mentioned, vary considerably with the degree of heat. In the *tepid bath* (from 80° to 95° F.) the central nervous system and the action of the heart are but slightly influenced; in the *warm bath* (from 96° to 102° or 103° F.) the heart's action is quickened, but the respiration is generally only slightly affected; in the *hot bath* (from 103° to 110° F.) the central nervous system becomes much more excited; not only is the heart's action further accelerated, but the respiration becomes rapid, and sometimes irregular; and the hyperæmia of the skin leads to perspiration on removal from the bath.

Baths of a temperature above 110° F. are scarcely ever used, and only for a very few minutes. The effects vary also considerably, according to the duration of the immersion.

Uses.—The *drinking courses* of these waters may assist in the treatment of irritable forms of affections of the throat, stomach, and intestines, with spasmodic cough, cardialgia, constipation from sluggish secretion of bile and intestinal secretions; and by increasing the tissue-change, and removing used-up material, they are useful in chronic rheumatism and gout.

One of the main uses of the *simple thermal baths* is to allay over-excitability and hypersensibility of the nervous system in its various spheres; thus they often act beneficially in cases of neuralgia, hyperæsthesia, painful menstruation, and hysterical tendency. Their reputation in painful wounds and cicatrices is historical. In these cases, as well as in chronic rheumatism in its various forms and sciatica, the hotter are more useful than the tepid baths. In some forms of paralysis and loss of muscular power depending on peripheral changes, such as exudations on nerve-sheaths, good effects are produced; but if they are caused by changes in the centres of the nervous system, not much is to be expected. In gout the internal use of other mineral waters is generally required, but as second courses the simple thermal waters are often useful; and in many delicate gouty persons the balneotherapeutic treatment ought to be restricted to courses of tepid baths, aided by climate and diet. Most of these conditions can be also treated with other waters.

The ordinary thermal bath requires in many cases the assistance of douches and massage; and in some, douches are preferable to the ordinary hot baths, either alone or in combination with massage.

Enumeration and Selection.—The choice of a simple thermal spa is to be guided, not by the name of the disease alone, but also by the state of constitution, and many concomitant circumstances. The simple thermal waters deserve, *cæteris paribus*, the preference, when gentle management is required—when it is desirable to make as slight demands as possible on the powers of the constitution. Their action is in this respect greatly assisted by the mountainous climate enjoyed by the majority of these baths. The selection of a special spa in a given case depends on the nature of the case in the widest sense; on the degree of elevation which is desirable; on the means of treatment obtainable and customary at the different spas, including the most important agent—the spa physician; on the accommodation, the food, manner of living, and social conditions; on the distance and means of reaching the spa; and on many other circumstances. Information on these subjects can only be obtained by the study of larger works, and by personal visits. We can give here only the names of the principal spas of this class arranged according to their elevation:—

Name	Country	Elevation (approximative). Feet	Temperature of springs. Fahrenheit
Panticosa	Spain (Pyrenees)	5000	77°–92°
Leukerbad (Loeche-les-Bains)	Switzerland	4600	102°–122°
Bormio	Italy	4300	90°–104°
Gastein	Austrian Alps	3300	95°–118°
Pfäffers	Switzerland	2115	100·4°
Johannisbad	Bohemia	2000	86°
Bagnères de Bigorre	France (Pyrenees)	1850	90°–95°
Ragatz	Switzerland	1570	96°
Badenweiler	Baden	1425	86°–90·5°
Landeck	Silesia (Prussia)	1400	66°–84·2°
Wildbad	Würtemberg	1323	95°–98·6°
Plombières	France	1310	66°–156°
Luxeuil	France	1300	65°–163°
Neuhaus	Styria (Austria)	1200	95°
Liebenzell	Würtemberg	1113	72°–82°
Warmbrunn	Silesia (Prussia)	1100	96·8°–104°
Tobelbad	Tyrol	1050	77°–82°
Aix-les-Bains	Savoy, France	1000	86°–120°
Buxton	England	1000 (nearly)	82°
Schlangenbad	Nassau (Prussia)	900	81·5°–86°
Neris	France	800	114°–125°
Römerbad and Tüffer	Styria (Austria)	700–800	93°–100°
Teplitz	Bohemia	650	95°–120°
Lucca	Italy	500	100°–129°
Dax	France	130	127°–140°
Bath	England	100	100°–120°

Many other slightly mineralised warm waters, whose principal action is to be referred to water and heat, might be mentioned here, while several of the places contained in the list, as Leukerbad, Bormio, Bagnères de Bigorre, and Bath, might find places in other divisions.

The very hot Algerian baths, Hammam-Meskoutin, Biskra, and Hammam-R'Irha, the last beautifully situated some sixty miles from Algiers, belong likewise to this class.

The United States of America are likewise rich in simple hot springs, which are partly already in use, partly awaiting development. Sooner or later they will equal and perhaps surpass the most celebrated thermal waters of Europe. We will only mention here a few of them: the 'Hot Springs' in Virginia; the 'Hot Springs' in Arkansas; the 'Calistoga Hot Springs,' California; the 'Geysers,' California; the 'Paso Robles Hot Springs' in California; the 'Idaho Hot Springs' in Colorado; the 'Warm Springs' in North Carolina; the 'Warm Springs' in Georgia; 'Lebanon Springs' in Columbia county, New York; the 'Warm Springs' and the 'Healing Springs' in Bath county, Virginia. (For further information we refer to *The*

Mineral Springs of the United States of America, by G. E. Walton, M.D., New York, 1883.)

Allied in their action, though more powerful in their demands on the system and in their effects, are the natural hot-vapour baths in the large cave of Monsummano in Upper Italy, and in the smaller excavation in the rocks of Battaglia in the Euganean mountains.

II. Common Salt or Muriated Saline Waters.—Composition.—Common salt, or chloride of sodium, is the principal solid constituent of the waters of this class; but this substance is contained also in many other mineral waters, especially in some alkaline, some sulphur, and some Glauber's salt waters, and has a considerable share in the effects of these waters. Some of the springs in this class contain also appreciable quantities of iron, and of carbonates of sodium, lithium, magnesium, and lime, by which their action is modified.

Action.—In order to appreciate the action of the common salt waters, we must bear in mind that common salt forms part of all the tissues and juices of the body; that it promotes digestion; that it is essential to the formation as well as the disintegration of cells and tissues; that it stimulates not only the retrogressive, but also the progressive tissue-change or nutrition of the body; and that it is a great agent in the processes of secretion and absorption. Chloride of sodium stimulates the secreting apparatus of the stomach and intestines, and hence the action of the bowels and the circulation of the portal system, and indirectly the general circulation. It quickens the tissue-change; and through this, as well as the increased circulation, it promotes absorption of pathological products, without lowering the organism. In larger doses, however, beyond about five drachms per diem, irritation of the mucous membrane of the stomach and intestines may be produced. The action of the common salt waters is modified by their accompanying properties, especially by the carbonic acid contained in them, by their temperature, and by the degree of their concentration.

The *carbonic acid* in this and other classes of waters quiets the sensitive nerves of the stomach; stimulates the secretion and peristaltic action of the stomach and bowels; and indirectly increases the secretion of the kidneys. In large quantities, however, if not rapidly ejected by eructation, it may produce, by being absorbed, poisonous effects on the blood and nervous system. The presence of carbonic acid in salt waters increases the effects of chloride of sodium on the stomach and intestines, and by accelerating the passage of the waters from the stomach into the intestinal canal, promotes the action of the bowels.

Elevation of the temperature of the water produces more rapid absorption, and thus diminishes the local and increases the more distant and constitutional effects.

Concentration increases the local stimulation.

As to the action of these waters in the form of *baths*, the chloride of sodium and other chlorides (though any absorption through the skin of these and other salts contained in mineral waters is doubtful, or, at all events, forms only a small part of their therapeutic effects) stimulate the cutaneous ends of the nerves and the capillaries, and promote through this the nutrition and tone of the skin, and indirectly the tissue-change, an action which is heightened by the presence of carbonic acid, as witnessed at the gaseous saline baths of Rehme and Nauheim. The action of the salt and of the carbonic acid on the skin is, however, not to be regarded as merely local, but as transmissible from the nerve-ends to the various nerve-centres, and producing through these reflex effects.

Uses.—Salt waters and salt baths are useful in weakness of the skin; in tendency to rheumatic fever or bronchitis; in retarded convalescence from acute and chronic illness; in enlargements of joints from preceding inflammation; in scrofulous complaints; in many forms of anæmia and chlorosis—especially those where iron alone is not borne; in numerous cases of Indian cachexia; and in cases of sluggish circulation in the portal system, which leads to innumerable varieties of digestive troubles, to congestion of the liver, and of the pelvic organs in women, and to piles.

Enumeration and Selection.—The same classes of cases, as far as the name goes, are treated alike by alkaline and sulphated waters. The individual conditions must guide the practitioner in deciding for either the one or the other kind of waters, and for the special spa, according to the strength of the springs, the additional ingredients, such as lithium and arsenic at Baden-Baden, the amount of carbonic acid, and the climatic and concomitant conditions. Spare and pale persons, we may mention, mostly bear the common salt waters better than strongly alkaline and sulphated waters. Common salt waters are to be found in almost all countries; we can only give the most important or best known. In *England*: Droitwich—perhaps the strongest of all brines, with good arrangements, Nantwich, Ashby-de-la-Zouche (Ivanhoe Baths), Middlewich, Woodhall, and Harrogate; Leamington and Cheltenham contain likewise much common salt, in addition to sulphate of sodium. In *North America*: St. Catharine's Wells, Michigan Congress Spring, Spring Lake Well, Fruit Port Well, the celebrated Saratoga Springs, and the Ballston Spa. In *Germany*: Kissingen, Homburg, Rehme-Oeynhausen, Nauheim, Kreuznach, Soden, Pyrmont (which contains salt as well as iron springs), Wiesbaden, Hall in Austria, Hall in the Tyrol, Hall in Wurtemberg, Reichenhall, Ischl, Kreuth, Durkheim, Kosen, Kœnigsdorff-Iastrzemb, Krankenheil, Mondorf, Salzungen, Canstatt, Cronthal, Baden-Baden, and several others. In *France*: Bourbonne-les-Bains, Lamotte-les-Bains, Balaruc, Salins, and others. In *Italy*: Ischia, Casteliamare, Castro-Caro, Monte Cattini, La Porretta. In *Switzerland*: Bex. In *Spain*: Las Caldas de Besava, Las Caldas de Estrae, and Las Caldas de Mombuy.

III. **Alkaline Waters.**—Composition.—The alkaline waters contain *carbonate of sodium* as a prominent constituent; they are also more or less rich in *carbonic acid*; and some are distinguished by so large a proportion of *chloride of sodium* as to warrant a subdivision into—(1) *simple alkaline waters*; and (2) *muriated alkaline waters*.

Action.—In considering the dietetic and medicinal value of these waters, we must bear in mind that sodium in combination with carbonic acid is a most important constituent of the human body. Oxidation and tissue-change seem to be greatly influenced by the presence of soda; various proteid bodies seem to be kept in solution by it; it has a considerable share in the secretion of saliva and bile, and in the digestive processes; and, according to Liebig, it acts as a vehicle for the carbonic acid from the blood to the lungs.

Carbonate of sodium may be considered as an antacid, as a diuretic, as a promoter of tissue-change, and as a solvent. The beneficial effects of alkalis are in general produced only by a systematic use of *small* doses; whilst *large* quantities cause emaciation by their excessive solvent effect, and diminish the tissue-change by their depressing influence on the heart's action. The action of soda differs in this respect from that of chloride of sodium, which even in considerable doses increases the tissue-change, and does not so easily exercise an emaciating effect.

Uses.—The conditions in which alkaline waters are mostly employed are certain forms of dyspepsia, with undue acidity of the stomach; congestive conditions of the liver from sluggish portal circulation; tendency to gall-stones; diabetes; uric-acid diathesis, and its results—gravel and lithiasis; some forms of gout; and especially chronic catarrhal affections of the mucous membranes of the respiratory, digestive, and genital organs.

Enumeration and Selection.—Where it is necessary to improve the state of the blood, or to avoid emaciation, the muriated alkaline are preferable to the simple alkaline waters.

1. The principal spas with *simple alkaline waters* are—(*a*) *Hot*: Vichy, Neuenahr, Mont Dore, Chaudes Aigues, and Neris, the three last being feebly mineralised; (*b*) *Cold*: Vals, Salzbrunn, Le Boulou, Evian, Bilin, Apollinaris, Gerolstein, Fachingen, Geilnau, Wilhelmsquelle, Taunus, Giesshubel, Soulzmatt, and Marcols. In North America the Bladon Springs in Alabama, the Sheldon Springs in Vermont.

2. The chief *muriated alkaline waters* are—(*a*) Ems, Royat, and La Bourboule, which represent the *hot* springs; (*b*) Luhatschowitz, Selters, Gleichenberg, Roisdorf, Rosbach, Vic-sur-Cère, and Toennistein, which are *cold*. In North America the Congress Springs in California, and the St. Louis Spring in Michigan, belong to this class. The so-called California Seltzer Springs are peculiar in so far as they contain a larger quantity of carbonate of magnesium (10 grains in a pint) than of either carbonate or chloride of sodium. These springs seem therefore to offer advantages in oxaluria.

We ought to remark that several of the waters in this class, especially La Bourboule and Mont Dore, contain *arsenic* in appreciable quantities, while others contain lithium, as Royat.

IV. **Sulphated Waters.**—Composition. We include under this term those springs which are characterised by a preponderating amount of the sulphates of sodium or magnesium, or both sulphates together. They may be subdivided into (1) *simple sulphated waters* or *bitter waters*; and (2) *alkaline sulphated waters*, which latter contain also carbonate and chloride of sodium.

Action.—The *bitter salts* can scarcely be said to be constituents of the organism; they seem to act by stimulating, and in larger doses irritating, the mucous membrane of the stomach and alimentary canal, causing thin watery secretion, and in large doses diarrhœa. Sulphate of sodium is less irritating than sulphate of magnesium. The peristaltic action of the bowels is likewise increased by them. Their continued employment is apt to cause emaciation. By the presence of carbonate and chloride of sodium, the action of the bitter salts is modified.

Uses.—The bitter waters are useful in habits of constipation with sluggish portal circulation, in hæmorrhoidal tendencies, in congestion and enlargement of the liver and spleen, in some forms of dyspepsia, in gall-stones and allied affections, in gouty conditions, lithiasis, and diabetes; and, *cæteris paribus*, have in stout and in so-called plethoric persons the preference over the muriated saline waters.

Enumeration and Selection.—Where prolonged courses are required, the weaker sulphated waters, and especially the alkaline sulphated waters, are to be preferred; whilst the stronger bitter waters are more frequently selected for occasional purging doses. (1) The principal *simple sulphated* or *bitter waters* are: Pullna, Saidschutz, Sedlitz, Birmensdorf, Ivanda, Hunyadi János and other springs near Ofen, Epsom, Rubinat, Las Caldas de Cuntio, Aranjuez, Friedrichshall, and Mergentheim, the two latter being also rich in chlorides. Weaker springs of a similar nature are at Leamington and Cheltenham—both with a large amount of common salt, at Scarborough, and at the Purton Spa. (2) The principal *alkaline sulphated waters* are Carlsbad, Marienbad, Tarasp-Schuls, Franzensbad, Elster, and Bertrich. The constitution and the action of the waters of Carlsbad and Bertrich are modified by their thermal nature. North America possesses some milder springs of this class: Estrill Springs, Crab Orchard Springs, Bedford Springs, Midland Well.

V. Iron or Chalybeate Waters.—Composition.—Iron is contained in the majority of mineral waters; but we regard as iron waters only those where the quantity of iron is, in proportion to the other constituents, so far predominant as to give a therapeutic character to the springs.

Action.—The formation of blood-globules, the contractility of the blood-vessels, the oxidation and the production of heat, and the general nutrition of tissues seem to be favoured by the use of iron waters. A small quantity only of iron seems to be absorbed by the stomach; none through the skin. The action of chalybeate baths seems to be due to the influence of the water and carbonic acid only.

Uses.—The conditions most benefited by chalybeate waters are the various forms of anæmia, or poverty of blood and particularly of red corpuscles, especially when caused by actual loss of blood, suppuration, or previous acute or chronic disease. The liver and digestive organs, however, must be in healthy working order, whilst in cases of anæmia accompanied by congestion of the liver and spleen, chalybeates alone are rarely useful, but must be preceded or modified in their action by the use of saline waters or other aperients; and this is often the case not only in anæmia of Indian and malarious cachexia, but also in chlorosis. Neuralgia, sterility, impotency, and general debility, are often benefited through improvement of the general health. Those iron waters are most useful which contain the iron in the form of the bicarbonate of the protoxide, kept in solution by free carbonic acid.

Enumeration and Selection. — Iron springs are (1) *comparatively pure*, that is, containing only a few grains of other substances in sixteen ounces of water: Schwalbach, Spa, Brückenau, Schandau, Liebwerda, Flinsberg, Freienwalde, Recoaro, Kœnigswarth, Liebenstein, Altwasser, Flitwick, Tunbridge Wells, and one of the springs at Harrogate; (2) *compound iron springs*, that is, which contain, in addition to iron and carbonic acid, a moderate quantity of other salts, especially the carbonates of sodium, calcium, and magnesium, the sulphates of sodium, magnesium, and calcium, and common salt: Aratapak, Orezza, Pyrmont, Driburg, Rippoldsau, Griesbach, Antogast, Petersthal, Elster, Bocklet, St. Moritz, Reinerz, Godesberg, Cudowa, Imnau, Bussang, and Santa Catarina. In North America: Bailey Springs, Stafford Springs, Greencastle Springs, Estill Springs, Schooley's Mountain Springs, Montvale Springs, Rawley Springs. Somewhat different in their action and less easily assimilated are the springs containing *sulphate of iron*. Representatives of this class are, in America—the Oak Orchard Acid Springs, the Bath Alum Springs, Stribling Springs, Bedford Alum Springs, and Variety Springs. The best known in Europe are: Flitwick in Bedfordshire, Muskau in Silesia, Parad in Hungaria, Alexisbad, and Ratzes. Rich in sulphate of iron in combination with *arsenic* are the waters of Roncegno and of Levico in the Austrian Tyrol; they are very powerful, and can only be taken in small doses.

VI. Sulphur Waters.—Composition.—Amongst sulphur waters we class those springs which contain either sulphuret of hydrogen, or the sulphuret of sodium, calcium, potassium, or magnesium, in an appreciable and constant proportion. They are partly thermal, partly cold; and some of them, especially Aix-la-Chapelle, Uriage, and Baden in Switzerland, the Columbia Springs in New York, and the Louisville Artesian Well in Kentucky, U.S.A., contain a considerable proportion of common salt and other solids, which are to be taken into consideration in the appreciation of their effects.

Action.—It is difficult to describe the physiological effects of the sulphur waters, so far as they depend on such minute quantities of sulphur as are contained in them. Sulphur-water baths seem to act in the same manner as simple baths. If the waters are taken internally, some sulphuretted hydrogen is probably absorbed, entering the circulation through the portal vein. The pure sulphur waters exercise a constipating rather than an aperient effect. The fæces become mostly blackened from sulphuret of iron. The protracted use of these waters is apt to lead to a certain degree of anæmia, possibly from the action of the sulphur on the iron of the blood-globules.

Uses.—Sulphur waters are mostly used in combined bathing and drinking courses, as also by inhalation, in cases of metallic poisoning; in congestion of the liver; piles; bronchial, laryngeal, and pharyngeal catarrh; in early chronic phthisis; in numerous cutaneous affections, especially the herpetic dyscrasia of the French; in rheumatism and gout; and in constitutional syphilis.

Enumeration and Selection.—The best known *thermal sulphur waters* are: Eaux Bonnes, Eaux Chaudes, Cauterets, Saint Sauveur, Barèges, Bagnères de Luchon, Ax, Escaldes, Le Vernet, Amélie-les-Bains, Uriage, Allevard, Aix-les-Bains, Aix-la-Chapelle, Baden in Austria, Baden in Switzerland, Lavey, and Schinznach in Switzerland, Battaglia and Abano in the Euganean mountains; Panticosa in Spain; Mehadia, and other springs in Hungary; and Helouan or Helwan, near Cairo. *Cold sulphur springs* are: Eilsen, Nenndorf, Langenbrucken, Weilbach, Memberg, Reutlingen, Enghien, Challes, Stachelberg, Heustrich, Gurnigel, some Harrogate springs, Llandrindod and Builth in Wales, Moffat and Strathpeffer in Scotland, and Lisdoonvarna in Ireland. There are also several important sulphur springs in the United States of America.

VII. Earthy and Calcareous Waters. Composition.—As *earthy* and *calcareous waters* we designate those springs in which the earthy substances, especially carbonate and sulphate of calcium and carbonate of magnesium, form the prominent constituents.

Action.—In the shape of baths, the earthy waters act almost in the same way as ordinary water baths. Internally taken, the carbonate of calcium exercises an antacid and a soothing effect on the mucous membrane of the stomach and intestines, and together with the sulphate of calcium is slightly astringent and constipating. If lime is absorbed, it may assist in the formation of cells and of bone, and may exercise also a soothing effect on other mucous membranes.

Uses.—These waters, according to their composition, are useful in digestive troubles with tendency to acidity, diarrhœa, and undue irritability of the mucous membrane. They are employed also in osteomalacia, rachitis, and tuberculosis; and, further, in some skin-diseases, especially in eczema and psoriasis, where, however, the long continuation of the warm bath, that is, the soaking of the skin, is of more importance than the nature of the solid constituents contained in the water. Some of these waters possess a great reputation in chronic catarrh of the bladder, and in tendency to gravel and stone; but probably the large quantity of water consumed, as, for instance, at Contrexéville, and the consequent dilution of the urine and the washing out of renal tubules, are here to be regarded as the principal causes of the useful effect. The best known earthy or calcareous waters are: Wildungen, Lippspringe, with the Inselbad, Weissenburg, Contrexéville, Vittel, Bagnères de Bigorre, St. Arnaud, and Cransac; and amongst the table waters: Couzan, St. Galmier, and the Taunus water. In North America the best known earthy or calcic springs are: the Butterworth Springs, Eaton Rapid Wells, and Leslie Well in Michigan; the Gettysburg Spring in Pennsylvania; the Sweet Springs in West Virginia; and the Alleghany Springs in Virginia.

Many of the waters mentioned in other classes might also be mentioned here, such as Bormio, Leuk, Bath, and Lucca, named under the simple thermal waters; and Baden in Austria, Baden in Switzerland, Schinznach, Battaglia, Abano, and others enumerated under the sulphur waters.

On prescribing Mineral Waters and Baths.—In every case we must first settle the question whether the treatment by mineral waters and baths offers advantages over ordinary treatment. If the question is answered in the affirmative, we have to consider not only the nature of the disease, but quite as much the nature of the individual in whom it occurs; the amount of vital forces in general; the power of reaction; the state of the different organs; and whether they are healthy and vigorous and can assist in relieving the diseased part of the organism, or whether they are feeble or crippled and unable to respond to any unusual demand made on them. Thus we shall be enabled to decide whether stronger therapeutic influences can be employed; whether longer and rougher journeys are permitted, and colder climates and seasons; or whether delicate treatment is essential, comprising the simple thermal baths, summer temperature, mountain climates of moderate elevation, sunny aspects, and easy journeys. The baths and waters are not to be selected according to the chemical constitution of their springs alone, but the means and appliances in use, and the accustomed methods of treatment at certain places, the qualities of the local physician, the accommodation, the food, the cooking, and the social conditions, the facility of reaching a place, the climate and other elements of 'change,' are each and every one to be taken into consideration. It must be evident already from these remarks that the same morbid affection can occasionally be treated with advantage by different classes of mineral waters and at different spas, and that apparently widely different diseases may be benefited by the same spa; not only because many mineral waters are composed of different active elements, but also because the internal and external administration of the same water may be so much varied as to produce a great variety of effects. In many instances the disease itself cannot be directly attacked, but our efforts must be directed towards improving the general constitution, and through this influencing the diseased portion of the organism.

In most cases the local physician is as important as the nature of the waters, and in some even more so.

We cannot do more here than give some hints regarding the groups of diseased conditions in which mineral waters may be prescribed.

1. *Anæmia.*—In cases of anæmia it is

essential to consider whether the condition is caused, first, by direct loss of blood and its component parts; secondly, indirectly by acute or chronic disease, sleeplessness, neuralgia, and inability to take up food; thirdly, by congestion of the pelvic organs, with loss of blood and albuminous juices; or, lastly, by lymphatic diseases, or visceral affections resulting from warm climates or from habitual constipation. The more the first cause preponderates, the more we may expect from the direct use of iron; and we have then to consider whether pharmaceutical preparations, or iron waters with or without change of climate, with or without baths, are to be preferred. In the indirect forms of anæmia the mildest thermal treatment, with mountainous climates of moderate elevation, or the latter alone, with or without suitable medicinal treatment, are often the only beneficial courses in delicate constitutions; whilst in others somewhat less feeble according to individual conditions, common salt waters and baths with or without iron, or the gaseous tepid salt baths of Nauheim and Rehme, or the much stronger influences of sea air and of sea baths, are useful. In the third group the common salt waters, with a certain amount of iron, and occasionally the sulphated saline waters, must generally precede every other attempt at strengthening; for the acceleration of the portal circulation, the regular emptying of the different branches of the portal vein, and the increased tissue-change are essential to the improvement of the nutrition and sanguification; and only after such a preliminary course the purer iron waters and the higher alpine air are likely to become useful.

2. *Sluggish portal circulation.*—A sluggish condition of the portal system forms a frequent complication, not only of anæmia, but of a great many ailments of the different systems of the body; and is often only a part of a general want of tone in the organic muscular fibre, especially of the right ventricle and of the whole venous system. It is difficult to find a name for these, by no means rare, constitutional defects, which form the main characteristics of what the old German physicians called 'abdominal plethora.' If we only know what we mean by the terms, we may call these conditions *portal venosity* and *general venosity* according to the extent of the defect. They form the principal complications and in many cases the main cause of the most varied digestive troubles, as acidity, sickness, flatulency, constipation, and intestinal catarrh. They are also at the root of congestion of the hæmorrhoidal vessels and piles, of varicosity of the legs, of congestion of the womb and ovaries and menstrual anomalies, of congestion of the liver and imperfect secretion of bile, and of chronic bronchial catarrh, with dilatation and imperfect contraction of the right ventricle. Gravel and gout are likewise often associated with sluggish portal circulation. In the treatment of these very numerous complaints, widely different though they appear to be, we have therefore always to ask how far they are complicated by portal venosity, and in how far diet, regimen, pharmaceutical and balneotherapeutic treatment directed against this venosity may relieve the special case before us. If this portal venosity occur in *lean* and *delicate* persons, the common salt waters are often useful, as Kissingen, Homburg, Soden, the Saratoga Springs, Michigan Congress Spring, Spring Lake Well in North America, &c., which increase the tissue-change without impairing the nutrition, internally and in the form of baths, or the simple thermal baths in sub-alpine situations, assisted by the internal use of salt waters. If the individual be *stout* and inclined to costiveness, the sulphated saline waters with soda and common salt, such as Carlsbad, Marienbad, Franzensbad, Elster, Brides-les-Bains, Luhatschowitz, and Tarasp, are the most effective; while again in others of this class the simple alkaline waters, such as Vichy, the Congress Spring, &c., are preferable. In all these cases, however, the treatment by waters and baths ought to be assisted by regulation of diet and exercise.

3. *Gravel.*—Gravel, especially uric acid gravel, is usually complicated with portal venosity, and is to be treated accordingly. As a symptomatic treatment, the alkaline mineral waters have a more lasting effect than the administration of pharmaceutical preparations; but more effective are alkaline waters containing sulphates, and especially the less concentrated and hot springs of Carlsbad. Most useful of all, especially for home treatment, are the waters of Luhatschowitz, with their peculiar combination of carbonates and chlorides. The earthy waters of Contrexéville and Wildbad have a historic reputation, and owe this in part to the large doses which can mostly be prescribed.

4. *Gout.*—Gout is likewise often complicated with and aggravated by portal venosity, and we must always endeavour to facilitate the removal of the products of the retrogressive tissue-change; but gout occurs in the most widely different constitutions. If gout and its allied forms be met with in so-called strong constitutions, with a good primary digestion, ability to sustain a long morning fast, accompanied perhaps by a tendency to stoutness, and an acid urine of tolerably high specific gravity, becoming iridescent with nitric acid, the alkaline sulphated waters of Carlsbad, and sometimes those of Marienbad, Franzensbad, Elster, Tarasp, and Brides-les-Bains, are most useful, though they cannot altogether remove the gouty disposition. If the time be short, and a long rest after the course not permitted,

the simple alkaline waters of Vichy may be selected, and in more delicate constitutions the muriated alkaline waters of Royat, Ems, or Baden-Baden. In lean and weak gouty patients the common salt waters of Homburg, Kissingen, Harrogate, and Leamington, the arsenical salt waters of La Bourboule, the waters of Wiesbaden, the muriated sulphur waters of Aix-la-Chapelle, or, again, weak muriated alkaline waters like Baden-Baden, deserve a trial. In many delicate persons the simple thermal waters of Buxton, Schlangenbad, Wildbad, Ragatz, Gastein, and Bath, and the sulphur waters of Aix-les-Bains and Bagnères de Luchon, offer great advantages; but numerous cases may be regarded as quite intractable by baths, waters, and medicines, and in these diet and climate and regulation of exercise are the only means of management.

5. *Chronic rheumatism.* — In chronic rheumatism, associated with exudation round the joints, the hot thermal treatment is the most useful, either at the hotter simple thermal spas, as Bath, Teplitz, the Euganean baths, the hot springs of North America, or the natural vapour baths of the cave of Monsummano; at the weaker hot salt waters of Royat, Wiesbaden, and Baden-Baden; or at the thermal sulphur waters, such as Aix-la-Chapelle, Aix-les-Bains, Barèges, Bagnères de Luchon, and Eaux Chaudes. For more delicate cases, especially in those combined with weakness of the muscles of the heart, with or without valvular disease, we have the gaseous thermal salt waters of Rehme and Nauheim. In the muscular varieties, with stiffness, the hotter waters are specially indicated, assisted by douches and shampooing. In many instances, however, the cause of constantly recurring rheumatism is weakness of the skin, and here the tonic forms of the cold water-cure and sea baths promise more permanent good than hot baths.

It is impossible, in a limited treatise, to enter into all the morbid conditions suitable for balneotherapeutic treatment; but the preceding remarks may show that the physician, in prescribing waters, ought to base his advice on the teachings of physiology, pathology, climatology, and general therapeutics, in the widest sense.

We might be expected to give a few hints on diet during mineral-water courses, but no general rules can be laid down. Every individual requires rules for his own case; and rules which may be necessary during the use of muriated saline, or sulphated saline waters, are not necessary in other courses—for instance, of simple thermal or of iron waters.

The bath physician ought to guide every invalid, according to his or her individual condition, as well with regard to diet as to the internal or external use of waters, and with regard to exercise and other hygienic and therapeutic aids. The result of a course of waters often depends entirely on this guidance. It is important, therefore, to supply the bath physician with a statement as to the ailments and the constitution of the invalid.

Length of Treatment.—It is a general belief that three or four weeks is the term for a course of waters or baths; but it is impossible to fix a definite time. As courses of iodide of potassium, of iron, of quinine, or of mercury must be of different duration in different individuals, exactly so we find it with mineral waters; and as two or three courses of a remedy may have to be taken in the same year, so it is often desirable to give two or three courses of Vichy, of Carlsbad, or of Spa waters, in one year, though not all of them need be taken at the spring. In many cases preparatory courses are advisable—climatic, medicinal, and balneotherapeutic; and in as large a number secondary courses. Most invalids ought not to return immediately after a course of baths to their usual abodes and accustomed ways of living. In many instances, moreover, it is imperatively necessary to abstain from work, and to keep to a simple diet for about a month or more after the course of waters, and this is especially the case with the more powerful waters like Carlsbad and Marienbad.

Season.—As to the period of the year, there is no time when the different waters might not be drunk, if it were necessary. Most spas are open only from May till October, some longer; some only from June till September; but some few localities are partially open also during the winter, especially Aix-la-Chapelle, Aix-les-Bains, Dax, Amelie-les-Bains, Bath, Baden-Baden, and Wiesbaden. Many waters can be taken at home, and at any time of the year; but the elements of change are wanting, and the strict adherence to regimen and diet is often difficult. During the summer months the demands on the human body are diminished by the external warmth and the greater equability of the meteorological influences; nature is more exhilarating, and invites to outdoor life and exercise, without much risk of chills and their consequences. Delicate persons, therefore, ought to select the summer months for courses at the spas. The later parts of the spring and the autumn, however, offer advantages to the more robust, who at those times find the baths and the hotels less crowded, and who can then receive more attention from the bath physician. And, besides, those who are unable to bear heat have in the earlier and later parts of the season the benefit of cooler air, which is to the average visitor a real advantage at some of the hotter localities, like Aix-les-Bains, Aix-la-Chapelle, Ems, Creuznach, Soden, Baden-Baden, and Ragatz.

Hermann Weber.

MIRYACHIT (Russ. *miriatchitje*, to play the fool).

Description.—This is the term applied in Russia and Eastern Siberia to a morbid condition, which, however, is met with under different names in various parts of the world. The term itself is part of a verb meaning 'to fool' or 'play the fool,' and the victim of the disease, if it may be so named, has a desire, apparently irresistible, to imitate whatever action is carried out in his presence, and also to repeat whatever is said to him or in his hearing. The condition, according to Dr. Jankovsky, is chronic, but subject to spontaneous remissions, and is not usually of such a character as to interfere with an ordinary occupation. The tendency is not infrequently hereditary, and is usually induced by contact with a *miriasha*—a person affected in this way; and, amidst a neurotic community in places where it is prevalent, the influence of such a person is in the highest degree disturbing. An exactly similar condition, according to Dr. Neale, is met with in Java under the name of *Lata*. On the northern frontier of Maine, between the United States and Canada, there exists the curious class of so-called 'jumpers,' who resemble in some points the sufferers from miryachit. But instead of imitating actions or repeating words, the sufferers from this condition are characterised by their inability to disobey any sudden sharp order which is given to them. Thus a man ordered to take hold of a red-hot stove was impelled to do so, although the effect was disastrous. A similar condition has been described by Dr. Bennett as existing in Griqualand among the natives and those of mixed race, who suffer from an irresistible impulse to dance, shout, or grimace on the occasion of any sudden or peculiar sound; and, like the 'jumpers,' they also will obey any sudden sharp order, oblivious of consequences.

Under whatever name or in whatever part of the world it is met with, the condition is essentially a psychical disturbance, and it affects chiefly those who are on the outskirts of civilisation. On the whole, men are more subject to it than women, and in the form met with in Africa men are apparently the only victims. In the Russian form, on the other hand, men are less frequently attacked than women. The condition has many resemblances to the great dancing epidemics of the middle ages, and almost seems like a relic of them. Like them, it spreads by contagion; and its manifestations are similarly the result of irresistible impulses, and are displayed amongst a class emotionally unstable and destitute of the self-control which is necessary in a well-ordered community. By some the Canadian form is ascribed to the excessive indulgence in tickling to which the class affected are addicted; but it is more likely that both this and its supposed effect are the expression of the same underlying instability.

Treatment.—Any treatment to be successful must be directed to combating the causes. Ordinary sedatives, such as the bromides, have been found to exercise little if any effect.

James Taylor.

MISCARRIAGE.—Synon.: Abortion; Fr. *Avortement*; *Fausse Couche*; Ger. *Fehlgeburt*.

Definition.—Miscarriage is the interruption of gestation before the fœtus has become viable.

Frequency.—The relative frequency of miscarriages, of premature labours (between the seventh and ninth months), and of full-time births, cannot be very closely estimated. Early abortions are often unnoticed or forgotten. The statement of Dr. Whitehead is very striking, that of sixty-four women who had lived in wedlock till the menopause, there were only eight who had not at some time had a miscarriage. His statistics show that the period at which abortions most frequently occur is about the third month.

Ætiology.—The causes of abortion may be found either: (1) on the part of the ovum or fœtus; or (2) on the part of the mother.

1. *Fœtal.*—The causes of miscarriage on the part of the ovum are: (*a*) all the diseases of the fœtus itself which compromise its life, such as acute fevers and chronic diseases—chiefly of syphilitic origin; and (*b*) many of the morbid changes in the fœtal appendages. Of the latter the most noteworthy are, first, diseases of the chorion, the most familiar of which is the hydatidiform degeneration; secondly, abnormal conditions of the umbilical cord, such as excessive torsion with constriction of the vessels, convolutions of it simultaneously round the neck and lower extremities, and the formation of tight knots upon it; and thirdly, abnormal relations and morbid conditions of the placenta. Where the placental area, for example, is of too limited extent, the ovum easily becomes detached from the uterus; where it is too large, extravasations of blood easily take place in the lobules. When the placenta is planted low down in the cavity of the uterus, it is liable to partial detachments; and thus in a great many cases abortion takes place at an early stage in patients who would have been subject to the greater dangers of unavoidable hæmorrhage had the pregnancy gone on towards the usual term. Again, the morbid processes which occur in the placenta, inflammatory, degenerative, or apoplectic, whether due to a syphilitic taint, or to other causes, lead to death of the embryo or fœtus, and thus in many instances to the early casting of the ovum. It is worth while to note that death of the embryo, and morbid changes in its appendages, do not necessarily

at once cause abortion. Three or four weeks usually elapse after the death of the fœtus ere its expulsion is effected; the decidual membrane having in the interval undergone retrogressive changes. It is only when such an extravasation of blood takes place as leads to sudden distension of the uterus, or when the membranes burst and such escape of liquor amnii occurs as leads to its sudden collapse, that the organ is stimulated to the immediate evacuation of its contents. Hence, while the ultimate cause of abortion is often enough traceable to the ovum, the immediate occasion is more frequently due to some maternal condition.

2. *Maternal.*—The causes of miscarriage on the part of the mother are either (*a*) *general*; or (*b*) *local*. (*a*) Amongst the *general* or constitutional conditions that favour the occurrence of abortion we note, first, all the causes that lead to depression of a woman's health. Abortions are frequent, for instance, in times of famine; amongst women who yield themselves to excesses; in anæmic women; and in those tainted with the syphilitic poison. Often enough, especially in the last class, the cause of the abortion can be traced to some morbid change in the maternal portion of the placenta; but sometimes it seems to be due simply to the impure or impoverished condition of the patient's blood. Secondly, fevers, such as the zymotic fevers, and acute inflammations, more particularly of important viscera, such as pneumonia, occurring in gravid women, very frequently become complicated by abortion. Thirdly, shock may bring on miscarriage, whether operating simply through the nervous system, of which we meet occasional examples, or, as is more frequently the case, by producing a more direct physical impression upon the uterus, as in cases where the patient leaps or steps suddenly down from a height, lifts a weight, stretches her arms above her head, or is exposed to any sudden jar or more protracted jolting. Though many cases of abortion are attributed to such a cause, it is always to be borne in mind that in some of these, at least, that supposed cause would not have led to the disaster unless there had already existed a predisposition in some morbid condition of the uterus or its contents.

Amongst (*b*) the *local* causes we find, first, and most frequently, diseased conditions of the deciduæ. Commonly in these cases the patient had previously been the subject of chronic endometritis; though occasionally cases are met with where there have been no marked symptoms previously, and the degenerative process may affect either the vera or reflexa or serotina, separately or simultaneously. Second in frequency under this head we have the abortions due to displacements of the uterus, these being commonly either descents or retroversions. Thirdly, neoplasms of the uterus, such as cancers or fibroid tumours, sometimes permit the occurrence of conception, but prevent gestation running to its natural term. Fourthly, the presence of tumours in the neighbouring organs, or inflammatory adhesions among them, may prevent the uterus from attaining its full growth, and compel it to early evacuation of its contents.

Symptoms and Diagnosis.—In dealing with a case of suspected miscarriage, we have to determine first that the patient is pregnant. This we do by a careful inquiry into the patient's history, and a complete physical diagnosis. Supposing that, by the usual investigation into the signs and symptoms of pregnancy, we are satisfied that gestation had begun, we have next to ascertain whether miscarriage is only threatening to come on, has fairly set in, or has already been completed.

The symptom that, in the great run of cases, first attracts attention, which usually goes on till the process is completed, and which continues for some hours or days subsequently, is hæmorrhage. The amount of blood lost varies indefinitely; and so does the manner of its escape. In certain cases the onset of pelvic pains, with the regular intermissions that betray their origin in the muscular contractions of the uterine walls, alarms the patient and attracts her attention before any escape of blood has taken place. These cases are exceptional. Usually the hæmorrhage precedes—and it may be for days or weeks—the expulsive action of the uterus. The cases, however, are rare—unless they be instances of very early abortion—where the process is completed without the accession of appreciably painful contractions. Occasionally there occur discharges of liquor amnii or other watery fluid, or of fragments of the degenerated membranes, or of the disintegrated fœtus.

These symptoms call for physical exploration of the uterus. If we find the uterus gravid, with the os undilated and the cervical canal above it unexpanded, the hæmorrhage being slight and the pains controllable, we regard and treat the case as one simply of threatened abortion. But if the pains are persistent, if the os uteri opens to admit the finger, or the canal of the cervix above it is becoming expanded; still more, if the uterine contents are being pressed down within reach of the exploring finger, we have to do with an actual abortion which it is useless to seek to avert. The treatment of actual abortion is often enough called for, even with quiescent uterus and closed canals, when the hæmorrhage is profuse.

In trying to determine whether the miscarriage is completed, we have first to examine the mole or mass that has been expelled. This consists sometimes of the ovum alone; of the ovum and decidua reflexa; or of the ovum with all the uterine deciduæ. Where the uterine contents escape in broken-down fragments, and cannot be satisfactorily pieced together, it becomes necessary to examine the uterus, and even to explore the interior of that organ with the finger; and in these and other cases where the diagnosis is doubtful, it may be requisite sometimes to dilate the cervix with a carbolised sponge or tupelo tent, or with Hegar's dilators, in order to get full access to the uterine cavity.

Treatment.—The treatment of miscarriage varies according as we have to do with a case of (1) threatening abortion; or (2) abortion in actual progress; or (3) incomplete abortion.

1. *Treatment of threatening abortion.*—The treatment in a case where abortion is merely threatening is largely expectant. The patient is put to bed, and kept at rest in the recumbent position. All exercise or excitement, physical or psychical, must be forbidden. A light, non-stimulating diet, with fluids for the most part cold, is to be enjoined; and any tendency either to constipation or to diarrhœa is to be combated. Where the hæmorrhage is continuous and the uterus atonic or flaccid, small doses of ergot—twenty drops, every six or eight hours, of the liquid extract—are useful. Diluted sulphuric acid or gallic acid, either alone or in combination with digitalis, may be administered. Where there are occasional pains accompanying the discharge, the best effects are obtained from the administration of opiates, which may be prescribed in the form of the acetate of lead and opium pill. Where the pains constitute the more urgent symptom, and the hæmorrhage is less, it may be well to check the uterine action at once by the use of an anæsthetic followed by opiates, or the administration of a dose of chloral; and the astringent may then be dispensed with. The opiates in such cases are best administered hypodermically or *per rectum*. In many cases the liquid extract of viburnum prunifolium in doses of ʒss–ʒi has proved useful as a sedative to the uterus in threatened abortions.

2. *Treatment of actual abortion.*—Where the stage of expectancy is clearly over, and the patency of the os internum, the persistence of the pains, or the profusion of the hæmorrhage, calls for active interference, there are two main indications to be fulfilled—namely, to restrain the hæmorrhage; and to ensure the complete evacuation of the uterus.

To restrain the hæmorrhage, we compel the uterus to more energetic contraction, first, by the administration of large repeated doses of ergot. A drachm of the liquid extract may be given every three or four hours; but the effect of the drug can be most speedily and safely ensured by the hypodermic injection of ergotin—according to some such formula as this: ℞ Ergotini ʒij; chloral hydratis ʒss; aquæ destillatæ ʒvj—16 drops to be injected into the gluteal muscle. The dialysed solution of ergotin is said to produce less irritation. Secondly, the genital canal must be plugged. Where we have no other means at command of checking the discharge, a carefully applied vaginal tampon may be trusted; or the vaginal plug may be used where the hæmorrhage is going on but there is still some hope that the abortion may be arrested. Where the indication is more urgent, the introduction of a sponge tent into the cervical canal is very much more satisfactory, and in every way more efficacious. It arrests the hæmorrhage immediately and inevitably; it excites the uterus to more energetic action; and it at the same time expands the cervical canal in all its length. Where the indication is present for still more rapid dilatation of the cervix, this may be effected by means of bougies, such as Hegar's.

The complete evacuation of the uterus may takeplace by the unaided efforts of its muscular walls. On visiting a patient in the morning, who had a sponge tent passed into the cervix uteri and a hypodermic injection of ergotin over night, we may find sponge and ovum and all expelled. Where the ovum is still *in utero*, if it be loose and the cervix dilated, compression of the uterus from above the pubes may suffice to make it expel its contents. Usually, however, it becomes necessary to get at the interior of the uterine cavity with a finger or fingers passed through the vaginal canal. In most cases it greatly facilitates the operation to anæsthetise the patient, and in some cases the previous administration of chloroform is absolutely necessary. To render the uterus accessible to the exploring fingers, it must either be pushed down from above or dragged down from below. The patient lying unconscious on her back, the fundus uteri may be depressed by the left hand pushed firmly and steadily down through the pelvic brim. The depression may be effected by an assistant, but never so satisfactorily as by the operator himself. Not less than two fingers of the right hand should be used for the internal manipulation; the middle finger being folded in the fornix vaginæ, whilst the index passes through the os to the fundus uteri, and sweeps round the entire ovum, detaching it at any adherent points. Sometimes the middle finger more conveniently enters the uterine cavity; and in most cases of miscarriage in the fourth month, the whole hand, except the thumb, may require to be passed into the vagina, and two or more fingers into the uterine cavity. Even where the vaginal orifice is not at first very wide, if the hand be carefully warmed and soaped, and the interstices of the fingers filled up on their palmar aspect with a quantity of half-melted soap, sufficient dilatation is speedily effected. Occasionally the smaller left hand may be employed for internal manipulation, while the stronger right is engaged in making the external pressure on the fundus uteri. Access to the interior of the uterus may in most cases be gained more easily by dragging the uterus down from below. One or other of the lips of the uterus—usually the anterior—is seized with a vulsellum, double or triple pronged, and slightly curved. One of the blades grasps the vaginal aspect of the front lip of the cervix as high up as the roof of the vagina, the other at a corresponding level within the cervical canal. The uterus is capable of being drawn far down without any injury to its ligaments, or any laceration by the bite of the vulsellum. It may be pulled down with the right hand and kept fixed by it, whilst the fingers of the left pass into the cavity, and explore and evacuate it. Or the vulsellum may be held in the left hand, or given to an assistant, to keep the uterus depressed, whilst the more familiar right-hand fingers do the intra-uterine work. The finger or fingers that have detached the ovum commonly succeed in extracting it, aided sometimes by pressure with the other hand from without. If not, there is no objection to laying hold of the loosened body with a pair of long dressing forceps, or a Lyon's or polypus forceps, and so withdrawing it; but no such instrument, even though it bear the name of abortion-forceps, ought to be trusted to for the detachment of a retained ovum or fragment of adherent placenta. The separation should always be effected by the direct action of the living finger.

3. *Treatment of incomplete abortion.* In mismanaged cases the uterus is left imperfectly evacuated, and the patient continues to suffer from menorrhagia and metrorrhagia—it may be for months subsequently. In such circumstances the use of the curette is invaluable. Sometimes a degree of dilatation with tupelo tent or otherwise is required, but usually the cervical canal easily permits of the passage of a curette, with which the surfaces of the uterus can be scraped and the entire cavity of the organ can be cleared out. The curetting should be accompanied or immediately followed by the washing out of the cavity with a stream of hot water, of the temperature of 110° to 120° F., containing 1 in 5,000 of corrosive sublimate, or some such antiseptic, with the view at once of checking further hæmorrhage and disinfecting the uterine cavity.

After-treatment.—The uterus having been completely emptied, the patient should be kept at absolute rest in bed, and subjected to the same treatment as an ordinary puerperal female.

Alexander Russell Simpson.

MITOSES (μίτος, a thread).—The appearances which nuclei present at different stages of karyokinesis. *See* Cell.

MITRAL VALVE AND ORIFICE, Diseases of. *See* Heart, Valves and Orifices of, Diseases of.

MODIFIED.—A term applied to a disease, or to any of the phenomena of a disease, such as an eruption, when, as the result of a recognised cause, they present unusual characters, or run an unusual course. Thus, small-pox is modified by vaccination. *See* Small-pox.

MOFFAT, in Scotland.—Sulphur and also chalybeate waters. *See* Mineral Waters.

MOGIGRAPHIA (μόγις, with difficulty; and γράφω, I write).—A synonym for writer's cramp. *See* Writer's Cramp.

MOLE.—MOLAR PREGNANCY. The moles that are met with in obstetrical practice are divided into two classes, (A) the *false*; and (B) the *true* moles. The false moles may be briefly dismissed, but it is desirable that they should be discussed in order to clear the ground for the consideration of the more important variety.

(A) **False Moles.**—False moles are so called as not being the result of conception. Substances unconnected with conception discharged from the virgin vagina are occasionally so described; such, for example, as shreds of vaginal mucous membrane, which the microscope should recognise. But the chief difficulty is with the membrane of membranous dysmenorrhœa, which may be mistaken for a true decidual membrane. Here we have to be guided by the history of previous attacks, the usual character of menstruation, and the microscopic examination of the discharged membrane, which shows the absence of structures characteristic of a fecundated ovum. Blood-clots, variously altered, may also be discharged by the non-pregnant, and give rise to some difficulty; especially partially decolorised clots, consisting mainly of fibrin. Here, again, the absence of chorionic loops is sufficiently characteristic. And, lastly, polypi and small fibroid tumours, or portions of larger ones, should not be difficult of recognition by naked-eye and microscopic examination.

(B) **True Moles.**—True moles are always the result of impregnation. Two varieties are recognised: (1) the *fleshy* or *carneous* mole; and (2) the *vesicular* or *hydatidiform* mole.

1. *The Carneous Mole.*—Ætiology and Pathology.—Extravasation of blood into the tissues of the developing placenta, or into the decidual membrane, or between the placenta and the uterine wall, rarely into the amnion, is the chief agent in the production of this mole. This extravasation may be due to any of the causes, such as over-exertion or excitement, which induce uterine action and lead to decidual detach-

ment. This damage to the ovular membranes leads almost invariably to the death of the embryo, which may entirely disappear or remain in the contracted amnial sac, small and blighted, surrounded by the thickened membranes, the whole forming a more or less firm and fleshy mass. On section, the inner aspect of the amnion presents an irregularly nodular appearance of a deep red, almost black, colour. If the amniotic fluid has escaped, and the embryo has entirely disappeared, the mass may still be recognised as originating in conception by the presence in its tissues of chorionic villi. A mole thus constituted may remain in the uterus for varying periods, but is generally expelled between the third and fifth months.

Symptoms.—The symptoms of early pregnancy become irregular, and ultimately subside; the size of the uterus, instead of increasing, becomes less; and, although at first there may be the customary cessation of menstruation, sooner or later irregular hæmorrhagic discharges, which may be bright, or chocolate-coloured from the breaking down of clot, and occasionally offensive from its decomposition, call attention to the interference that has occurred with the progress of the pregnancy. On examination, the uterus is found more solid than usual, and smaller than it should be were pregnancy normal.

Treatment.—The treatment essentially is to empty the uterus. While the mole remains in its cavity, the patient is exposed to the risk of hæmorrhage on the one hand, and of septic infection on the other. The administration of ergot may be sufficient to stimulate the uterus to throw off its contents; but should it not be, then the use of the sound will often succeed. Should the uterus still remain inert, we have to fall back upon the use of carbolised tents, or Hegar's dilators, to dilate the cervix, when the contents may be removed by the finger, by ovum forceps, or the curette, alone or in combination according to the special condition of each case. After emptying the uterus, it is advisable to wash it out with some warm antiseptic injection.

2. *The Vesicular* or *Hydatidiform Mole.*—The term 'hydatid mole' is somewhat misleading. There are no true hydatids in it. True hydatids are shut sacs, enclosed one within another, and containing echinococci; the vesicular mole consists of more or less pedunculated cysts, growing from one another.

Ætiology and Pathology.—All authorities agree that the vesicles in hydatid mole are formed from the chorionic villi. These undergo proliferation with myxomatous degeneration, and the cysts so formed contain fluid, in which mucin is found, as well as albumen and some salts. The vesicles vary in size from a small currant to a chestnut. Their mode of attachment one to another makes the so-called resemblance to a bunch of grapes incorrect. They are not attached by stalks to branches of a main stem, but each vesicle is attached by a pedicle to another cyst, and the first of the series, that nearest the ovum, springs direct from the outer surface of the chorion. The pedunculated structure intervening between the cysts represents the unaltered tissues of the villi. This degeneration affects the villi of the chorion within the first ten weeks of pregnancy. Later on, when the villi have become vascular and the placenta definitely formed, this degeneration seems incapable of occurrence. In most cases the embryo disappears altogether; in a few it may be found, but insignificant and blighted, the degeneration of the villi preceding and determining the death of the embryo. In these there is generally present some portion of placental structure, which is free from vesicular degeneration. These cystic villi occasionally penetrate the uterine wall, enter the sinuses, and even reach to the uterine peritoneum. The precise ætiology of this mole is still obscure; the balance of evidence is perhaps in favour of the error being maternal rather than fœtal, from its occasional recurrence in the same patient. And it is believed that, among maternal predisposing causes, syphilis holds an important place. It is more common in the multipara than in the primipara.

Symptoms.—The symptoms are at first those of ordinary pregnancy, but with the tendency to be more pronounced than under normal conditions. The abdominal swelling increases more rapidly than it should; the reflex symptoms are aggravated; and the patient complains of an unusual amount of discomfort and malaise. At the fourth month of pregnancy the uterus approaches the size usual at the sixth month. There is with this a tendency to the loss of the ovoid form, and the assumption of a globular or more transversely wide shape. In some cases there is a tendency to febrile disturbances.

Diagnosis.—Physical examination often yields important information. Palpation may give us, as Dr. Leishman remarks, a significant doughy sensation, with absence of any fœtal outlines in the uterus; while, at the same time, the intermittent contractions of the tumour prove it to be uterine. Auscultation reveals the absence of any fœtal heart sounds, and vaginal examination of ballottement. If any labour-pains have occurred, and the integrity of the ovum have been disturbed, the escape of some of the vesicles will make the diagnosis complete. The fluid being sanguineous in character, and the vesicles whitish, has given rise to the simile of 'white currants floating in red-currant juice,' attributed to Gooch.

Treatment.—The treatment consists in the removal of the uterine contents. This may be attempted at first by the administration of ergot; failing this, the passage of the sound into the uterus will often stimulate uterine contraction, and induce the expulsion of the mole. Should still the uterus not respond, the use of tents rendered aseptic is indicated, or of Hegar's dilators, or, in the case of the more fully developed uteri, of the hydrostatic dilators. After dilatation of the os is accomplished, the contents of the uterus may be removed by two or three fingers introduced into its cavity, aided by external pressure on the fundus; in rare cases, it may even be necessary to introduce the whole hand.

After the removal of the uterine contents, it is advisable to wash out the cavity with some antiseptic solution, and, if there has been much hæmorrhage and a tendency to uterine inertia, with the solution of perchloride of iron used in *post-partum* hæmorrhage. It need hardly be said that the removal of the entire contents is of the first importance: should any portions be left, there is risk on the one hand of hæmorrhage, and on the other of septic infection.

It is important to remember that twin pregnancies may occur, in which vesicular degeneration affects the chorion of but one ovum; and that quite possibly the sound ovum may proceed to full development, as is said to have occurred at the birth of the anatomist Beclard.

Alfred Wiltshire. Henry Gervis.

MOLES. Synon.: *Nævus Pigmentosus.*

Definition.—A mole usually consists of a small congenital fibrous growth of the skin, with an excess of pigment.

Description and Pathology.—Although moles are usually raised above the surface of the skin, and contain a certain quantity of fat and connective tissue, together with pigmentary deposits, yet we also occasionally meet with some which are flat, and appear to be nothing more than dark pigment spots; on the other hand, some fibrous moles are no darker than the surrounding skin. Not infrequently there is a small tuft of strong hair growing from the mole.

Properly speaking, moles are congenital, but dark spots exactly resembling them in superficial appearance are often met with as an acquired pigmentary change.

Moles vary much in size. As a rule they are not bigger than a split pea, but they are sometimes much larger. Usually they are single or very sparsely scattered over certain parts of the body; occasionally, however, they are met with in large numbers. The regions most commonly affected are the face, neck, back, and arms; much more rarely the chest, the abdomen, and lower extremities. They have no tendency to be distributed symmetrically.

Treatment.—Small congenital moles of the usual size can be easily destroyed by nitric acid or a saturated solution of potassa fusa in water. Large moles can only be removed by the knife, some positions being much more favourable to their removal than others. This point should be especially taken into consideration when the mole is situated on the cheek a little below the eye, as the contraction of the scar may interfere with the closure of the eyelid.

With regard to the removal of acquired pigmentary moles, the result of destruction by caustic is by no means always satisfactory. The writer has on several occasions seen the application of nitric acid followed by the production of a small central scar and a ring of pigment immediately outside, considerably larger than the original mole; this is never the case when the mole is congenital.

Robert Liveing.

MOLIMEN (*molior*, I move or stir).—An impulse or effort. The word is chiefly used in connexion with menstruation, to indicate the effort which appears to be made by the system to perform this function. *See* Menses or Menstruation, Disorders of.

MOLLITIES OSSIUM (Lat.).—Synon.: *Osteomalacia*; *Malacosteon*; Fr. *Ramollissement des Os*; Ger. *Knochenerweichung.*

Definition.—A condition in which the bones of the skeleton become by degrees decalcified, so that they can no longer sustain the weight of the body, but bend or break on slight provocation.

Mollities ossium has been called an excentric atrophy; but the minute changes which occur are not those of atrophy, but rather of active decalcification of the bone. It is a non-inflammatory lymphoid change, in which the bone is decalcified before the trabecular structure disappears.

Ætiology and Pathology.—The causes of mollities ossium are unknown. It affects the female sex almost exclusively; and only occurs in adults, and during the period of child-bearing. There is some intimate connexion between the outbreak of mollities ossium and the gravid state; and repeated pregnancies appear to predispose to its occurrence. The disease seems to occur in the lower classes of the people, who are exposed to hardship and have inadequate food. In certain localities it would seem to be endemic. Mollities ossium has been ascribed to changes in the nutrition of the bone; and to a process akin to chronic osteitis or osteomyelitis, but there is never any ossific periostitis. It has also been referred to an excess of lactic acid in the blood; and this acid is said to have been found in the bones and urine of persons affected by the disease.

Anatomical Characters.—The bone in mollities ossium becomes gradually decalcified, the change spreading from within outwards, until a mere shell of external compact tissue is left, but this cortical layer never wholly disappears. The medullary cavity enlarges in all directions, occupying the epiphysis, and invading the cortical substance, until the interior becomes a gelatiniform mass, enclosed in a periosteal shell. The bone can be cut into layers with a knife, or indented by the pressure of the finger.

In the stage of acute progress the medulla is very vascular, the vessels are enlarged, and here and there extravasations of blood occur. The medullary spaces are filled with nucleated marrow-corpuscles; the trabeculæ give way; the osseous particles disappear; the fat-cells diminish, and gradually disappear; and finally the whole interior is filled with a pale or yellowish gelatinous substance. In extreme cases the external covering may be merely the fibrous periosteum, with a few plates of bone on its interior.

Symptoms.—One of the earliest symptoms of mollities ossium is aching rheumatoid pains in the affected bones, generally aggravated at night. The vertebral column, the ribs, and the pelvis are the parts first affected; and in these serious deformity shortly becomes manifest. The weight of the body causes extreme lateral and so-called angular curvatures. The ribs are bent and broken; one series of fractures taking place in the axillary line, usually directed inwards, is produced by external pressure; whilst a second or third row of fractures takes place by more indirect force—the one near the head of the ribs, the other outside the sternum. The arms often lie in a trough-shaped hollow on the sides of the body. The sternum gives way in several places, and is displaced forwards.

Through the weight of the body acting from above, the promontory of the sacrum is projected forwards, whilst the lateral pressure of the head of the femur against the acetabulum causes the transverse diameter of the pelvic outlet to diminish. It thus assumes a trifoliate shape, the pubic symphysis often projecting forwards at right angles to its normal direction, with its horizontal rami in contact; and the floor of one acetabulum may even touch the other. The bones of the extremities suffer from multiple fractures, and bend from the most trifling causes; and these are very imperfectly repaired in the later stages of the disease, although in the earlier they unite readily by bony callus. As the disease progresses, the body becomes more and more misshapen; the patient more completely helpless and bedridden; and death usually ensues from exhaustion, after a more or less protracted interval, or the sufferer is carried off by intercurrent disease. Female subjects frequently die in consequence of severe instrumental interference required during pregnancy. There is no constitutional cachexia.

Diagnosis.—The diagnosis of mollities ossium is at first very obscure. The pains resemble those of rheumatism. The character of the deformity will, however, settle any doubts. The disease should not be confounded with rickets, which is a disease of infancy or childhood, due to delayed ossification, and producing prominent curvatures of the shafts of the bones, and enlargements near the epiphyses, very distinct in type from the infractions and extravagant distortions of the osteomalacic skeleton. Nor does mollities resemble the fatty atrophy of bones due to senile changes, in which condition, though fracture be common, there is no general deformity involving different parts of the skeleton.

Prognosis.—The prognosis in most instances is unfavourable. In some well-marked cases of softening, the bones appear to have afterwards recovered their normal consistence, but this is very unusual.

Treatment.—No remedial measures, as yet discovered, have either arrested the progress of mollities ossium or promoted its cure. Women affected in this way should be restrained, if possible, from further childbearing, not only to avert increase of the disease, but to avoid the dangers attending childbirth in cases of deformed pelvis. Otherwise, an ample supply of nourishing food, rest in the recumbent position, and abundance of fresh air, are, combined with iron and quinine internally, the principal means of treatment at our disposal. William Mac Cormac.

MOLLUSCUM CONTAGIOSUM.—

Synon.: *Meliceris*; Fr. *Molluscum Contagieux*; Ger. *Schwammgeschwulst.*

Description. — Molluscum contagiosum was first described by Bateman. It consists of small, round, prominent tumours, at first of minute size and translucent appearance, but slowly growing to the dimensions of a pea, or even, in rare instances, of a hazel-nut. The larger ones are sometimes pedunculated, but the smaller are for the most part sessile. In an early stage they have been aptly compared to a small drop of wax. In the centre of these little wart-like growths there forms a slight depression, so that they are more or less umbilicated, and this depression is believed by some to correspond to the open mouth of a sebaceous duct. Each tumour has a thick wall, and contains when developed a white, semi-fluid, milky substance, which may be easily squeezed out after making a small cut with the lancet. The little growths occur either singly or—more commonly—sparsely and irregularly scattered over the skin of the face and neck, and sometimes on other parts of the body. The older ones, after attaining a certain size, usually become inflamed and die out, while a new crop succeeds them. This affection is unattended with pain, itching, or any constitutional disturbance. It may be communicated from person to person by inoculation. The disease is not a very common one, but is probably rather more often met with in England than in other countries; it is more common in children than in adults.

The most interesting point in connexion with molluscum contagiosum is the question as to its mode of production and propagation; and some difference of opinion exists even at the present time with regard to its contagious nature. On the whole, there is strong evidence in favour of its being propagated by inoculation. The evidence in favour of this is of two kinds—(1) that of direct experiment; (2) that of clinical observation. With regard to the former, the disease has been reproduced by artificial inoculation. The evidence derived from clinical observation is even more strongly in favour of the communicable nature of the disease. Many observers have recorded cases which it would be difficult to explain except on the supposition that the disease was contagious in a limited degree; but perhaps the strongest evidence ever adduced has been supplied in the experience of the writer. A single case of the disease was introduced into a girl's school in the parish of St. Marylebone, and in the course of a few months it had spread to eight other children in the school. Subsequently four more children and one of the servants were attacked, so that there were at one time in all fourteen cases. It is very difficult to understand how so large a number of children could be affected at one time unless the disease were in some way communicated from one to another, especially when we remember that it is far from common. Amongst adult sufferers from this disease a large proportion, in the experience of the writer, are frequenters of Turkish baths.

Diagnosis.—It is not easy to mistake molluscum contagiosum for any other disease, but we sometimes meet with small sebaceous tumours, especially about the scrotum in adults, closely resembling it in external appearance. They have, however, no contagious properties, and they do not spread over large areas of skin, a feature we are familiar with in molluscum contagiosum. It need hardly be pointed out that molluscum contagiosum must not be confounded with molluscum fibrosum, which is a perfectly different malady. *See* Molluscum Fibrosum.

Treatment.—When the number of growths of molluscum contagiosum is small, the treatment is simple. They should each be divided with the point of a lancet, and then be touched with some caustic. For this purpose the acid nitrate of mercury may be used, or a saturated solution of potassa fusa in water. When the little tumours are very numerous, it is probably best to leave them entirely alone; after a time they become a little inflamed, dry up, and disappear. The disease, however, if left to itself, is always tedious.

Robert Liveing.

MOLLUSCUM FIBROSUM. — Synon.: *Molluscum Simplex*; *Molluscum Pendulum*; Fibroma; Fr. *Molluscum Fibreux*.

Description.—This disease consists of small tumours of hypertrophic fibrous tissue springing from the subcutaneous structures. Some of these may remain undeveloped, and, though not visible to the eye, can be felt by passing the hand over the skin. Others form visible, though small, sessile growths; more frequently, however, the little tumours are pedunculated and pendulous, somewhat egg-shaped, and covered with normal skin. The size of these growths varies from a small pea to a filbert, or larger; sometimes they even attain the dimensions of a hen's egg, but this is very exceptional. The skin covering them is of a natural colour, and rather more vascular than normal; the consistency of the tumour is soft, but at the same time firm on pressure. The affection is quite unattended with pain or with subjective sensations of any kind. The disease may take the form of single or a few scattered pedunculated tumours, or the whole body may be covered with them. It is highly probable that these outgrowths exist in an undeveloped form at the time of birth, though they may be too small to be detected; at all events they show themselves at an early age. When fully developed they have no tendency to undergo further changes, such as those of ulceration or degeneration, but remain stationary during life. They belong to the category of hypertrophic malformations of the skin, rather than to that of morbid growths. Hebra has rightly pointed out that those who suffer from general molluscum fibrosum are often somewhat mentally deficient—that is, they may be imperfectly developed in mind as well as in body.

Treatment.—This consists in snipping off the little pedunculated tumours with a pair of scissors. It is unnecessary to interfere with those which are not pedunculated.

Robert Liveing.

MONOMANIA. — Synon.: Fr. *Monomanie*; Ger. *Wahnsinn*.—This term is falling into disuse by reason of its vagueness, and because it has been employed by various writers to denote different kinds of insanity. Some have used it to denote an insanity which is indicated by some one particular delusion, the mind remaining clear on every other point. Others mean by it an insanity without delusion, an *affective* or *impulsive* insanity, the essence of which is the absence of delusion, and the so-called integrity of the intellectual portion of the mind. Esquirol thought it a disorder of the faculties limited to a few subjects, with excitement, and gay and expansive passion; while, according to others, melancholia without delusion would be an instance of affective monomania. We may take it, however, that all authors are agreed in using the term 'monomania' to indicate a partial insanity, which enables the patient to converse and act rationally to a considerable degree, and therefore renders his responsibility a matter of question. Such cases form the grounds of forensic contention, whether criminal or civil; but it is better to affix to them some more precise term, and to indicate symptomatologically and pathologically the exact nature of the mental and bodily condition of the alleged lunatic.

G. F. BLANDFORD.

MONSUMMANA, Cave of, in Upper Italy.—Natural vapour baths. *See* MINERAL WATERS.

MONT DORE, in France.—Simple thermal water, containing arsenic and soda. *See* MINERAL WATERS.

MONTE-CATINI, in Tuscany.—Thermal muriated saline waters.

MONTMIRAIL, in France (Vaucluse).—Sulphated saline, bitter waters.

MONTPELLIER, in the South of France.—Variable, fairly warm, winter climate. High winds from N.E. and N.W. *See* CLIMATE, Treatment of Disease by.

MORAL INSANITY.—*See* INSANITY, Varieties of.

MORBID (*morbus*, a disease).—This word merely signifies *diseased*, and is used, in its several applications, as a technical or scientific term, in contradistinction to the term *healthy*. Among the most common examples of these applications may be mentioned *morbid anatomy* and *histology*, which imply the anatomy and histology of diseased conditions; *morbid sensations* or *feelings*, as distinguished from healthy sensations, whether connected with either of the ordinary senses or with some particular organ, such as appetite; *morbid actions*; *morbid secretions* or *discharges*; and *morbid growths*. The word is employed in a somewhat special sense, in relation to individuals who are mentally low in spirits and despondent, without any obvious cause to account for this condition; such individuals are often spoken of as being in a *morbid state*.

MORBIDITY (*morbus*, a disease).—This term is employed to denote the amount of illness existing in a given community; and, as 'mortality' expresses the death-rate, so 'morbidity' indicates the sick-rate, whether the diseases be fatal or not.

Since health is an extremely ill-defined state, marked out by no absolute boundaries, and since many people suffer from diseases that are concealed intentionally or through ignorance, it becomes a matter of considerable difficulty to express with certainty the amount of illness that may exist at any time. Some information may, however, be obtained from the records of sick-clubs and benefit-societies, on which statistics may be based of the average time their subscribers are ill during the year, in relation to employment, age, locality, and other circumstances. From the statistics of these friendly-societies it has been estimated that nine days in the year per member are lost through sickness.

By an investigation of this subject the rates of mortality come to possess an extended significance, for they thus indicate not merely the proportion between the living and the dead, but between the latter and the two classes of the living, namely, the healthy and the diseased; and, as a branch of State Medicine, they must doubtless come to take a prominent place. As further knowledge provides accurate facts and figures, the subject will have a distinct practical bearing, in estimating the value of men for work, if the average liability to disease and the total amount of illness an individual may expect to suffer be known; while it is reasonable to believe that as the 'aptitudes to disease' are further conditioned, the means for prevention may be extended.

W. H. ALLCHIN.

MORBIFIC (*morbus*, disease; and *facio*, I make).—This word is properly applied to any cause that produces a disease. Such a cause is often spoken of as a *morbific agent*.

MORBILLI (dim. of *morbus*, a disease). A synonym for measles. *See* MEASLES.

MORBUS.—This is the Latin word for *disease*. Formerly it was frequently employed, but is not much in vogue at the present day. When applied to particular diseases, it is associated with some qualifying adjective or noun, indicating the nature or seat of such disease, some peculiarity by which it is characterised, or the name of some renowned authority upon it. It would not serve any useful purpose to give a list of the diseases with which the word is connected, and it will suffice to cite, as examples, some of its more common applications, such as *morbus cordis*, disease of the heart; *morbus coxæ* or *coxarius*, disease of the hip-joint; *morbus cerealis*, ergotism; *morbus Brightii*, Bright's disease; *morbus cæruleus*, blue disease, cyanosis.

MORGINS, in Switzerland.—Chalybeate waters. *See* MINERAL WATERS.

MOROCCO, in North Africa.—A warm, healthy winter climate. Tangiers is exposed to cold, damp S.W. winds in autumn and spring, and to E. winds. Living is superior to Malaga. *See* CLIMATE, Treatment of Disease by.

MORPHINISM.—Synon.: The Morphine Habit; Fr. *Morphinisme*; Ger. *Morphiumsucht.*

Definition.—A term applied to the habitual indulgence in morphine, or—in a more extended sense—in any preparation containing that alkaloid.

Forms and Quantities.—Opium-eating, laudanum-drinking, opium-smoking, and the hypodermic injection of morphine as a practice are all forms of morphinism. It is undoubted that most adults can by use habituate themselves to the taking of large doses of opium, but to this there appears to be a personal limit, and some are so susceptible to the influence of the drug that no tolerance of it is ever established. Half a pint of laudanum per diem, or three-quarters of an ounce of opium, are doses that have often been reached, and the former appears to have been De Quincey's maximum. Half or a third of this, or even less, is a more usual quantity. The largest amount the writer has known to be taken for a lengthened period was an average of forty-eight grains of acetate of morphine per diem, used in injections, with a maximum of ninety-six grains per diem on some days. Its use is often combined with that of cocaine, which prevents the after-sickness attendant upon the use of morphine.

Ætiology.—Morphinism is most frequently met with in neurotic individuals. The habit originates usually in the legitimate employment of morphine or opium for therapeutic purposes. In other instances it can be traced to a single definite act of indulgence in the drug—either casually, or in obedience to the promptings of some hereditary craving or of depressed melancholic feelings.

Effects.—So far as the effects on the organism are concerned, it is immaterial whether opium or the alkaloid be swallowed or used hypodermically. Minor differences there are, but the general results are the same. These are listlessness, loss of energy, inaptitude for business and exertion, dreaminess, exaltation of fancy, loss of appetite, emaciation, a sallow skin, diminished liver and kidney secretion and hence costiveness. Digestive troubles are prominent, attributable to the use of the drug; and yet if this be suspended the craving for it becomes intolerable, so that no amount of resolution as a rule leads to total abstention from its use. But many or all of these symptoms, except the craving, may be absent; and most physicians have had experience of opium-takers whose habit in this respect would not be suspected from their appearance. Probably, on the whole, the indulgence in opium tends to shorten life, though this has been doubted, and opium-takers are asserted to be unusually free from catarrhal affections. Nevertheless, morphinism is a most baneful habit; and though it may not appreciably shorten life, or cause serious maladies, the morphinist is often indolent, weak, untruthful, and irresolute, unfitted to lead a life of active and useful exertion.

Great differences of opinion exist as to the pernicious or other effects of *opium-smoking.* Some would have us believe that the practice is pernicious, not to say deadly; but debasing it often is. The pictures drawn as to its effects are evidently coloured by the bias of the observer. On the other hand, some would persuade us that the practice is harmless, not to say beneficial. Doubtless neither view is absolutely correct, and whilst opium-smoking is pernicious, the evils have been greatly exaggerated. Moreover, opium-smoking is so bound up with other vicious and idle habits, as to make it very difficult to differentiate between the effects of opium and of such habits. Excess in opium-smoking, like excess in tobacco-smoking, is injurious, and too often indulged in by the idle and dreamy. But it is doubtful whether very distinct and unmistakable results can be traced to a slight indulgence in opium-smoking. Morphine is not volatilised during the process, and the basic bodies volatilised are analogous to those volatilised in tobacco-smoking, such as picoline and pyridine, which, however, undoubtedly have marked physiological activities.

Treatment.—The one point in the treatment of morphinism—be it laudanum-drinking, the hypodermic use of morphine, or opium-smoking—is to cut off the use of the drug at once and completely, and every effort should be made to accomplish it.[1] Seclusion and the influence of a special nurse conduce powerfully to a successful result; and massage is sometimes a useful adjunct. The craving for opium is, however, so overpowering, and other symptoms become so urgent, such as intense headaches, insomnia, vomiting, diarrhœa, palpitation, dyspnœa, and heat and dryness of the skin, that the patient has seldom resolution enough to avoid its use. Seclusion, with constant vigilant attendance, is generally indispensable. Tonics, cold baths, moderate exercise, and good food constitute the best treatment. A week or two's abstinence may suffice to break off the habit, but very commonly the patient relapses into his old vicious practice. A yachting excursion or a long sea voyage, without access to opium, may effect a cure when all other means have failed.

Thomas Stevenson.

MORPHŒA.—*See* Scleroderma.

MORTALITY.—Synon.: Rate of Mortality; Death-rate; Fr. *Mortalité*; Ger. *Sterblichkeit.*

Definition.—The proportion of persons dying to those surviving under given circumstances; or, more usually, the proportion borne by the persons who die to the whole number of those subjected to the given circumstances.

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[1] According to some authorities, it is better to reduce the morphine gradually before its complete removal.—Editor.

Thus we may have to do with the annual mortality of the population of a country, a district, or a city; or of a body of men similarly circumstanced, as of clergymen or of lead-miners; or of bodies of men otherwise alike, but subjected to different conditions of climate, &c., as the British army; or of the population, or any section of the population, at special ages, as of infants in factory towns.

Or we may be concerned with the proportions of deaths to survivors, or to the whole number of entrants, during and after exposure to a special cause or causes of death, operating either speedily or during a protracted period. Hereunder come, for example, the mortality sustained by the population of Rio Janeiro, or New Orleans, during an epidemic of yellow fever; or that suffered by a number of persons in passing through an attack of enteric fever or pneumonia.

Estimation of Mortality.—The annual mortality of a population is reckoned, not on the numbers in existence at the beginning of a year, but on the average number in existence on the several days of the year, or, what is nearly the same thing, on the mean population of the year. The necessity of this becomes evident, when we consider that in our own country the large towns are mostly increasing at a very rapid rate, while some agricultural parishes and unprosperous places actually decline in population. In the towns, therefore, the death-rate, if reckoned on the last census, or even on the number believed or estimated to exist at the beginning of the given year, would come out higher than it ought to be, while in declining parishes it would be somewhat too low. Similarly the annual mortality of bodies of troops is calculated on the mean strength.

Two formulæ are in use for specifying death-rates. In the first the proportion of deaths is taken as unity: thus, the mortality in England and Wales in 1878 would be stated as 1 in 46. In the second, which is more convenient and is now generally employed, the number of lives at risk is taken as 100 or 1,000: thus the mortality of 1878 would come out 21·7. Either formula is convertible into the other by simple division: thus 1,000 ÷ 46 = 21·7; and 1,000 ÷ 21·7 = 46.

The death-rates of large civilised countries, in which registration is strictly carried out, give a pretty fair representation of the viability of the population. So much may be said for England, Wales, and Scotland, and for most of the European States, but not, unfortunately, for Ireland, where the weakness of the registration laws makes the record defective.

Mortality of Nations.—The following were the death-rates per 1,000 of most of the principal States of Europe during the periods indicated:—

	In years	Per 1,000 living
Norway	1846–55	17·9
Sweden	1869–78	18·9
Denmark	„	19·2
England and Wales	„	21·8
Scotland	„	22·1
Belgium	„	22·6
Switzerland	1870–78	23·5
France	1869–78	24·3
Or excluding two years of war	. . . .	22·5
Netherlands	1869–78	24·4
German Empire	1872–78	27·2
Italy	1869–78	29·5
Spain	1861–70	29·7
Austria	1869–78	31·1
Hungary	1868–77	39·6
Or excluding two cholera years	. . . .	36·1

The ensuing table exhibits the death-rates of the same countries a few years later.[1] In every case there had been more or less improvement:—

Norway	1882–86	16·9
Sweden	1882–85	17·5
Ireland	1882–86	18·1
Denmark	„	18·5
Scotland	„	19·3
England and Wales	„	19·4
Belgium	„	20·6
Switzerland	„	20·7
The Netherlands	„	21·5
France	„	22·2
Prussia	„	25·5
Spain	1876–78	25·8
German Empire	1882–86	25·9
Italy	„	27·3
Austria	„	30·0
Hungary	„	33·4

The death-rate of Russia, except in the extreme north, is high. It was stated at 35·9 in 1842. That of Portugal the writer has not been able to obtain. Those of Turkey and of Greece are unknown. In many of the British colonies it is lower than even in Norway. Thus the average mortality during the five years 1882–86 was in [2]

Victoria, 14·8	New South Wales, 15·6
Queensland, 19·7	South Australia, 14·3
West Australia, 18·6	Tasmania, 15·6
New Zealand, 10·8	

Mortality of Cities.—The mortality of cities is in this country almost invariably higher than that of the open country. But this rule does not apply to all other countries; the exceptions occur mostly where endemic fevers are prevalent in the country. Thus the mortality rate in 1887 was in London, 19·6; in Edinburgh, 19·8, and in Dublin, 30·6; and in 28 other large towns in England it varied between 16·9 in Brighton and 28·7 in Manchester; while in 50 towns of the second class the extremes were 12·4 at Maidstone and 13·3 at Burton; 23·8 at Stockport and 24·9 at Wigan; the average of the 28 towns being 20·8 per 1,000, and of the 50 towns 19·0. In the same year the rural districts and small towns of England yielded an average rate of 17·4 only. There are a considerable number of districts, almost all rural, which year after year fall below 17; and 17 was accordingly fixed upon by the late Registrar-General for England as a kind of standard to be aimed at by sanitarians. And there are districts in England, and entire small counties in Scotland, where the rate frequently falls below even 15.

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[1] These figures have been brought up to date as far as possible.—Editor.

[2] Hayter, *Australian Statistics*.

The following table exhibits the death-rates experienced in 1878, and again in 1887, in a number of foreign and colonial cities:—

	1878	1887		1878	1887
Calcutta . .	37·7	24·0	Paris . .	24·9	23·0
Madras . .	48·8	40·0	Brussels . .	28·0	21·0
Bombay . .	41·8	26·0	Amsterdam .	24·4	22·0
New York .	24·8	26·0	Rotterdam .	27·3	21·0
Brooklyn . .	20·1	23·0	The Hague .	26·4	20·0
Philadelphia .	18·0	22·0	Copenhagen .	22·0	24·0
Montreal . .	30·9	—	Stockholm .	22·4	21·0
Alexandria .	45·4	38·0	Christiania .	18·5	23·0
Melbourne, 1873 and 1875 .	22·8	21·0	St. Petersburg	47·1	28·0
			Berlin . .	29·9	22·0
Rome . .	29·8	29·0	Hamburg . .	26·9	27·0
Naples . .	33·1	—	Dresden . .	24·7	22·0
Turin . .	31·1	26·0	Munich . .	34·6	30·0
Venice . .	28·7	25·0	Breslau . .	29·9	29·0
Trieste . .	36·2	29·0	Vienna . .	25·6	26·0
Geneva . .	23·6	21·0	Budapest . .	40·3	32·0

ANALYSIS OF RESULTS.—These tables awaken, by the enormous differences between the several cities and countries, a curiosity respecting the causes of such differences, which, however, the figures themselves go far towards satisfying. It is at once evident that, whatever may be the case in the open country, cities suffer to a considerable extent in the ratio of their ignorance and neglect of sanitary laws, and of the poverty and squalor, or barbarism of their populations. Mark, for example, the contrast between Philadelphia or Geneva, and Alexandria, Budapest, or St. Petersburg! Cities having a steadily warm climate, or a climate of extremes, are more unhealthy than those which enjoy a temperate one. By this consideration, combined with that of their superior civilisation, may be explained the favourable position of the cities of Western as compared with those of Eastern Europe. The short, hot summers are very fatal in the latter region, and even in Southern Germany and at Stockholm; while in Western Europe generally, and especially in Scotland, winter and spring are the deadly seasons. It is noteworthy that in most of the large cities of Italy the short, sharp, and changeable winter is not less deadly than the hot summer and malarious autumn; in fact good winter climates for *poitrinaires* are exceptional even in Italy.

In Great Britain the influence of climate *per se* on the annual mortality of the several cities and districts is not very great; and its effects are obscured by those of other agencies. But if we confine our attention to the rural districts, where the disturbing factors are less important, we shall find that the rates of mortality are on the whole slightly more favourable in the north than in the south. Of all the counties in Great Britain Orkney-and-Shetland stands best, with an annual mortality, on an average of 10 years,[1] of 15·13; and Shetland, the more northern division, stands better than Orkney. Great Britain is, therefore, no exception to the rule that in Europe mortality decreases from south to north. This is in no way inconsistent with the fact that throughout Great Britain winter is the deadly season, and cold is more fatal than heat, thoracic than abdominal diseases.

INFLUENCE OF SEASONS.—The following were the death-rates of the four seasons in England and Wales, in 1868–77:—

	Winter	Spring	Summer	Autumn	Year
In the chief towns .	25·8	22·5	23·1	24·2	23·7
In the small towns and rural districts .	21·7	19·3	17·2	18·5	19·0

In Scotland the seasonal mortality, owing, doubtless, to the less intensity of the summer heat, follows pretty nearly the order of the English small towns and rural districts. Thus, in 1878: winter, 25·2; spring, 23·2; summer, 19·8; autumn, 20·4; year, 22·3.

It would seem, however, that in London, in the early part of the seventeenth century, when the death-rate, owing to the closeness and filthiness of the city, was fearfully high, the maximum was attained in summer, the figures standing as follows in 1606–10, during which years the plague was absent. Average mortality per cent.: winter (J. F. M.), 1·4; spring, 1·5; summer, 2·7; autumn, 2·0; total, 7·0.

INFLUENCE OF DENSITY OF POPULATION.—In accordance with a principle already laid down, that in communities sufficiently advanced to furnish mortality statistics the death-rate diminishes with the progress of civilisation, the mortality of London has since the seventeenth century gradually and greatly diminished. At the beginning of this nineteenth century it had sunk to 29, in 1840–49 it was 25·3, in 1870–78, 23, and in 1887 only 19·6.

The death-rate is also diminishing in France, Belgium, the Netherlands, Sweden, and Germany, in all of which countries the population is believed to be advancing in comfort and general well-being; but in southern and eastern Europe, where comparatively little advance has taken place in these respects, no such diminution can be demonstrated.

Nor, though evident in London and in several other great towns, can a large and permanent diminution of the death-rate be positively affirmed of Great Britain generally. In Scotland, indeed, there was a decided increase from 1855 until 1876, when a decline, which may prove transient only, set in. And in England no improvement could be shown for many years before 1871, since which date there has been an almost unbroken succession of years of low mortality concurring with a generally low temperature and excessive fall of rain.

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[1] 1866–75.

The great antagonistic influence in Great Britain may be found in Dr. Farr's principle, 'That mortality increases with density of population.' And 'urbanisation' advances so rapidly in Great Britain, that all the efforts and devices of sanitary and medical science are scarcely able to do more than neutralise its evil effects. Part of the apparent improvement is largely due to the diminution of typhoid fever. Contrary to the general belief, the expectation of life in males aged over 20, and in females over 45, was actually less in the period 1870-80 than in that of 1838–54.

Sources of Fallacy.—It may be as well to advert to some of the principal sources of fallacy, which hamper us in appreciating national and local death-rates. One of these is the varying number of births. The birth-rate ranges in the Continental States of Europe from about 40 in Germany and Austria, and even more in Russia and Hungary, down to 25 in France;[1] and in Britain from 48 or 50 in some coal and iron districts, down to 22 in the county of Sutherland. The late Dr. Letheby maintained that a high birth-rate was a direct cause of a high death-rate, owing to the great mortality among infants. This was an error; the two often concur, but the former is not a cause of the latter, unless where the infants perish in enormous proportion. The usual result in this country of a large and especially of an increasing birth-rate, is to augment in the community the proportion of children beyond infancy, and of young persons, who ordinarily suffer a very low death-rate as compared with old or even middle-aged persons. The favourable rates prevailing among these young persons overpowering the unfavourable ones of the infants, and of the comparatively small number of old people, the apparent death-rate is actually diminished, instead of being increased as Letheby supposed. And this points to the true reason why the death-rate of France is higher than that of England, whereas the expectation of life in the two countries is about the same at most ages, the birth-rate of France being so extremely low (Bertillon). *The lower the average age of the population, the lower the death-rate.*

A considerable amount of emigration or immigration affects the death-rate in proportion to the average age of the migrants. Thus the mortality of most great and growing towns would stand worse than it does, were it not for the large numbers of young and healthy persons from the country who settle in them. Watering-places and residential towns appear somewhat healthier than they really are, by reason of the numbers of young domestic servants who form a large portion of their population. But it is in our colonies that the effect of migration on the death-rate can best be studied. The unexampled death-rate of New Zealand, already quoted, is the result of two kinds of causes, one set of which we may call real, the other factitious or apparent. The former are the cool, equable climate, and the orderly and comfortable condition of the population; the latter are the constant stream of mostly youthful immigrants, and the very high birth-rate.

Influence of Age and Sex.—The influence of age and sex on the mortality in England and Wales may be best shown in a tabular form.

Mortality per 1,000 at twelve groups of ages in males and females in the 41 years 1838–78:—

	All Ages	0–	5–	10–	15–	20–	25–
Males	23·3	71	8	4	6	8	9
Females . . .	21·2	62	8	4	7	8	9
		35–	45–	55–	65–	75–	85–
Males	23·3	13	18	32	67	147	311
Females . . .	21·2	12	15	28	59	134	287

The superiority of the women is here well-marked, except during childhood and the years of early married life and much child-bearing. And this difference has been still greater during the later decades, owing chiefly to the decreasing vitality of males after the prime of life; thus in 1871–80 the death-rate of males from 45 to 55 was 20, that of females only 15.

Influence of Race.—The influence of race is usually difficult to separate from that of habits of life. In Europe the Jews offer the most notable example. It may be sufficient to quote from Oesterlen Neufville's statistics of Frankfort-on-the-Maine, which show that there the average age of Christians at death was 36·9 years, but that of Jews was 48·7; and from Hoffman, the death-rate of the Jews of Prussia, which was only 21·6 per 1,000, against 29·6 among the Christians.

Influence of Station and Occupation.—The influence of station and occupation on mortality is very great. The subject has been carefully handled by Dr. Farr in the Supplement to the Registrar-General for

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[1] In 1890 the birth-rate in France actually fell to 21·6.

England's thirty-fifth *Report*, and again by Dr. W. Ogle, in the Supplement to the forty-fifth. Briefly, it may be said that of all trades or professions that can be isolated, clergymen, barristers, farmers, agricultural labourers, gamekeepers, and grocers seem to stand best in this respect. Booksellers, paper-makers, wheelwrights, and carpenters also suffer but a small mortality. Schoolmasters and teachers go on well up to fifty-five. Solicitors, domestic servants, watchmakers, shoemakers, and blacksmiths range not far from the average rates; so do bakers (though such is not the current opinion), and the whole tribe of weavers and most kinds of shopkeepers. The workers in iron, as a rule, experience but a low mortality in early life, but a high one as they grow older; the same may be said of millers, and, somewhat strangely, and no doubt for very different reasons, of Roman Catholic priests. Artists come out pretty well, musicians very badly. Tailors begin very ill, and end fairly. Medical men, alas! perish frequently in early life, and only attain a respectable position after fifty-five; the figures for chemists, also, are rather high. The figures for drapers, formerly bad, have improved of late years, as have those for commercial travellers. Those for miners, naturally enough, are not very different from those for iron-workers, except the tin and copper miners of Cornwall, who stand badly. Tobacconists, as might be expected, suffer very heavily until middle life. Printers, bookbinders, clerks, glass manufacturers, dock labourers, porters, railway employés, butchers, cabmen, draymen, and chimney-sweepers, all suffer a very high mortality. And about the worst positions are occupied by dealers in alcohol (brewers, innkeepers, and especially hotel servants) and in lead (painters), and by potters, cutlers, and tilemakers.

These facts are of considerable practical interest in relation to questions of life insurance.

Mortality of Diseases.—Some acquaintance with the mortality of diseases, and the extent to which it is influenced by age, sex, climate, season, &c., is also of great value for prognosis. Information on this subject will be found under the heads of the several diseases; moreover, the limits of this article are not sufficient to admit of much discussion of the subject.

A few facts respecting the acute infectious diseases will, however, be of interest.

1. *Typhoid Fever.*—The average death-rate of enteric fever was put by Murchison, in accordance with British, French, and German hospital statistics, at 17·4 per cent. There is a good deal of ground for putting the average mortality of children and youths at 11 or 12, but it is probable that only the worst cases occurring in children find their way into hospitals. Over fifty years of age somewhere near one-half usually die (Liebermeister). The mortality from typhoid would appear, however, to be decreasing at a more rapid rate than the number of cases of the disease.

2. *Typhus.*—In typhus the mortality varies extremely in different epidemics, sometimes rising above the average of enteric fever, more often, perhaps, falling below it. In Ireland it is usually low, averaging probably 9 or 10 per cent., or less. The mortality of children from this disease is much lower than from enteric fever (Murchison, Lebert, &c.) The number of deaths ascribed to typhus (that is, continued fever, including enteric) in the register is, however, largest in proportion to the living under 5 years; is low from 10 to 15, and again from 25 to 35; and then increases gradually up to extreme old age. One cannot help suspecting that other febrile affections of children are confounded with typhus and enteric fevers.

3. *Measles.*—The mortality from epidemics of this disease is often as low as 2 or 3 per cent., but it has been known to rise to 30 per cent. under unfavourable circumstances, as where children, or even adults, are crowded together in a hospital. Among 'virgin' communities (as in well-known epidemics in Iceland, Färoe, Madagascar, Fiji) the mortality is sometimes frightfully large. It is comparatively small in summer; and decidedly small among the comfortable classes, owing doubtless to the exercise of greater care. It is beyond comparison greatest in the second year of life, and by the tenth has become quite trifling; but adults *may* die of measles.

4. *Scarlatina.* — There is a prodigious difference in the deadliness of different epidemics of this disease, even in the same locality. In Southern Europe it is comparatively a mild disease; in Britain it is most severe; yet even here eighty successive cases may occur without a death. But a mortality under 10 per cent. may be considered moderate (Thomas, in Ziemssen); it is often much higher. It is at its maximum from the second to the fourth year, but continues very deadly up to ten or twelve; by fifteen it has almost reached a minimum, but, unlike measles, continues to be somewhat formidable throughout life, especially to parturient women. Season and station in life make little difference in its deadliness.

5. *Small-pox.*—Small-pox did and does, in unvaccinated communities, where it has long been at home, destroy somewhere about 10 per cent. of the population; and of persons unprotected by vaccination who are attacked, 40 per cent. often perish. Among 'virgin' communities it is still more deadly. Age makes comparatively little difference in its fatality.

6. *Whooping-Cough.*—The death-rate of this disease is very large in the first year of life, declining afterwards like that of measles,

but rather more rapidly, and becoming quite insignificant before the tenth year. Whooping-cough is more fatal in winter than in summer, in towns than in the country, among the poor than among the rich; but these differences, except the first, are not very well-marked. JOHN BEDDOE.

MORTIFICATION (*mors*, death; and *facio*, I make).—A popular name for gangrene. *See* GANGRENE.

MORVAN'S DISEASE.—An affection met with especially in a district of Brittany, and named after the physician who first described it. The disease has strong points of resemblance to anæsthetic leprosy. It is a chronic affection, implicating the upper extremities more especially, and characterised by neuralgic pains, cutaneous anæsthesia, and painless and destructive whitlows. Well-marked neuritis and perineuritis have been found in the bodies of those dying of the disease; and in some cases these changes have been associated with syringomyelia. *See* SPINAL CORD, Special Diseases of: Syringomyelia.

MOTILITY, Disorders of.—The power of executing movements of the different parts, or of the body as a whole, may be interfered with in various ways; and as such disabilities are generally partial, the particular movements that happen to be implicated will also differ among themselves in different cases.

The disorders of movement to be referred to in this place are principally those in which the muscles of one of the limbs or of other external parts of the body are concerned—though disorders of the same kind, and also of different degrees, are likewise frequent, in which we may find perverted movements of viscera and their ducts, as well as of blood-vessels: in other words, portions of the involuntary muscular system are apt to have their functional activity deranged, after some of the same modes as portions of the voluntary muscular system.

In such cases, almost without exception—and to whichever class the defects may belong—the disordered motility is due primarily to some defective or abnormal action of the nerve-centres or of the nerves in relation with the muscles implicated, rather than to any primitive disease of the muscles themselves.

CLASSIFICATION.—Disorders of motility are divisible into three primary classes, according as they show themselves (A) in response to voluntary incitations; (B) in response to mere 'reflex' impressions; or (C) spontaneously. The particular muscles implicated (or the mode of distribution of the various defects) will necessarily differ much according to the extent and situation of the disease in the nerve-centres or in the nerve-trunks to which the defects are due. In some cases particular defects of motility can be confidently referred to disease of the brain, and even of particular parts thereof; in others they may be referred to disease of the spinal cord in particular regions; or, in other cases still, they may be as clearly due to some altered condition of nerve-roots or of nerve-trunks in their continuity.

A. Disorders of Voluntary Movements.—Under this head are to be included different varieties of disordered movement.

1. *Diminution of motor power.*—This varies much in degree in different cases. There may be mere weakness (paresis) or actual loss of power (paralysis) of one or more limbs, or of particular sets of muscles. The type of the paralysis will vary according to the seat and extent of the lesion. Thus it may be due to a cerebral lesion, and be of the hemiplegic type (*see* HEMIPLEGIA); or it may be due to a spinal lesion, and be of the paraplegic type (*see* PARAPLEGIA); or the loss of power may be owing to disease or injury of some nerve-trunk, and then be of the type of a peripheral paralysis, such as we get in facial palsy.

2. *Imperfect coördination of movements.* Here the several muscles concerned with the production of a given movement act without the relative subordination and gradation of force needful for its proper execution. Some muscles contract too powerfully and others not enough, or some contract too quickly and others too slowly, with the effect of producing a spasmodic or otherwise disordered movement—one by which the end desired is not readily attained. The condition thus produced is known as '*ataxia*,' of which there are two principal varieties—one caused by disease of the posterior columns of the spinal cord (*see* LOCOMOTOR ATAXY); and the other by disease of the cerebellum (*see* CEREBELLUM, Lesions of). Ataxia is, in fact, a condition for the most part caused by the defects described in the previous category, together with that to be mentioned in the next, the two states co-existing (in different proportions in different cases) among muscles called into simultaneous or successive activity for the execution of various complex movements. A kind of ataxy may indeed be induced by mere paresis in some muscles of a physiological group, that is of some muscles whose business it is habitually to act in combination with others.

3. *Spasmodic action of certain muscles.*—On volitional incitations reaching the spinal cord in certain states of disease, some of the muscles whose contraction is to be brought about are thrown into a condition of overaction or tonic spasm, whereby the performance of the movement is greatly interfered with (*see* WRITER'S CRAMP). In such cases there is almost always in addition increased

reflex excitability, so that it is in some cases difficult to say how much of the spasm is primarily due to the volitional incitation, and how much to reflex spasms caused by cutaneous impressions consequent upon the commencing movement. Some of these conditions are especially met with in cases where portions of the cord are cut off from the so-called 'inhibiting' influence of the brain, at the same time that there is hyperæmia, with increased excitability of the then active regions of spinal grey matter. This state of things is particularly frequent in 'primary sclerosis of the lateral columns.' On the other hand, the initiation of voluntary movements may, in other cases, give rise to clonic spasms in the parts moved, especially in certain cases of disseminated or insular sclerosis. *See* SPINAL CORD, Diseases of.

4. *Tremors, shakings, or choreic movements.*—Tremors (fine or coarse) and shakings are really clonic spasms of limited range; and all gradations may at times be met with between these several types of disordered movement. Such morbid movements of one or other grade, even if they exist more or less continuously, are usually increased by volitional incitations. This is the case, for instance, in the trembling from mercurial poisoning or from chronic alcoholism, as well as in that from senile changes; in the shakings met with in disseminated sclerosis; and also in the more irregular movements, often of wider range, characteristic of chorea. *See* CHOREA; SPINAL CORD, Diseases of; and TREMOR.

B. Disorders of Reflex Motility.—The conditions on which disordered movements, due to increase of reflex excitability, depend, have been above referred to. The withdrawal of brain-influence from, and the increased hyperæmia of certain tracts of spinal grey matter, seem to be the main causes, and these are met with principally in certain forms of paraplegia, and in spasmodic spinal paralysis, or primary sclerosis of the lateral columns. The mere weakening of cerebral influence will, however, lead to an increased manifestation of reflex movements, as may be seen in certain nervous or delicate persons, in infants, or in young children.

Two forms of reflex actions have to be discriminated, namely, those excited by cutaneous impressions—*skin reflexes*; and those induced by taps or slight blows upon tendons —*tendon reflexes* (*see* SPINAL CORD, Diseases of). Both forms are often unduly exalted in the same person, though sometimes the skin reflexes may be normal, whilst the tendon reflexes are greatly exaggerated.

Reflex movements of both kinds may be diminished, either (1) from disease of afferent nerve-roots outside or within the cord, as in tabes dorsalis; (2) from destructive disease of the grey matter of the cord, as in many cases of severe paraplegia; or (3) from disease of the motor roots or nerves supplying particular groups of muscles.

An increase or a diminution of reflex excitability is frequently met with, and is often of much importance, in connexion with one or other of the viscera, such as the heart, the stomach, the bladder, or the intestines. This undue nervous excitability may be dependent upon morbid conditions, partly of the bulb or spinal cord, and partly perhaps of some of the visceral nerves.

As possible conditions of much importance in the ætiology of many nervous affections, we may here also mention disordered activity of certain vaso-motor centres, capable either immediately or remotely of influencing the calibre of the blood-vessels supplying certain portions of the brain or cord. In this manner there might be induced either spasm of their vessels, with greatly lowered blood-supply; or paralysis of vessels, with consequent hyperæmia in such nerve-centres. These conditions would correspond with the death-like pallors or the flushings occasionally observable in the face or other tracts of skin. The doubt exists, however, as to how long such mere reflex pallors or flushings may persist in nerve-centres—that is, when they are simply due to functional defects. Are they always merely transient phenomena, or may they persist for days or even weeks, as some clinical facts would lead us to suppose?

C. Spontaneous Movements.—The movements which are manifested 'spontaneously' are various in nature or degree, though they are of kinds similar to those that may be excited by voluntary incitations. We need only enumerate these different varieties here, and briefly indicate either the diseases in which they are encountered, or the conditions on which they depend. (*a*) *Tremors*, such as present themselves in paralysis agitans, or mercurial poisoning. (*b*) *Twitchings*, or *startings*, occurring in one or more limbs, either upper or lower, in some cases of cerebral and of spinal disease. The more irregular but less spasmodic movements, known as (*c*) *choreic*, occurring principally in the disease from which they derive their name (being sometimes indefinite, and at others distinctly co-ordinated). (*d*) *Spasms*, which may be either co-ordinated, as in some cases of chorea; clonic, as in epilepsy, eclampsia, and other allied affections; or tonic, as in tetany, tetanus, strychnine-poisoning, and certain spinal affections, as well as in some cerebral diseases.

Conditions of *rigidity* and *contraction*, due to a more or less permanent tonic spasm, are scarcely to be described under the head of 'spontaneous movements,' since in such conditions, although there is powerful muscular contraction, there is no actual movement; and, similarly, the spontaneous *flickerings* of muscular fibres, seen in so many cases of progressive muscular atrophy, deserve to be mentioned here, even though no movements are produced, owing to the small number of muscular fibres involved at any one time. The flickerings themselves are really clonic spasms involving a few fibres simultaneously.

Treatment.—The treatment of these different nervous conditions is considered fully under the various special articles to which reference has been made.

H. Charlton Bastian.

MOUTH, Diseases of.—The principal diseases of the mouth may be thus enumerated: (1) Inflammation and its results, including (1*a*) Thrush; (2) Gumboil; (3) Ranula; (4) Lingual Dermoids; (5) Salivary Calculus; (6) Salivary Fistula; and (7) New-growths and Epulis. Diseases of the tongue and the teeth are treated of in other articles.

1. **Stomatitis.**—Synon.: Fr. *Stomatite*; Ger. *Mundschleimhautentzündung*.

Definition.—Inflammation of the mouth.

Varieties.—Inflammation of the mouth may be *acute* or *chronic*. According to the more striking lesions found, we speak of *catarrhal*, *follicular*, *ulcerative*, and *gangrenous* stomatitis. Lastly, inflammations of the buccal mucosa may be classed according to their cause, for example, *syphilitic*, *scorbutic*, or *mercurial* stomatitis.

Ætiology.—Mechanical irritants such as a sharp tooth or a tooth-plate; chemical irritants, especially alcohol; burns and scalds, hot tobacco-smoke; mercurialism; the growth of parasites in the mucosa, such as thrush; the eruption of teeth, with accompanying digestive disturbances; some acute specific fevers; erysipelas, diphtheria, syphilis, and scurvy, are the principal causes of stomatitis.

Symptoms.—In *acute catarrhal* forms the mouth is hot; and the mucosa is more or less red, swollen, tender, and unduly sensitive to heat, salt, spices, and the like. All these changes are least marked upon the dense hard palate and gums. The secretion of mucus is increased, and it may form a tough slimy layer upon the surface, more or less turbid from contained epithelial cells and leucocytes. The excessive redness and raw appearance of the surface are largely due to the rapid shedding of the surface epithelium; but in less intense cases, white patches of all shapes and sizes indicate increased production of epithelium, the cells remaining adherent for some time. In the less intense forms, especially when of some duration, the mucous glands on the lips, cheeks, and palate swell and form reddish-grey nodules or even small cysts, often surrounded by a ring of injection. This is the form known as *follicular* stomatitis. Sometimes the follicles break down and form small ulcers. But there are certain forms of stomatitis, of which more or less extensive ulceration is characteristic. One of these is called, *par excellence*, *ulcerative stomatitis*.

Ulcerative stomatitis (putrid sore mouth) is not a further development of the above-described acute catarrh. It occurs chiefly in sickly children living under faulty hygienic conditions. After a slight febrile illness or malaise for two or three days, the child is noticed to eat with some difficulty, to suffer from more or less salivation, and to have a very foul breath. The cheek is perhaps swollen. On one side of the mouth, sometimes on both, one or more grey-based ulcers will be found upon the cheek, gums, and tongue. These may extend in depth till the alveolus is bare. No hard line can be drawn between ulcerative stomatitis and cancrum oris (*see* Cancrum Oris). If left alone, these ulcers generally heal in seven to fourteen days, but they may become chronic. Ulcers are very prone to form in stomatitis resulting from mercurialism, scurvy, or syphilis.

In *chronic catarrh* of the mouth the chief signs are undue sensitiveness of the mucosa, and the presence of white patches (leucoplakia). Fissures may form in these patches. This chronic epithelial overgrowth derives its chief importance from the fact that it is sometimes the forerunner of epithelioma. The chief causes of chronic catarrh appear to be smoking, dram-drinking, indulgence in hot spices, and syphilis; but frequently no cause is evident.

Treatment.—The avoidance of irritation, and the treatment of any general disease or digestive trouble, which may be regarded as a cause of the stomatitis, are the first points to be attended to. Food should be taken cool, and free from excess of salt or sugar, and from hot spices; alcohol and smoking should be forbidden. The feeding of infants at the breast and, still more, of bottle-fed children, should be inquired into, and all defects remedied. The mouth should be wiped out after each meal with a rag moistened with some mild antiseptic. Borax lotion or a little powdered borax, allowed to melt slowly in the mouth, is very soothing. In acute cases ice is grateful.

In *ulcerative stomatitis*, chlorate of potassium should be given internally with due care, and used also as a gargle. It is almost a specific. Borax lotions are useful; and it is well to begin the treatment by wiping the ulcer and thoroughly applying 1 in 1000 lotion of perchloride of mercury. This may be repeated daily. Finely powdered iodoform should be occasionally dusted on the sore. The hygiene of the mouth and of the whole body should be cared for. Change of air is most valuable. Nitric acid or ammonia and bark form an excellent tonic; and cod-liver oil and iron are generally useful later.

In *chronic leucoplakia*, treatment in syphilitic cases should include painting the patches with a lotion of bicyanide of mercury (gr. ij. v. ad ℥j.) In simple cases they should be painted with bicarbonate of potassium (gr. xx. ad ℥j.), or chromic acid (gr. v. x. ad ℥j.), the latter solution to be used every second day.

1*a*. **Thrush.**—Synon.: Fr. *Muguet*; Ger. *Soor*; *Schwammchen*.

Thrush is a parasitic stomatitis which occurs chiefly in young infants, and usually in such as are depressed in health, congenital syphilis thus ranking as a predisposing cause. It is not, however, rare to find infants in good health attacked. Adults do not, as a rule, suffer from this parasite, except towards the end of exhausting illnesses, especially phthisis; so the appearance of thrush in adults is usually an evil omen. Rarely a non-parasitic stomatitis or sore-throat depresses the mouth-tissues of adults sufficiently to allow the parasite to grow.

The thrush parasite is the *oidium albicans* (fig. 110), discovered by Gruby in 1842. Its exact nature seems still to be doubtful. It is *not* the oidium lactis, as formerly supposed; and Grawitz's statement that it is the *saccharomyces mycoderma*, or mould of wine, is generally received as correct. It affects mucosæ covered with stratified epithelium, especially that of the mouth and fauces; it is not uncommon in the pharynx and œsophagus, but is rarely found growing lower in the alimentary tract. It is sometimes found growing in broncho-pneumonic foci, having been inhaled. The parasite grows in the middle layers of stratified epithelial laminæ, and consists of numerous mycelial threads mixed up with spores and fine granular *débris*. The neighbouring epithelial cells are destroyed and ultimately thrown off, leaving what looks like an ulcer; but almost always the deepest layer of epithelium remains covering the papillæ.

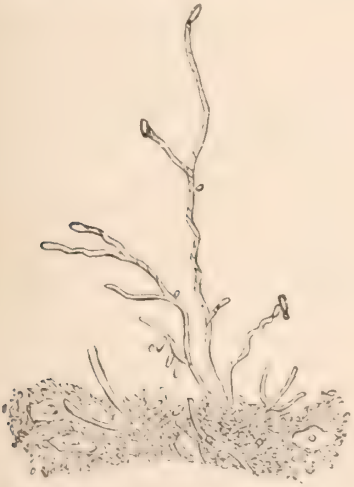

Fig. 110.—Oidium albicans, or Saccharomyces mycoderma.

Symptoms.—It is said that the first sign of thrush is some general heat and redness of the mouth, together with the secretion of a sticky layer of mucus of *acid* reaction, and containing many cells, among which spores and threads are already recognisable. Then small white roundish patches form, and run together into larger ones. The patches are surrounded by a vascular ring. At first they are pretty firmly adherent, later on easily detachable, leaving 'ulcers.' Sucking may become painful. More or less disturbance of the gastro-intestinal functions is usually present. Mothers suckling children with thrush are very liable to sore nipples.

If the above be taken as the typical symptoms of thrush, we must add that in many cases the parasite excites no inflammatory phenomena whatever, suggesting a parallel with tinea tonsurans, which also may or may not cause inflammation.

Thrush is commonly said by mothers 'to go through' children. This means that, whilst thrush is present in the mouth, and the child is perhaps suffering from gastro-intestinal symptoms, redness, excoriation, and perhaps ulceration appear at the anus, and spread more or less widely to adjacent parts. Some think that in the child's depressed condition of health any tendency to intertrigo or eczema would show itself, and that acrid evacuations would render the anal region specially liable; but in the writer's opinion the above history is very strongly in favour of congenital syphilis, and he finds that treatment generally supports this view.

Treatment.—Care in feeding children regularly at proper intervals, in the selection of milk and preparation of food for hand-fed children, scrupulous cleanliness with regard to bottles, spoons, &c., used in feeding the child, and especially the precaution of wiping out a child's mouth thoroughly after each meal with rag or wool wet with glycerine of borax, make up a highly successful prophylaxis against thrush. When the trouble is present, all these precautions must be carefully observed, and a food suitable to the patient must be found. Gastro-intestinal symptoms must be relieved. The patches of thrush in the mouth and throat should be frequently painted with glycerine of borax, the B.P. solution of sulphurous acid (1 in 6 of water), salicylic acid solution (1 in 250), sulphite of sodium solution (ʒj. ad ℥j.), or almost any other non-irritant antiseptic. Good hygienic surroundings, change of air, and supporting treatment are often necessary to bring about the recovery of feeble patients, and are helpful to all.

2. **Gumboil.**—Synon.: *Parulis*; Fr. *Parulie*; Ger. *Zahnfleischgeschwür*.

Description.—A 'gumboil' is a small abscess pointing upon the gum. The term 'alveolar abscess' includes all gumboils and many other cases; for, whilst indicating that such abscesses almost invariably start in the alveolus or socket of a tooth, it says nothing as to their pointing, the directions in which they tend being very various.

The cause of an alveolar abscess is almost invariably caries of the tooth in connexion with which the abscess arises. The irritant is therefore most probably some septic organism which gains entrance to the pulp-cavity and excites an inflammation of the pulp, which spreads along a fang. Usually the whole tooth dies as a result. An abscess may form at the base of a tooth already dead, though not carious, the irritant probably entering between the socket and the tooth, but not necessarily, for an abscess is rarely found connected with a sound living tooth, and the pulp of a sound (though dead) tooth may be found putrid. An abscess occasionally arises in connexion with a partially erupted tooth, especially a wisdom-tooth in the eruption of which there is difficulty; or, again, a cyst round a retained tooth may suppurate and resemble an ordinary alveolar abscess.

In the ordinary alveolar abscess pus is formed about the apex of the fang within the alveolus, whence the acute early pain. The bone around the apex of the fang is rapidly softened; and the *outer* plate of the jaw, being decidedly thinner than the inner, yields, and the pus escapes into the tissues outside the jaw. More or less swelling of the face now occurs, and, coincidently, diminution of pain. The pus then forces its way towards the surface in the direction of least resistance, and very often bursts on the gum, or between this and the cheek. But this is by no means always the result, the point of bursting being sometimes so distant from the seat of irritation that the latter runs some risk of remaining unrecognised. The following, more or less, unusual points are therefore noted. Abscesses from the upper incisors may not uncommonly burrow between the hard palate and its coverings, and open far back; rarely they burst into the nose, causing a discharge from the nostrils; and still more rarely through the lip. The palatine roots of the upper molars may also cause a palatine abscess; whilst pus starting from tho external fangs is sometimes conducted, apparently along the buccinator fascia, to the cheek, where it bursts. Affection of, and suppuration in, the autrum is most likely to result from the first upper molar fangs; but disease of any upper tooth, especially molar or bicuspid, may be the cause of continued suppuration. Abscess from the lower incisors rarely bursts on or below the chin. Abscess from the lower molars and bicuspids, more commonly than from any other teeth, bursts upon the face. From the lower wisdom-tooth an abscess may burst far back upon the fauces, near a molar or bicuspid, or below the jaw. In a few cases the pus of these latter abscesses has burrowed, from insufficient drainage, down the neck, even as low as the clavicle. Rarely an abscess from a lower molar finds its way through the *inner* plate of the jaw.

Symptoms.—At first the tooth appears too long (from periostitis); and is the seat of pain, which is relieved by pressure upon the tooth. Soon it becomes so tender that all pressure is unendurable, and pain increases rapidly, often becoming very severe. After twenty-four to forty-eight hours the pain diminishes or disappears, and the face swells more or less. Finally the abscess, if left to itself, bursts. It may discharge freely through the opening, and sometimes through and around the tooth. Sometimes it undoubtedly heals, and the tooth remains firmly fixed, or a sinus may remain, giving little trouble if it open into the mouth, much disfigurement if on the face, or frequent abscesses may form. Abscess from a non-erupted or carious wisdom-tooth is specially likely to be accompanied by chronic trismus. Grave results, such as death from pyæmia, are very rare.

Treatment.—An acute alveolar inflammation may be aborted by disinfecting the tooth-cavity with pure carbolic acid, scarifying the gum, and applying frequent hot fomentations to the mouth. Where the above treatment fails to relieve the early acute pain (toothache), pus not having yet made its escape from the alveolus, extraction of the tooth (discovered by smart tapping with a steel instrument if the patient cannot clearly indicate which is aching) is the best remedy. When the tooth is valuable, Tomes has suggested that an incision should be made down to the bone opposite the diseased tooth, and the outer plate of the jaw drilled at the level of the apex of the fang—not a very painful operation, he says. When abscess is present and the tooth of little or no value, removal of the tooth often provides sufficient drainage; but if the patient cannot be easily watched, an incision also should be made into the abscess between the cheek and jaw, especially as, with cocaine, it adds nothing to the pain. This incision should always be made immediately when the abscess is threatening to burst through the skin; also when pus is stripping up the soft parts from the hard palate. The skin over the pus may then be painted with flexile collodion, and elastic pressure maintained with a bandage over cotton-wool. Thinned red skin may thus often be preserved. When bursting through the skin seems inevitable, it should always be anticipated by a short incision, through which a fine tube may be introduced. The result of this will be a much in-drawn scar, but in the course of months the depression diminishes till it may become hardly noticeable. In making incisions between the jaw and cheek, the points to be attended to are to use a small scalpel, cut close and parallel to the jaw, and direct the point a little towards the bone. The presence of pain and swelling are reasons for the immediate performance of extraction, and not for its postponement till these symptoms shall have subsided. In all chronic sinuses of doubtful nature about the mouth, lower part of the face, or neck—even as low as the clavicle—the teeth should be carefully examined and put in order. It will probably be useless to endeavour to save a tooth which has given rise to chronic sinus or to recurrent abscesses. Even after removal of the tooth and gouging of the alveolus, the sinus may remain for months, but ultimately close. An opening upon the face may in these cases close if a probe be passed along the sinus and freely cut upon from within the mouth. To preserve a tooth, the pulp-cavity is to be emptied and rendered aseptic, and then it and its prolongations must be filled. If the process is successful, the tooth heals in as does a clean foreign body; if it fail, fresh abscesses form and extraction becomes necessary. *See* TEETH, Diseases of.

3. Ranula.—SYNON.: Fr. *Grenouillette*; Ger. *Ranula*; *Froschleingeschwulst*.

DESCRIPTION.—Ranula is a cystic swelling situate more or less upon one side of the frænum linguæ, rarely upon both sides; affecting both sexes at all ages, but chiefly occurring in adult life. It is not uncommonly referred to an injury after which it has appeared; it increases slowly, rarely becomes larger than a chestnut, is painless, and causes inconvenience only by its size. The swelling in the mouth is smooth, rounded, tense or soft, elastic or fluctuating, and has a bluish pellucid appearance strongly suggestive of its cystic nature. The mucosa is non-adherent and free from folds over the swelling, across which tortuous veins often wind. Only with ranulæ of exceptional size is any swelling perceptible below the jaw.

PATHOLOGY.—This is doubtful, and several modes of origin have been described. Distension of Wharton's duct may certainly occur, but in the majority of cases this duct is clear, and a probe introduced passes over the swelling. Wound of the duct and extravasation of saliva may cause the appearance of a cystic swelling. Some believe that the sublingual gland and its principal duct (Bartholin's) are the chief seats of ranula, but this is unlikely. Fleischmann's bursa—on each side of the frænum, between the mucosa and the muscles—is probably sometimes the seat of a pathological effusion. Dilatation of a mucous gland may occur beneath the tongue, especially that known as the Blandin-Nühn gland from the names of its describers. This was found adherent to the cyst by von Recklinghausen and Sonnenberg in one instance, and they adduced many good reasons for thinking that this gland was, at least, a very common seat of the cystic distension known as ranula.

TREATMENT.—A thick silk seton may be tied and remain in for three to seven days, according to the degree of irritation excited; this may be serious, and run on to abscess. Other methods of treatment are (*a*) opening the cyst freely, drying it out, applying pure carbolic acid, and packing with iodoform gauze; (*b*) cutting a V-shaped flap in the wall, and fixing its apex into the cavity with a stitch; (*c*) dissecting out the whole cyst, or the superficial part of it, upon which the Blandin-Nühn gland would lie (von Recklinghausen). Dr. Woakes reports a cure from the injection of a saturated watery solution of chromic acid.

4. Lingual Dermoids.—DESCRIPTION. Lingual dermoids occur in two situations—in the mid-line between the genioglossi, and on either side of the tongue, between the genioglossus and mylohyoid. They are rare, and are due to the inclusion of an epithelial germ connected either with the invagination of the mouth-pit or stomatodœum, the closure of the first visceral arch or of the first branchial cleft, or with the fœtal ductus thyroglossus (His), which extends from the foramen cæcum of the tongue to the thyroid isthmus, and is regarded as the remains of the hypopharyngeal diverticulum or protrusion from the foregut to form the thyroid body. Cysts between the genioglossi and in the mid-line of the neck, as low as the thyroid isthmus, are probably connected with the ductus thyroglossus, or with the union in the mid-line of the upper branchial arches; cysts on either side of the mid-line with closure of the branchial clefts or with the junction of the stomatodœum and foregut. The contents vary, being sometimes the usual cheesy, epithelial mass, with or without pale hairs intermixed; sometimes only a brownish mucoid fluid, in which float small masses of fatty epithelium. The lining of the cyst is generally a delicate layer of stratified epithelium, derived, it is thought, from epiblast; but it has lately been suggested that some of these cysts, especially those with mucoid contents, may be derived from hypoblast.

Though really congenital in origin, and usually reaching a size to attract notice in early life, these cysts often remain small for many years, and then, without obvious cause, begin to enlarge. They may not appear until mid-life or even later. They form smooth, round or oval, tense, elastic and fluctuating, or doughy swellings beneath the tongue, in the mid-line or on one side; they are usually firmer to the touch than ranulæ; unlike ranulæ they project chiefly towards the skin and but slightly into the mouth, the mucosa over them being normal unless some dilated veins ramify in it; they never have the translucent appearance of ranulæ, but it is said that some have a yellowish appearance owing to the colour of the sebaceous stuff showing through. They cause inconvenience in proportion to their size.

Treatment.—This consists of complete removal by dissection; when inconvenience or unsightliness renders treatment desirable. The incision should be made on the most prominent part of the cyst within the mouth *right down to the cyst-wall.* Traction with forceps upon the cyst and occasional touches with the knife will now generally suffice. If large, the cyst may be opened and emptied. If still more room is required, we must incise through the skin on to the most prominent piece of the swelling. When no mouth-incision is made, the wound may be treated aseptically. A wound in the mouth should be sponged with chloride of zinc solution (gr. xx. ad ℥j.) and freely dusted with iodoform; subsequently the mouth must be frequently washed with boric acid or borax lotions, and ice may be constantly sucked if inflammation tends to ensue.

5. Salivary Calculus.—Synon.: Fr. *Calcul Salivaire*; Ger. *Speichelstein.*

Description.—Friable concretions, composed chiefly of phosphate of lime, are not very uncommon in the ducts of the parotid, submaxillary, and sublingual glands. They vary in size from a pin's head to a filbert, or even larger, are elongated in form, and not infrequently they form around some small foreign body—a seed or a bit of woody fibre—which has made its way into the duct. They may lie in the substance of the gland, but are usually found in the duct. They are easily felt from the mouth, but are rarely complained of unless they give rise to the following symptoms. Without obvious cause inflammation causes complete or partial obstruction of the duct; the gland swells and becomes hard, but is neither tender nor painful as a rule. In the case of the submaxillary duct, the side of the tongue and floor of the mouth are red, and more or less swollen; an abscess may form in the latter situation.

Treatment.—If a concretion can be felt, either with a finger or with a probe passed along the duct, an incision should be made on to it, and the calculus removed with care, lest it break and the fragments excite more inflammation than did the entire mass. Local inflammation requires a poultice outside, and constant fomentation of the mouth with hot boric acid or borax lotions; if an abscess form it should be opened and treated similarly.

6. Salivary Fistula.—Synon.: Fr. *Fistule Salivaire*; Ger. *Speichelfistel.*

Description.—Occasionally the duct of the parotid gland (Steno's duct) is wounded or involved in an ulceration, or an abscess forms in its track and bursts externally. In such cases a salivary fistula is likely to be the result. The secretion from the parotid instead of making its way into the mouth dribbles over the cheek.

Treatment.—Whenever the parotid duct is involved in a wound of the cheek, an opening opposite the wound should be made into the mouth; the duct should be most carefully sutured, as also should be the tissues superficial to the duct. When a fistula has formed, all ulceration should have ceased for weeks or months before any operation is undertaken for its closure. The first point in all operations for established fistula is to secure a free drain into the mouth for saliva, either by dilating the distal end of the duct with catgut threads, or by puncturing the mucosa of the cheek in two places from the depth of the fistula, and passing a stout bit of silver wire through the holes and tying it in the mouth. The closure of the opening in the skin has been effected by light cauterisations; by paring the edges, dissecting up skin flaps for some distance and bringing them together; or, best of all, by removing the edges and adjacent skin and twisting in a flap to fill the gap. A small wool dressing should be applied after either of these operations, and kept in place by a truss; all movement of the cheek should be avoided.

7. New-Growths.—Most of these start from the tongue or jaws. Papillomata and epitheliomata are not uncommon on other parts of the mouth also; they present their usual characteristics, and are treated by removal. The swollen mucosa round a sinus, leading to a sequestrum of the hard palate, sometimes presents a striking resemblance to an epithelioma.

Epulis.—Synon.: Fr. *Épulide*; Ger. *Epulis.*

Description.—'Epulis' is a somewhat loosely used word applied to tumours projecting upon the gum. Without an adjective indicating the nature of the growth, it really conveys nothing beyond the situation of the mass; but custom has practically limited its application to two common and often clinically indistinguishable pathological varieties, the fibrous and the myeloid.

These tumours spring from the fibrous tissues of the gum, or from the alveolar periosteum and bone—the myeloid growths always, and fibrous usually, having a connexion with bone. Sometimes small growths of the latter nature come away attached to the fang of an extracted tooth, as if they had originated from the fibrous covering of the fang.

Epulides are commoner in connexion with the lower than with the upper jaw. They form smooth, rounded, or lobulated masses, usually quite sessile, varying from pinkish-white through red to purple-red in colour, and firm or semi-elastic to the touch. They are covered at first by the epithelium and mucosa of the gum, but ultimately they may ulcerate from pressure against the teeth or other irritation. Most commonly they present between two teeth, displacing one or more; or they may project upon either the superficial or the deep surface of the alveolus—the latter but rarely. Growth is not very rapid, and there are no signs of deep infiltration of the jaw.

Treatment.—This consists in free removal of the growth, together with any bone in connexion with it. Sometimes this may be effected under cocaine, especially with growths on the superficial surface of the gum; in other cases an anæsthetic is necessary, two or three teeth must be extracted, and the whole thickness of the alveolus cut away with a small saw and bone-forceps. After such treatment, recurrence is unusual; but myeloid growths sometimes show exceptional malignancy, and require specially free handling.

Stanley Boyd.

MOVABLE KIDNEY.—*See* Kidneys, Diseases of.

MOVEMENT, Therapeutical Uses of.—Synon.: Movement Cure; Kinesitherapeutics; Fr. *Gymnastique Suédoise*; Ger. *Kinesitherapie*.

Description.—The method of treatment of disease by movement appears to have been first designed by Ling, a member of the Royal Swedish Academy, about the beginning of the present century. The movements employed are said to be of three classes, namely: (1) *active movements*, executed by the patient himself, or by the patient aided by an assistant; (2) *passive movements*, performed by the assistant on the patient; and (3) *acts of resistance to movements*, whether executed by the assistant against the patient, or by the patient against the assistant.

Uses.—The several classes of movements, for which mechanical arrangements are also contrived, when scientifically employed, are used in the treatment of paralysis, curvatures of the spine or limbs, and injuries and diseases of the joints. Movements of the nature of friction or shampooing are also employed in the treatment of certain diseases of internal organs. *See* Friction; Massage; and Shampooing.

MOXÆ (Eastern).—A term for a form of counter-irritation, which consists in producing an eschar by burning certain materials upon the skin of a part. Moxæ were originally prepared in Eastern countries from the leaves of the artemisia; but when they are used in this country, cotton-wool and like substances are employed. *See* Counter-irritants.

MUCOID DEGENERATION.—A form of degeneration, which is associated with the production of a mucus-like substance. *See* Degeneration.

MUCOUS MEMBRANES, Diseases of.—This class of membranes, which line organs and passages communicating with the exterior of the body, though presenting modifications as to their minute structure in different parts of the body, exhibit a general resemblance in their construction, and consist essentially of submucous tissue; a basement-membrane; epithelium of various kinds covering the free surface; and numerous glands or follicles, differing in their characters in different tracts. They are highly vascular as a rule; and many of them are richly provided with absorbent vessels. The present article is intended to treat briefly, from a general point of view, of the morbid conditions to which mucous structures as a class are liable. Those connected with the several mucous tracts are discussed under their appropriate headings.

1. **Injury.**—Most of the mucous surfaces are exposed to injury from various causes. This may come from without, the cause being either mechanical, chemical, or excessive heat. As illustrations may be mentioned injury to the mucous lining of the alimentary canal or air-passages by foreign bodies; corrosion from swallowing strong acids; and burning or scalding of the mouth or of parts lower down, in consequence of inhaling a hot blast or swallowing boiling water. In other cases the injury may originate within the body, as by calculi passing along tubes or lodged in cavities lined by mucous membranes; hardened fæces in the intestines; parasites; or the rupture of enlarged veins, aneurysms, or abscesses into mucous cavities.

The effects of an injury to a mucous surface differ much in their nature and extent, according to its cause. Thus there may be a mere contusion; a superficial erosion or abrasion; a more or less extensive wound or rupture, other structures being then also involved; a burn or scald; or actual destruction by corrosives. More or less inflammation is liable to follow injury to a mucous surface. Subsequently ulcers may be produced, which by their cicatrisation may give rise to constriction or actual obliteration of tubes, and other untoward consequences.

2. **Hyperæmia and Anæmia.**—The mucous membranes are very prone to become the seat of congestion, either active, mechanical, or passive. *Active hyperæmia* may be a part of a physiological process, as is seen in the gastric mucous membrane during the process of digestion. Any slight irritation may also cause it, and it is scarcely practicable to indicate a distinct line of demarcation between this condition and inflammation, of which active congestion constitutes the earliest stage. It is characterised by bright redness, new vessels frequently coming to view; and at first by a tendency

to dryness of the affected membrane, which may be followed by excessive and altered secretion. *Mechanical congestion* is often an important morbid condition in connexion with mucous structures, giving rise to troublesome symptoms. For instance, in cases of cardiac disease, obstructing the pulmonary circulation, the mucous lining of the air-passages becomes more or less congested permanently; and if the general venous circulation becomes overloaded from a similar cause, other mucous tracts suffer, especially that of the alimentary canal. This tract is also directly involved in cases of portal obstruction. Particular portions of a mucous membrane might become the seat of mechanical congestion, if some local vein should become obstructed from any cause. The effects of this condition are in the first instance to make the colour deeper, with a more or less venous hue; and at last the small veins may be evidently dilated and varicose. The secretion becomes modified in quantity and quality, and in time a permanent discharge is likely to be established, consisting of an unhealthy thick and tenacious mucus; while the proper secretion of special glands, such as the gastric juice, is interfered with. In some instances mechanical congestion gives rise to an abundant flow of a watery mucus. The membrane itself is also liable to become altered, being swollen at first; and ultimately it may become permanently thickened and firmer than normal, owing to increase of connective tissue, while its own special structures degenerate. Hæmorrhage may occur as the result of venous congestion of a mucous surface, especially if the vessels are permanently distended or varicose. *Passive congestion* may follow inflammation of a mucous membrane; or it occurs in persons of relaxed and feeble habit; or follows excessive use of a part covered with a mucous membrane, as in the case of the throat.

Anæmia in connexion with a mucous membrane is important only when this is a part of general anæmia from any cause. Those mucous surfaces which are visible, such as the conjunctivæ, the lining of the mouth and lips or the gums, give the most striking evidence of this condition, as indicated by their pallor or actual bloodlessness. An anæmic condition of the alimentary canal probably interferes in an important degree with the functions of its mucous membrane, and with the formation of the secretions which it normally produces.

3. **Inflammation.**—Various forms and degrees of inflammation are of very common occurrence in connexion with mucous membranes, and a large number of cases in ordinary practice belong to this class. Without entering upon any description, it will suffice to state here that the inflammation may be acute, sub-acute, or chronic; and either catarrhal, croupous, or diphtheritic in character (*see* INFLAMMATION). Different tracts of membrane present different degrees of liability to these several forms of inflammation; and the catarrhal form not only has various grades of intensity, with corresponding variety in its products, which may become muco-purulent or actually purulent, but these products also differ in their nature in connexion with different membranes of the mucous class. Further, inflammation from special causes, such as gonorrhœa, is characterised by running a more or less definite course, and forming special products of an infective nature. When the inflammation is of a severe type, it may end in more or less destruction of the mucous tissues, as indicated by erosion, ulceration, or even gangrene. Where the submucous tissue is loose, œdema is very liable to occur. From this cause, as well as from thickening of the mucous membrane itself, from a plug of mucus, or from a croupous or other deposit on the surface, narrowing or even actual closure of any tube or passage lined by such a membrane is apt to be produced, especially at its orifice. Inflammation may also give rise to submucous suppuration. When the inflammation is chronic, permanent changes are set up in mucous tissues, the normal elements being altered or entirely removed, and a fibroid material being formed in course of time, so that the membrane is rendered permanently thickened and tough.

The cause of inflammation of a mucous membrane may be *local*, including injury, mechanical or chemical irritation, or that resulting from undue heat or cold, morbid products or growths; or *general*, such as chilling of the body from 'a cold,' or blood-poisoning in connexion with fevers and other conditions; or the inflammation may be a manifestation of some *specific disease*—for instance, diphtheria or gonorrhœa. Some mucous tracts are particularly liable to be affected under certain predisposing conditions, and at certain periods of life. Thus, bronchitis is very common in children and old persons; while the former are also exceedingly subject to catarrh of the membrane lining the alimentary canal.

4. **Ulceration.**—Ulcers are of common occurrence on mucous surfaces. They usually result from injury or inflammation; or are the effect of certain special morbid processes, as in the case of typhoid fever, syphilis, tubercular disease, cancer, dysentery, scarlatina, or diphtheria. Ulceration may exceptionally depend upon destruction of the tissues by parasitic growths, as in some cases of thrush, or in actinomycosis. Some pathologists believe that ulceration of a mucous membrane occasionally arises from embolic plugging of arteries, and consequent death of a limited portion of this membrane, which separates, leaving an ulcer. In the

case of the stomach it has also been supposed that under certain circumstances the gastric juice may so act upon the mucous lining as to destroy it. A peculiar form of ulcer is sometimes observed in the duodenum after severe burns. Ulceration of a mucous membrane often begins in connexion with the glandular structures; this may be due in the first instance to mere blocking up of their orifices, leading to accumulation of their products and subsequent inflammation; but certain special morbid processes commence in these structures. Inflammation may cause ulceration, either by directly destroying the membrane rapidly or gradually, or by setting up submucous suppuration.

Mucous ulcers differ much in their seat, extent, depth, shape, and other characters, according to their nature and cause. The simple forms are either mere erosions, or of the catarrhal or follicular varieties; and in each of the special diseases already mentioned the ulcers present peculiar characters. Occasionally they assume a gangrenous condition. If an ulcer extends deeply, it involves other tissues besides those of the mucous membrane, and may thus lead to perforation of cavities or tubes, and other untoward consequences. It not uncommonly gives rise to hæmorrhage. Cicatrisation often takes place, and this may lead to permanent contraction, stricture, or even complete closure of channels lined by mucous membranes, with more or less thickening and induration. Ulceration frequently destroys the glandular structures, which are not afterwards renewed.

5. **Gangrene.**—Occasionally the tissues forming a mucous membrane mortify, as the result either of severe injury, corrosion, inflammation, or vascular obstruction. The gangrene is of the moist kind, and the dead tissues may separate in a mass or in shreds. Consequently an ulcer is left; or actual perforation of a tube or hollow organ may take place.

6. **Nutritive Changes.** *Hypertrophy* of mucous tissues is sometimes seen, but this may appear to be the case when it is not really so, the membrane being thickened and firm, owing to chronic inflammation, and the formation of fibrous tissue. *Atrophy* is not uncommon, especially of certain of the elements of mucous membranes, such as the glands or epithelium. *Degeneration* is also often observed, affecting these and other structures. This degeneration may be of a senile character; or of a special kind, such as albuminoid or mucous degeneration. Not uncommonly mucous tissues are relaxed and deficient in tone, their nutrition being impaired.

7. **Deposits and New-Growths.**—The chief new-formations observed in connexion with mucous membranes are polypi, villous growths, epithelioma, and tubercle. Syphilitic gummata may involve these membranes. Malignant growths may originate in connexion with certain mucous membranes or the submucous tissue, and epithelioma often starts from a mucous surface. Cysts occasionally form, originating from the glands or epithelial structures. The peculiar eruptions of some of the exanthemata may occur on mucous surfaces, especially small-pox; and also herpes. Certain animal or vegetable parasites are often associated with mucous membranes, and actinomycosis demands special notice in this connexion. *See* ACTINOMYCOSIS.

8. **Special Diseases.**—It will suffice to remark under this head that in certain diseases mucous membranes are particularly affected, such as typhoid fever, diphtheria, measles, scarlatina, and dysentery.

SYMPTOMS.—The symptoms which may arise in connexion with one or other of the diseases affecting mucous membranes just indicated, are of the following nature:—

1. *Morbid sensations*, usually of a more or less painful character, are often experienced. These will vary in degree and kind, not only with the nature of the disease, but also with the particular mucous surface which happens to be involved, some being much more sensitive than others. Painful sensations are chiefly met with in connexion with injury, inflammation, ulceration, or malignant disease, and they will be localised in accordance with the seat of the mischief. As a general rule, it may be stated that the sensation is one of heat or burning, rawness, or soreness; and it is usually much increased by any direct irritation of the affected surface, to which mucous membranes, from their situation, are specially exposed. Sometimes the morbid sensation consists in a feeling of tickling, itching, or undue irritability and sensibility to sensory impressions, such as those of heat and cold. It must be borne in mind that serious lesions of mucous surfaces, which, as a rule, cause marked pain, may exist without producing any such effect.

2. *Hæmorrhage* from mucous surfaces is of common occurrence, the amount of blood lost varying from a mere trace to a quantity sufficient to cause death. The bleeding may apparently take place quite spontaneously, and without any evident cause, as in some cases of epistaxis; or it may be associated with congestion, injury, inflammation, ulceration, gangrene, new-growths, or other conditions.

3. *Morbid products* are very frequently formed on mucous surfaces, or the normal secretions are modified in quantity or quality. Thus, the mucus may be deficient or excessive; and either thin or watery, unduly viscid and adhesive, modified in its reaction, or otherwise altered. A free serous flow may take place from a mucous membrane, as the result of congestion or catarrh. Muco-

purulent matter, actual pus, and croupous or diphtheritic membrane, are among the chief morbid products formed in connexion with mucous surfaces. Not only do these materials reveal their presence by being discharged externally in various ways, but they may themselves cause additional symptoms, by affecting substances with which they come into contact. For instance, in the alimentary canal unhealthy mucous secretions often lead to fermentation and decomposition of food, with their consequences; and similar effects are produced on the urine by morbid products formed in the renal pelvis or bladder. Some mucous discharges are also themselves irritating, and affect injuriously the surfaces over which they pass, causing pain, or setting up secondary inflammation. Gangrenous tissues may also be separated.

4. *Expulsive actions* of different kinds are often excited by morbid conditions connected with mucous surfaces lining passages and organs. These may be illustrated by sneezing, coughing, vomiting, undue action of the bowels, and frequent micturition. They may result merely from excessive sensibility or irritability of the membrane; or from the presence of blood, or of the morbid materials already mentioned, which need to be got rid of.

5. The *special functions* of certain mucous membranes are very liable to be interfered with when they are affected in various ways, especially in consequence of changes in the epithelium and glandular structures. This may be best illustrated by the alimentary canal, where dyspeptic symptoms often arise from changes of this character, the secretions necessary for the process of digestion not being properly formed; and the function of absorption by the intestinal wall is not uncommonly more or less imperfectly performed.

6. *Obstruction* or *contraction* of tubes or orifices lined by mucous membranes may arise from inflammatory or hypertrophic thickening, submucous œdema or suppuration, inspissated secretion, cicatrisation of ulcers, or some forms of new-growth. The consequent effects and symptoms are similar to those from other forms of obstruction, such as dysphagia when the œsophagus is affected, dilatation of the stomach from obstruction of the pylorus, retention of urine when the urethra is involved, or some form of dyspnœa when the air-tubes are obstructed.

7. *Physical examination*, particularly by *inspection*, at once reveals the condition of mucous surfaces which are visible. This may be aided by suitable instruments in the examination of parts which are situated more internally. Special modes of examination give us important information as to the diseases of certain mucous membranes, such as that lining the air-tubes, the gastric surface, or the interior of the bladder.

8. *General symptoms.*—Diseases of mucous membranes are often accompanied with symptoms affecting the general system. The most obvious of these are fever and wasting, which may arise from various causes. Pyrexia is not as a rule high in connexion with inflammation of mucous surfaces. It must be remembered that certain affections of this class of membranes are but manifestations of some general or constitutional disease, which presents its own symptoms.

Treatment. — The general principles or indications in the treatment of diseases of mucous membranes may be summed up as follows: 1. To relieve pain and other sensations by appropriate means. 2. To check hæmorrhages, if they are in such amount as to need interference. 3. To subdue inflammatory action. 4. To brace up and give tone to relaxed tissues. 5. To influence secretions and morbid products, increasing or diminishing the former, checking or modifying discharges, and endeavouring to affect special materials, such as diphtheritic deposits. 6. To allay undue excitability which tends to cause violent actions; to aid such actions as may be necessary to expel excessive excretions or morbid products; or in other ways to prevent their accumulation. 7. To supply the place of, and prevent the symptoms resulting from the want of secretions necessary for special purposes, which are formed by certain mucous surfaces, such as the gastric juice. 8. To treat particular morbid conditions, such as ulcers, gangrene, new-growths, or constriction, with the view of curing them. 9. To treat general symptoms.

Local applications, or such remedies as when administered internally come into contact with the affected surface, whether directly or after absorption, are of much value in the treatment of diseased mucous membranes. These may be anodyne, sedative, caustic, stimulating, astringent, demulcent, antiseptic, or of other kinds, according to the action required; and they are often advantageously applied in special ways. Operative procedures are not infrequently required. *General* treatment is often of the greatest service in the management of diseases of mucous membranes, and this may be the only indication needing attention. Moreover, it must be borne in mind that there are certain diseases in which the morbid condition of the mucous membrane is but a part of the general malady, and calls for no special treatment.

Frederick T. Roberts.

MUCOUS PATCH.—Synon.: Mucous Tubercle; Condyloma; Fr. *Plaque Muqueuse*; Ger. *Breite Feigwarze.*

When the term 'condyloma' is used, 'syphilitic' ought always to be prefixed, to avoid confusion with the simple form of growth. *See* Condyloma.

Definition.—A patch of syphilitic eruption upon mucous membrane or moist skin.

Ætiology.—Mucous patches belong to what are commonly known as the secondary manifestations of syphilis; they may appear early or late, both in the acquired and in the inherited disease, and are very liable to return time after time.

Experimental inoculation of the discharge of mucous patches has proved that it is capable of producing a hard sore at the point of insertion, followed by general symptoms; and clinical observation shows that these lesions are the most frequent means of spreading syphilis.

Description.—Mucous patches on the skin appear as flattened elevations of a round or oval shape, with a broad base, of a reddish colour, and generally covered by a thin grey pellicle. When in close proximity they coalesce, and form a mass of irregular shape and size, which may be fissured and ulcerated. When situated upon a mucous membrane they are usually less raised, and whitish in colour, especially in the throat, where they have been termed *plaques opalines*. The primary sore may assume the appearance of a mucous patch. The growths also sometimes become warty on the surface.

Favourite seats of mucous patches are the genital organs, and the moist skin about the anus. They may also be found at the umbilicus, in the axillæ, auditory meatus, or nose, on the nipples, and between the toes; in stout and dirty persons they may be met with wherever folds of skin meet and perspiration collects. They are very common about the lips, mouth, tongue, and throat; and occasionally are seen on the cervix uteri. Want of cleanliness favours their development, as does irritation from any cause, especially smoking and chewing tobacco.

Treatment.—Mucous patches, being highly contagious, should always be got rid of as soon as possible. In the mouth or throat, carbolic acid, or a solution of chromic acid (twenty grains to the ounce), may be applied from time to time, and an astringent mouthwash used several times a day. Mucous patches on external parts usually disappear quickly under strict cleanliness and the application of calomel (one part) and oxide of zinc (three parts), care being taken to keep opposed surfaces apart with lint or wool. If the growths persist, carbolic acid or nitrate of silver or even the acid nitrate of mercury should be applied. General treatment must of course be carried out at the same time. *See* Syphilis.

George G. Gascoyen. Arthur Cooper.

MUCOUS RÂLE.—An adventitious sound heard on auscultating the chest in certain forms of disease, and due to the passage of air through viscid fluid in the bronchi. *See* Physical Examination.

MUCOUS SECRETION, Disorders of.—*See* Mucous Membranes, Diseases of; and Secretions, Disorders of.

MUCOUS TUBERCLES.—*See* Mucous Patch.

MULTILOCULAR (*multi*, many; and *loculi*, small spaces).—A term applied to cysts and other forms of growths, and to pulmonary cavities, when they consist of many small spaces or loculi. *See* Cysts.

MULTIPLE NEURITIS.—A synonym for peripheral neuritis. *See* Neuritis, Multiple.

MUMPS.—Synon.: *Parotitis*; *Cynanche Parotidea*; Fr. *Oreillons*; Ger. *Mumps*.

Definition.—An acute, febrile, infectious disease; attended with swelling of the salivary glands—mostly of the parotids; and ending in resolution.

Ætiology.—This is an affection more commonly seen in young persons—boys, growing girls, and young men; but it may occur in adults of either sex who are much with those affected with the disease, and who have not had the complaint before. Mumps rarely attacks the same person twice. It may occur as an epidemic in large institutions, such as schools and barracks. It is conveyed from person to person by contagion—that is, by infecting particles produced in the course of the disease, and given off by the sick, possibly even before the glands are affected, certainly for two or three weeks afterwards. It has an incubation-period of from eight days to three weeks.

Some hygienic defects may favour the spread of mumps. Whether it prevails more at one season than another is uncertain.

Anatomical Characters.—Not many, probably no cases of idiopathic parotitis afford the pathologist an opportunity of making a *post-mortem* examination into the nature of the affection. But arguing from analogy, some maintain that here, as in the more frequently fatal symptomatic parotitis, the inflammation has its starting-point in the gland-tissue proper, or in a catarrh of its duct. Others again assert, and this has long been the prevalent opinion, that the interstitial and the connective tissues around the gland are the seat of the mischief. The affection is probably both parenchymatous and interstitial. But wherever the inflammation has its origin, certain it is that the interstitial and cellular tissues around the gland are the parts which give most evidence of the existence of the disease. They become hyperæmic, infiltrated with serous fluid, and consequently much swollen. And this œdematous state passes to structures beyond those pertaining directly to the parotid gland. Seldom does there appear to be any fibrinous exudation poured out; and still less frequently do the tissues exhibit any tendency to break down and to suppurate. The swelling completely disappears about three days after the fever. On the subsidence of the local lesion a so-called metastasis to the testicle and other glandular and fibrous structures is not rare. Alterations in the kidneys and atrophy of the testicles have followed; nor have the investments of the nerves, or the surfaces of the heart, always escaped.

Symptoms and Diagnosis.—Some general symptoms always precede the local manifestations of mumps; they may be so slight as almost to escape notice; or fatigue by day, restlessness at night, chilliness or vomiting may mark the prodromal stage. These initial symptoms do not occur until a week after exposure to infection, and may not be followed at once by the local signs. Mostly, after a week of malaise, or only a look of illness, the onset of mumps is sudden, with chill, rarely rigor, sometimes vomiting, and well-marked fever, often only a few hours before pain and swelling begin in the parotid or submaxillary glands.

One restless night follows, either from pain, or from fever, or both. Sometimes the pain is severe, and the temperature only elevated by one degree; sometimes the fever is more evident. It generally reaches 100° F. or 101°, and frequently rises to 103° or 104°; at this point it is not long maintained, but subsides as the local lesion is established, falling to the normal, or even below it, on the third or fourth day of the disease. The temperature may be low while the swelling is still marked and painful; and in some cases appetite returns before eating is easy. This happens when the patient is kept at rest in bed. Without such precaution, sudden and great elevations of temperature may occur at the end of the first week, either without serious local mischief, or with orchitis, deafness, tinnitus of one ear, and albuminuria, not always transient; rheumatism, and heart-affections, leaving traces both of pericardial and of endocardial inflammation, may also occur.

From face-ache and enlarged lymphatic glands, the sudden sensation of pain or stiffness in the parotid or submaxillary gland, following on the general symptoms, and absence of any such local trouble as usually affects the lymphatics, together with the history of a possible infection, will generally suffice for the diagnosis of mumps. Further evidence is obtained on examining the spot, where, besides the deeply seated swelling, considerable tumefaction of the parts surrounding the gland exists near the lobe of the ear, which very soon thereafter increases to such an extent as to involve more or less the whole of one side of the face, and passes down on to the neck. Coincidently with the appearance of this enlargement, the pyrexia declines in some cases; while in others some days elapse before the subsidence of the fever. Pain is now complained of, and the patient can no longer open his mouth to the usual extent. Yawning excites severe pain; in fact, it can hardly be effected. The yawn is aborted. So with mastication and speaking—they are greatly impaired, and the sufferer prefers to fast, and to remain silent, rather than endure the pain involved in the effort to perform either act. The saliva is either largely increased, going the length of salivation, or much diminished in quantity. If pressure be made over the swelling, the patient quickly indicates the unpleasantness and the pain of the proceeding; and the sensation afforded by manipulation is that of an elastic tumour, with a slightly softer feeling in the centre. The skin over the swelling may be slightly reddened; often there is no deviation from the normal colour, the skin remaining pale, but glossy, and œdematous. In many cases these symptoms are not nearly so severe, and the disproportion between the amount of distortion of the countenance and the actual suffering is sufficiently astonishing, as well to the patient as to the sympathising friends. Most frequently the affection is limited to one side of the face; but as the swelling of the one side subsides, the other may take it up, when it runs through the same series of events, with, possibly, an interval of a few days between them. Rarely are the two sides simultaneously affected; but in such a case the uneasiness, pain, and discomfort are of course greatly increased. After the continuance of these symptoms for about six or eight days, they begin to abate, the œdema lessens, the pain is lost, the stiffness and tension disappear, and in a few days the face acquires its usual appearance. A mild uncomplicated case endures about a fortnight. Occasionally there is left for some time after this, a certain degree of hardness in the neighbourhood of the parotid, which gives no uneasiness, and can rarely be mistaken for tumour. In like manner, the history of the case will disclose the nature of other local pains, or of orchitis.

Not uncommonly, especially in young subjects, a 'metastasis' takes place from the parotid gland to the testicle in boys, and to the mamma or ovary in girls. When this occurs, and it may happen at any period of the disease, an exacerbation of the fever takes place, and at the same time pain in the inguinal region is complained of. An examination of the parts reveals the fact that there is swelling of the testicle, an orchitis, as well as an accompanying œdema of the scrotum. Rarely is the orchitis bilateral. In the case of the girl the vulva becomes the seat of œdema, and on pressure over the region of the ovary pain is elicited. The 'metastasis' may take place before the inflammation of the parotid has entirely subsided; and when the orchitis abates, the parotid may again take on the inflammatory condition. Inflammation of the coverings of the brain is to be feared on sudden subsidence of the inflammation of the parotid, if no orchitis follow the disappearance of the original affection. Delirium, amblyopia, conjunctivitis, albuminuria, or gastro-intestinal disturbances are occasional complications.

Prognosis.—This is almost invariably favourable in mumps, unless in the very weakly and in the tuberculous, or in the rare event of meningitis being developed. It may be said to be always a disease of a comparatively trivial nature, producing considerable pain and much discomfort, but not endangering the life of the sufferer. In very exceptional instances the inflammation of the parotid terminates in abscess. The indications of such an untoward result are increased pain in the centre of the swelling, hardness, and dark red appearance of the skin over the spot. In time the abscess discharges outwardly, or into the external auditory meatus. Atrophy of the testis sometimes follows 'metastatic' orchitis.

Treatment.—It may not, in every case, and at all seasons, be necessary to confine a patient suffering from mumps to his bed. But little treatment, beyond rest and care for the week or ten days this disease lasts, is required; still it is more prudent for the first few days to enjoin rest in bed. This is particularly necessary if the patient be young. In every case going out into the open air should be forbidden, and the patient recommended to keep as much as possible to one room. Rise of temperature means increased waste, and this is cancelled by rest. The bowels may require relief, as constipation keeps up disturbance of the temperature. All active evacuants should be avoided. It may be well to give some simple saline, as bicarbonate of potassium with lemon juice, and diluents during the first few days; ice is always grateful. A dose of chloral may be required at night (in children a grain for each year of the patient's age) if there be any restlessness.

As to local treatment, not much is required, unless the pain be unusually severe. It will be sufficient in most cases to protect the part from the air by means of a light handkerchief. Should more active interference be called for, some anodyne may be used, or soothing embrocation, such as the opium liniment, belladonna liniment, or external warmth; discretion in the use of these may safely enough be left in the hands of the patient himself, if of mature years. If there be the slightest tendency to suppuration, indicated by increase of fever and tenderness over the gland, with redness of the overlying skin, poultices must be had recourse to, and so soon as distinct fluctuation is discovered the abscess must be opened, otherwise the gland-tissue becomes still further disorganised, the lobules become softened and break down, and the gland is permanently destroyed. The application of leeches is useless in reducing the inflammation, or in staying the formation of the abscess. They may be of service in lessening the pain of metastatic orchitis or ovaritis; but these are well treated by the same gentle means employed in the case of the parotid itself. It is almost universally recommended in the case of a metastasis to try to induce a return of the inflammation to its original source, by the application of irritants to the parotid, such as a mustard poultice. This seems unnecessary in the majority of instances, as the inflammation is of such a mild type; besides, it implies a belief in the dictum that this is a true metastasis, and not merely another manifestation of the same morbid condition which originally gave rise to the parotitis. Tepid sponging is of use during the course of the disease, and a warm bath may be required when metastasis threatens. Sometimes wine or brandy is required.

Considerable anæmia and much debility may persist even when mumps has been mild in its course, especially in the weakly or unhealthy, so that tonics, with iron and cod-liver oil, may have to be continued for some time. C. Muirhead.

MÜNSTER AM STEIN, near Kreuznach, in Rhenish Prussia.—Muriated saline waters. *See* Mineral Waters.

MURMUR.—This term, as used in auscultation, was originally applied to the natural sounds heard over the lungs in respiration; but its employment has since been extended to include a great variety of auscultatory sounds connected with the heart, the blood-vessels, the placenta, &c. *See* Physical Examination.

MUSCÆ VOLITANTES (*musca*, a fly; *volitans*, floating about). *See* Eye, and its Appendages, Diseases of.

MUSCLES, Diseases of.—Synon.: Fr. *Maladies des Muscles*; Ger. *Muskelkrankheiten.*

In describing the diseases of the muscular tissue attention will be confined to the voluntary muscles, excluding diseases of the muscular substance of the heart and other organs, which are treated of under their appropriate headings. Many of the morbid states of the voluntary muscles come properly under the consideration of the surgeon, and others are more suitably treated of in special articles on the various diseases of the nervous system with which they are associated. There still remain, however, certain diseases of muscles to be described here.

1. Acute Inflammation.—Synon.: Myositis. — Ordinary inflammation of muscle, leading to exudation and suppuration, arises chiefly as a result of injury, rupture of a muscle, or extension of inflammation from neighbouring diseased bones. Inflammation sometimes, however, arises spontaneously, particularly in the tongue, diaphragm, and psoas muscle; in the latter situation forming one variety of psoas abscess. The symptoms are pain, tenderness, and swelling, corresponding to the seat of the inflammation. Exudation of serum and of lymph takes place, and subsequently an abscess may form; occasionally the process goes on to gangrene.

Secondary inflammations and formations of pus are of more frequent occurrence than simple inflammation and abscess. They arise in the course of the various forms of pyæmia. The presence of such secondary abscesses in muscles is especially characteristic of glanders and farcy, where inflammatory infiltrations of various sizes appear in many of the muscles, especially those of the arm. Disintegration takes place in their centre, and a collection of puriform fluid results.

2. **Chronic Indurating Inflammation.**—In this form of inflammation there is proliferation of cells in the interstitial tissue, causing the muscle to become hard and painful. The whole muscle may be attacked, or the process may be limited to one or more portions. Infants are often attacked by chronic inflammation of the sterno-mastoid muscle. The whole muscle becomes hard and painful, but rarely suppurates. The disease usually yields to soothing external applications; but if it be of syphilitic origin, the use of internal antisyphilitic remedies may be required. In adults chronic indurative myositis of a syphilitic character may occur in the sterno-mastoid, the various muscles of the leg and arm, the temporal and masseter muscles, the tongue, and other parts. The disease may appear either as a diffuse inflammation, with the usual signs of pain on movement, tenderness, and some swelling—or sometimes a series of beaded swellings; or as a circumscribed inflammation, with an abundant infiltration of nucleated cells. If the inflammation does not soon subside, the cellular exudation becomes organised into contracting fibrous tissue, and the compressed muscular fibres atrophy. In diffuse myositis permanent contraction of the muscle may result from this cause; in circumscribed syphilitic myositis a fibrous tumour in the interior of the muscle may result; sometimes a gummy tumour is formed. Syphilitic tumours thus formed in the muscle bear a great resemblance to malignant tumours. Indeed, it is often found that the only means of distinguishing the two clinically is by the effect of iodide of potassium in causing the disappearance of the former.

3. **Rheumatic Inflammation.**—The morbid changes in this form of inflammation rarely pass beyond the stage of congestion and serous exudation, though occasionally proliferation of the interstitial tissue may occur, and callosities may be formed. *See* RHEUMATISM, MUSCULAR.

4. **Hæmorrhage.**—Hæmorrhage takes place in muscle not only from injury, but frequently in the course of typhus and typhoid fevers and pyæmia; also in leucocythæmia.

5. **Rupture.**—Rupture of muscle is a subject which falls more properly into the domain of the surgeon, but the accident occurs also in circumstances which may bring it under the notice of the physician. Violent contraction of a muscle, without external injury, may lead to partial rupture of its fibres—for example, the gastrocnemius. The violent spasms of tetanus occasionally cause complete rupture of a muscle, particularly of the muscles of the back, the rectus femoris, and the psoas. Rupture of muscles has been known to occur in the delirium of fever; and may be the cause of abscess forming in muscle, as described above.

TREATMENT.—The treatment of ruptured muscle consists mainly in rest; in the support of the muscle by uniform bandaging; and in suitable applications, should abscess form.

6. **Lesions of Sensibility.**—(*a*) *Myalgia.* This term was given by the late Dr. Inman to a painful condition of the muscles arising in those who are in feeble health. The pain is similar to that which is present in a muscle after long-continued and fatiguing exertion—for example, in the limbs after a long walk, or in the diaphragm and intercostals after violent laughing. In persons who are debilitated, pain may arise in the muscles after very slight exertion, and this constitutes myalgia. It is often accompanied by cramps at intervals. The pain is most commonly felt at the tendinous insertion of the muscle. The abdominal muscles are frequently the seat of myalgia, such as the costal origin of the external oblique—causing, according to some authorities, that pain in the side which is so common in women—and the pubic insertion of the recti. The muscles of the back, and especially the trapezius, also suffer; the muscles of the limbs much less frequently. When situated in the trunk, myalgia is often mistaken for some congestive or inflammatory condition of the liver, spleen, or other viscus lying beneath. The pains of myalgia are distinguished by their hot and burning character. They are increased by exercise of the affected muscle, and disappear when it is relaxed or artificially supported. However severe the pain may be, the pulse remains unaffected; but it is usually uniformly weak and fast.

The muscles or their fibrous connexions are also the seat of pain in the condition known as muscular rheumatism.

Treatment. The muscles should have rest and support by bandaging. Tonic treatment is required. Dr. Inman especially recommended cod-liver oil and tincture of perchloride of iron. Friction and counter-irritation do little good. Exercise is of no use, unless combined with fresh air and good diet.

(*b*) *Muscular anæsthesia.*—This term is given by Dr. Russell Reynolds to a group of symptoms occasionally met with, and believed by him to be caused by loss of the 'muscular sense.' *See* Muscular Sense, Disorders of.

7. **Atrophy and Degenerations.**—(*a*) *Simple atrophy.* Simple atrophy of the substance of muscular fibres arises either from general defective nutrition, during the course of wasting diseases, such as phthisis, in cachectic conditions, or after severe fevers; or as a local condition from disuse of the muscle. The muscles become pale and flabby. The ultimate fibres are reduced in volume, but preserve their anatomical characters, still showing the longitudinal and transverse striation. The atrophy is sometimes so advanced in parts, that the muscular substance of the fibre entirely disappears, and nothing is left but the sheath of the sarcolemma, which appears in the form of fibrous bands between the remaining muscular fibres.

As a local condition, atrophy is most frequently seen in muscles in the neighbourhood of a diseased joint, or in a paralysed limb. In these cases the atrophy is usually combined with more or less interstitial deposit of fat between the ultimate fibres, constituting *fatty growth* on or *infiltration* of muscle. Occasionally the amount of fat is so great as to cause an actual increase in bulk of the muscle, so that it appears hypertrophied. The atrophic and other changes arising in paralysed muscles are considered in their appropriate articles. Fatty infiltration of muscles may also arise as a primary condition, when there is an excess of fat in the blood, and atrophy of the muscular substance results from it.

(*b*) *Fatty degeneration.*—Here the fat is deposited, not between the ultimate fibres, as in fatty infiltration of muscle, but in their interior. Rows of minute granules appear in the longitudinal striæ, and gradually increase until the whole breadth of the fibre is occupied by them, and nothing is left but the sarcolemma. When the degeneration reaches this extent, it is of course irrecoverable. Muscles affected by this change become very soft and friable. This degeneration is met with much oftener in the heart than in voluntary muscles. It is sometimes associated with atrophy of the fibres in the muscles of limbs attacked by certain forms of paralysis. It is met with also in fever and phosphorus-poisoning, granular degeneration being the first stage. *See* Fatty Degeneration.

(*c*) *Granular degeneration.*—Granular degeneration of muscles occurs in fevers and acute diseases. The ultimate fibres become swollen and opaque, being filled with fine granules. These clear up on the addition of acetic acid; this test distinguishing granular from fatty degeneration. The muscles which are affected by it are soft and friable and easily rupture. The fibres no doubt ultimately recover their natural appearances; but if the disease be severe and long-continued, granular degeneration advances to fatty degeneration, as is seen in cases of phosphorus-poisoning.

(*d*) *Waxy degeneration*; *Vitreous degeneration*; *Myositis typhosa.*—This degeneration was first described by Zenker. The affected fibres swell and lose their striation; and become of a homogeneous, translucent aspect. After a time transverse fractures appear in each fibre, dividing it into a series of short cylinders. The nuclei of the sarcolemma also multiply. The change does not attack all the muscular fibres of a part uniformly; for healthy and degenerated fibres are seen side by side. It is observed chiefly in typhoid fever, cholera, and other acute febrile diseases, being often associated with the granular degeneration. It is usually found in the adductor muscles of the thigh, the abdominal and pectoral muscles, and the diaphragm; appearing in patches of one or more square inches, pale and glassy; gradually becoming softened and pulpy. It is now considered to be a condition of *coagulative necrosis* of the muscle.

(*e*) *Fibroid degeneration.*—Fibroid degeneration of muscle has already been referred to as a result of myositis. Chronic or repeated inflammation, of a rheumatic or syphilitic character, leads to the formation of fibrous tissue in muscle, and the muscle becomes of a tough, whitish character.

(*f*) *Ossification.*—Ossification of muscle is a rare result of chronic inflammation or irritation. It is observed to occur in muscles which are subject to pressure, as the deltoid in soldiers, and the adductors of the thighs in riders. In a few cases ossification of a considerable number of the muscles has taken place.

8. **Tumours.**—Besides the syphilitic, fibrous, and gummatous tumours already referred to, muscle is subject to growths of a sarcomatous and cancerous nature. Fatty, cartilaginous, vascular, and other tumours are also met with in this tissue, but rarely.

9. **Parasitic Affections.** — The chief disease of muscles belonging to this group is that due to the presence of *trichinæ* (*see* Entozoa). The *Cysticercus cellulosæ* is also sometimes found in muscles. *See also* Pelodera.

Alexander Davidson.

MUSCULAR ATROPHY, PROGRESSIVE.—*See* Progressive Muscular Atrophy.

MUSCULAR DYSTROPHY, PROGRESSIVE.—*See* PROGRESSIVE MUSCULAR DYSTROPHY.

MUSCULAR HYPERTROPHY.—An increase in muscular tissue, affecting either the voluntary muscles, or the muscular tissue of special organs, such as the heart, the intestine, or the bladder. True muscular hypertrophy must not be confounded with an increase in the volume of muscular structures from hyperplasia of the connective-tissue elements. *See* HYPERTROPHY; and PROGRESSIVE MUSCULAR DYSTROPHY.

MUSCULAR RHEUMATISM.—A form of rheumatism affecting the muscles. *See* RHEUMATISM, MUSCULAR.

MUSCULAR SENSE, Disorders of. By the term 'muscular sense' is meant the sensation by which we are aware of the degree of force exerted by contracting muscles. By it we become conscious of the resistance to contraction, that is, the tension of the fibres. rather than of the contraction itself. This sense must be distinguished from the 'common sensibility' which muscles possess, and by which we feel—(1) pain on firm pressure; and (2) pain on tetanic contraction, whether spontaneous ('cramp'), or excited by faradisation, independently of the excitation of cutaneous nerves, as when the skin is insensitive. It must also be distinguished from (3) the sense of muscular fatigue. The muscular sense proper has been referred to a sensation in the joints, skin, and other parts, or of the position of the limb, but it may be unimpaired when this latter sensation is lost (*see* KINÆSTHESIS). But the term is often applied to the sense of posture. Probably this, and the discrimination of weights, are merely varieties of the manifestation of this sense. It has been thought to be merely the consciousness of the degree of the outgoing motor-impulse, but it may be lost when motor-power is normal, as in some cases under the observation of the writer, in which the muscular sense was suddenly lost in one arm, although the power was unimpaired. A poker did not seem heavier than a feather. The sensibility probably depends upon afferent fibres, which have been found by Tschirjew to terminate between the fibrillæ. They seem to be stimulated both by lateral pressure and longitudinal extension. They apparently course with the motor fibres in the mixed nerves, but pass to the spinal cord in the posterior roots. From the fact that the common and special sensibility of muscles may be lost in different degrees, it has been conjectured that in the cord the paths are not quite the same. The impulses thus generated may act first on the spinal cord, then on the cerebellum, and thence on the motor cortex.

Hyperæsthesia.—Increase of the common sensibility of muscles is not unusual (*e.g.* after cramp), but very little is known of that of the muscular sense. The sensation of restlessness, impelling movement, has been attributed to it, but without sufficient reason.

Anæsthesia.—Diminution of common sensation in muscles is frequent, with or without loss of voluntary power. Diminution of the special sensibility, *muscular anæsthesia*, or *muscular analgesia*, is occasionally observed, commonly in consequence of central disease, especially of the spinal cord, and is usually associated with a diminution of other forms of sensibility. Loss of muscular sense, however, may be present when cutaneous sensibility is unimpaired. The diseases in which muscular anæsthesia is commonly observed are locomotor ataxy and hysteria. In the former it is probably the cause of the ataxy; it bears no necessary relation to the change in cutaneous sensibility.

SYMPTOMS.—In muscular anæsthesia the patient is unaware of the degree of force exerted by the contracting muscles, and is dependent for his knowledge of the position of his limb, and of its movements, mainly upon cutaneous impressions. Ignorance of the degree of contraction interferes with muscular coördination, by rendering this dependent on cutaneous and ocular perceptions. When these are perfect, the amount of incoördination may be slight. The condition of the muscular sense is ascertained by observing the accuracy of movement with and without closure of the eyes, and especially by ascertaining the sensitiveness to movement against resistance so applied as to affect the cutaneous nerves as little as possible. The best method for this purpose is to suspend a weight, in a bag or cloth, to the limb, and observe (*a*) the minimum which can be recognised; and (*b*) the least increase in a greater weight which can be distinctly perceived. The sensibility of the two limbs may be conveniently compared. In each of these points the muscular sense may present a deviation from the normal, and the change in the two is not always proportioned. The minimum recognisable, and the minimum difference recognisable, vary in different parts. The latter amounts in the case of the arm in health to a difference of $\frac{1}{40}$th in a weight of three or four pounds. Balls of similar size and appearance, but of different weights, have been employed for the same purpose.

TREATMENT.—Muscular anæsthesia usually occurs as part of a wider affection, as in hysteria and ataxy, and rarely requires special treatment. Sudden local loss of muscular sense commonly depends on an acute, localised change in the cord, and requires rest and counter-irritation. A case under the writer's care, involving the arm, was rapidly benefited by this treatment. Faradisation of the muscles may be useful in some cases.

W. R. GOWERS.

MUSCULAR SPASM.—*See* SPASM.

MUSCULAR TIC. A synonym for facial spasm. *See* FACIAL SPASM.

MUSCULAR TREMORS.—*See* TREMOR.

MUSHROOMS, Poisoning by.—SYNON.: Fr. *Empoisonnement par les Champignons*; Ger. *Pilzvergiftung*.

Poisoning by mushrooms is a not very common occurrence. Great discrepancy of opinion has existed as to the poisonous or harmless nature of some species of fungi. We are now, however, increasing our hitherto limited knowledge of the various species and varieties of mushrooms; and the comparatively recent researches of Schmiedeberg, Koppe, and others, have thrown great light upon the active principle of at least one mushroom—the fly-fungus. The varied toxic symptoms produced by the ingestion of mushrooms become more easily explicable when we bear in mind that only a few fungi are apparently poisonous under all conditions. They are *Amanita muscaria*, the fly-fungus, which grows not very plentifully in this country; *Russula integra* seu *emetica* (*Agaricus integer* seu *emeticus*), also not very common; *Boletus luridus* (*B. perniciosus*, *B. bovinus*): and *Amanita phalloides* (*A. bulbosa*, *A. venenosa*, *A. viridis*), to which belong the varieties termed *Agaricus citrinus* and *Agaricus virescens*. Other fungi are poisonous only under special conditions, among which may be named idiosyncrasy, and the susceptibility of young children to the toxic effects of mushrooms. The delicious edible morel even has been known to produce fatal results. It must not be forgotten that gastro-intestinal catarrh of a severe character may result from the ingestion of a large quantity of ill-cooked indigestible fungus-tissue; that the highly nitrogenous tissue of fungi is peculiarly prone to rapid decomposition; and that fungi as a class absorb excretory animal matters, perhaps unchanged. These circumstances may serve to explain some of the apparent anomalies connected with mushroom-poisoning. Some kinds of poisonous mushrooms have their active principle either dissipated or destroyed by the prolonged heat employed in thorough cooking.

ANATOMICAL CHARACTERS.—Evidence of gastro-intestinal catarrh, more prominent in the stomach than in the intestines; signs of cardiac paralysis, or of asphyxia; occasionally fatty degeneration of the liver and other viscera; and minute sub-serous extravasations of blood, have all been noted after death from mushroom-poisoning.

SYMPTOMS.—The symptoms of mushroom-poisoning are of a twofold character: gastro-intestinal irritation, and a so-called narcosis. After a meal of poisonous mushrooms has been taken, colic sets in, followed by nausea and repeated vomiting; and diarrhœa eventually supervenes. The onset of symptoms does not as a rule manifest itself till after the lapse of some hours, six or eight or more, from partaking of the fungi. But this period is liable to great variation, and may be much shorter. Fragments of the fungi may be recognised in the fæces; and, indeed, were it not for this, and the history of the case, a diagnosis from violent ordinary gastro-intestinal catarrh would often be impossible. In severe and fatal cases the stools of the patient may become rice-watery in character; the patient becomes algid, collapsed, and cyanosed, with muscular contractions; and in children convulsions are not rarely met with. The sufferer eventually becomes somnolent, and falls into a state of sopor; but this is perhaps not due to a true narcosis, but to the drain of fluid from the system, and carbonic acid poisoning.

When the *Amanita muscaria* has been taken, cerebral symptoms are more prominent. The patient appears to be in a state of inebriation; and there frequently appears to be a tendency to dash the head against a wall or other solid object. These symptoms are, however, not exclusively met with in muscarine poisoning, but may be observed when other fungi have been eaten.

DIAGNOSIS.—The history of the case, and the detection of particles of the fungi in the fæces, are usually sufficient; but in the absence of these a diagnosis from natural disease is perhaps impossible. It has been proposed to test for the presence of muscarine, the active alkaloid of the fly-fungus, by applying a drop of the concentrated or unconcentrated urine to the heart of a frog. Muscarine causes the heart of the animal to stop in the state of diastole.

PROGNOSIS.—The patient cannot be considered safe for at least three days, unless the more prominent symptoms have been markedly alleviated. Death may occur at any period between six and seventy-two hours. Recovery is frequent.

TREATMENT. In poisoning by mushrooms emetics should be promptly administered, to evacuate the stomach, and those which are not of a depressing nature should be selected. The stomach-pump is perhaps of little service, seeing how persistently the particles of fungi adhere to the walls of the gastro-intestinal canal. Oleaginous purgatives, as, for example, a spoonful of castor oil in olive oil, may be advantageously administered. Fortunately the action of *muscarine*, which Schmiedeberg and Koppe have isolated as the active alkaloid of *Amanita muscaria*, and which is probably identical with *bulbosine*, stated by Letellier and Speneux to be the active principle of *Amanita phalloides*, is pretty well known. *Amanitine*, an alkaloid, is said to be an active principle in certain fungi, and is perhaps closely allied to muscarine. Atropine appears to be a direct antidote to muscarine; and digitalis appears to be so in a lesser degree. Atropine should therefore be given in small doses in cases of poisoning by *Amanita muscaria*; and failing this some preparation of digitalis. Should atropine be administered, it would be well to avoid the use of opium; but if atropine be not administered, the exhaustive diarrhœa may have to be combated by the use of opiates combined with astringents.

Thomas Stevenson.

MUSKAU, in Silesia, in Germany. Sulphate of iron waters.

MYALGIA (μῦς, a muscle; and ἄλγος, pain).—A name for pain in a muscle. *See* Muscles, Diseases of; and Rheumatism, Muscular.

MYCETOMA (μύκης, a mushroom).—A synonym for fungus-foot of India. *See* Fungus-disease of India; and Actinomycosis.

MYCOSIS FUNGOIDES (μύκης, a mushroom or fungus).—Synon.: *Granuloma Fungoides* (Auspitz); *Fibroma Fungoides* (Tilbury Fox); *Lèpre Indigène* (Guérard); *Lymphadénie Cutanée* (Gillot); and probably *Eczema Hypertrophicum et Tuberculatum* (Erasmus Wilson).

The name here employed is that ultimately used by Alibert, who first described the disease in 1814 under the title of *Pian fungoïde*; and is descriptive of the tumours which are present in its later stages, irrespective of all theories as to their pathology.

Definition.—A chronic disease of the skin, characterised by a more or less prolonged eczematoid condition, followed by the development of multiple fungating tumours; and almost invariably terminating fatally.

The affection is undoubtedly less rare than is usually supposed; at least six cases have been shown in recent years at the Dermatological Society of London, two of which were under the observation of the writer.

Ætiology.—Of the ætiology of mycosis fungoides little that is definite is known. It attacks men with much greater frequency than women, and usually in middle adult life—from forty to fifty years of age; but one case is reported to have begun at the age of five (Port). It is certainly neither hereditary nor contagious.

Symptoms and Course.—The *first* manifestations of mycosis fungoides may resemble an erythema, an urticaria, or the earlier stages of an eczema. They usually consist of well-defined macules, or more extensive erythematous patches, of a pinkish or bright red colour which does not completely disappear on pressure. These may remain discrete, or may coalesce so as to cover large areas of skin, and show a marked predilection for development upon the trunk, scalp, and face, while the upper extremities are more frequently and more severely affected than the lower. The lesions are in the majority of cases notably asymmetrical. Erysipelatous outbreaks, with some elevation of temperature, are prone to occur from time to time, and are usually followed by temporary amelioration of all the symptoms. The patches, which are at first on a level with the surrounding skin, soon become elevated, infiltrated, dense to the touch, and covered with some fine desquamation. They are accompanied by a variable, but generally considerable, amount of burning, tingling, or itching, the latter symptom being in exceptional cases excruciating; papules and vesicles may form upon the patches either spontaneously or as the result of scratching or rubbing. It is almost pathognomonic of the disease that all these manifestations appear and disappear spontaneously with remarkable rapidity, leaving previously affected skin apparently healthy, or at most only slightly atrophic, scaly, or pigmented.

Although partial recovery may thus be said to occur, and complete recovery sometimes seems imminent, the disease invariably progresses to its *second stage*, which is characterised by the deeper infiltration of the derma, and the gradually increasing prominence of the patches, to constitute the *plaques lichénoïdes* of Bazin. They are irregular in outline, sharply demarcated, bossy on the surface, of a deep purplish or brownish-red colour, and may either be covered with thick scales like a psoriasis, or may ooze and scab like an eczema. These lesions present the same peculiarity as to rapid disappearance as those of the first stage. Another phenomenon noted in a few of the recorded cases—which constituted a marked feature in the two cases observed by the writer—consists in the frequent appearance of deeply seated lumps indistinguishable from boils, most of which disappear without treatment; some, however, rupture and discharge their pus, but never a necrotic 'core' comparable to that of a true boil. They may, or may not, leave disfiguring scars. When the scalp is involved the hair usually falls rapidly. The nails often become yellow, brittle, and deformed.

After a variable period of time the *third stage* of the disease is attained. It is characterised by the development of peculiar, generally multiple tumours upon skin which is either erythematous or infiltrated; occasionally, however, they spring up from apparently healthy skin. The tumours vary greatly in size, those on the hands being often not bigger than a bean and 'let into' the skin, while on the trunk they may be the size of an orange, or even larger. When situated in considerable numbers upon the face they give a leonine expression very similar to that seen in leprosy. The tumours are sessile, sharply defined, firm, generally of a peculiar deep red colour, but sometimes pale pink or yellowish; they are usually lobulated, and have not inaptly been likened to tomatoes; the epidermis over them is intact, but stretched, tense, and glistening. The amount of pain attending them is variable, but usually they are tender to manipulation. Occasionally tumours appear in the mouth or fauces. In some of the reported cases early and conspicuous involvement of lymphatic glands has been noted, as well as leucocythæmia and enlargement of the spleen, but these appear to the writer to be examples of a separate disorder—a form of lymphadenoma—which it is of importance to differentiate from mycosis fungoides. The same may be said of the form described by Vidal as *Mycosis à tumeurs d'emblée*, in which there is no eczematoid, pre-mycosic stage, but the growths, which are usually localised, constitute the first and only manifestation of the disease. Such cases are probably examples of a form of true sarcoma of the skin (Perrin, Hallopeau).

When once developed the tumours may remain unaltered for an indefinite period. More frequently, however, a large number of them spontaneously disappear, leaving the skin either hardened, shrunken, pigmented, and desquamating, or else apparently healthy. Fresh erythematous and eczematoid patches nevertheless make their appearance, and fresh tumours, either singly or in crops; in one case (Stelwagon) as many as six hundred were finally present. Of these a certain number ulcerate slowly, the epidermis over them being destroyed; and hideous fungating ulcers are thus formed, from which a thin, ichorous, intensely fœtid fluid is discharged. At this stage itching and smarting usually cease, and the tumours become painless. But now for the first time—and the point is one of the most curious and characteristic features of the affection—the general health begins to suffer. Although many of the deep ulcerations may cicatrise, a profound marasmus is gradually established, the patient being usually ultimately carried off by diarrhœa or pulmonary complications.

Duration.—The duration of mycosis fungoides varies from a few months to twenty years or more (Besnier); on the average it is from five to six years. In one of the cases observed by the writer, apparent complete recovery took place under treatment, and persisted for more than six months, when a relapse occurred, during which the patient, who was very alcoholic, contracted acute pneumonia, of which he died. It is noteworthy that growths in internal organs have only been observed three times (Duhring, Galliard, Pye-Smith), and in each instance the association appears to have been a coincidence, as the internal tumours did not present the characters of the external ones.

Anatomical Characters.—The morbid changes are strictly confined to the skin and subcutaneous tissue. In the earlier erythematous stages, microscopical examination reveals turgescence of the capillaries, with diapedesis of red corpuscles, and considerable round-cell infiltration in spots in the upper layers of the corium. Mitoses are present in great abundance (Philippson). The rete Malpighii and epidermis are normal. The tumours are entirely composed of lymphoid cells, closely resembling those of round-celled sarcoma at first sight; but on closer inspection they are found to be in the meshes of a fine embryonic connective-tissue stroma. The cells are round or oval, almost uniform in size and shape, being about as large as a white blood-corpuscle; their nuclei are large and often multiple. In the earlier stages, and at the margin of the tumours, the granulation-cells are most abundant round the capillaries, the line of demarcation between healthy and diseased tissue being very ill-defined. In the centre of the tumours very few capillaries are present, and areas of cheesy degeneration exist here and there.

Pathology.—Divergent views are held as to the pathological group to which the tumours in mycosis fungoides belong. It will suffice here to state that Cornil and Ranvier regard them as *lymphadenomata*, and are followed by many of the French school; while Kaposi, Funk, and many German authorities, maintain that they are nothing else than *sarcomata*. Most recent observers, however, considering not only their microscopical characters, but also their clinical peculiarities, follow Auspitz in relegating them to the group of *infective granulomata*, the other members of which are tuberculosis, leprosy, rhinoscleroma, actinomycosis, glanders, and syphilis, all of which, except the last, would appear to have been shown to be due to the irritative presence of specific micro-organisms. Although many researches have been carried out by different investigators, only the most contradictory conclusions have hitherto been arrived at. Quite recently, however, Stelwagon and Hatch have demonstrated the existence in the tumours and in the capillaries surrounding them of micrococci averaging ·75 μ in diameter, of which pure cultures were obtained after repeated inoculations on the usual cultivating media. These micrococci did not liquefy gelatine, clearly showing that they are not pyogenic staphylococci, which they resemble in their morphology; but all attempts to reproduce the disease by inoculation in animals proved unsuccessful.

Diagnosis.—In the later stages of mycosis fungoides no difficulty presents itself as regards diagnosis; but in the earliest stage it may be impossible to differentiate the disease from urticaria, erythema multiforme, or even pityriasis rubra. Its persistence and ulterior developments soon, however, settle the point. In the eczematoid phase the localisation of the patches, their asymmetry, the amount of infiltration and sharp delimitation, the scantiness of discharge, and their spontaneous appearance and disappearance, generally serve to distinguish the condition from any recognised type of eczema. The absence of anæsthesia, of leucoderma, of bullæ and atrophic nerve-changes, the characters of the mycosic tumours, and the history, enable one to distinguish mycosis fungoides from tubercular leprosy.

Frambœsia may, apparently, resemble it closely, but is a disease of tropical climates only, the tumours are always small, and there is no pre-mycosic eczematoid stage. The main points of difference from sarcoma and various forms of lymphadenoma of the skin have been already briefly alluded to.

Prognosis.—The prognosis of this disease is necessarily gloomy, but its rate of progress varies widely in different cases. It is only when the final ulcerative and cachectic phase is reached that the patient's condition becomes a very painful or utterly hopeless one.

Treatment.—One case of complete and permanent recovery is reported (Bazin) after an accidental attack of erysipelas; inoculation with the streptococci of that disease, in a manner similar to that successfully carried out in the treatment of intractable cases of lupus, carcinoma, and sarcoma (Fehleisen), appears, therefore, to be a rational and legitimate procedure.

Arsenic internally, in full and steadily increased doses, has yielded in many cases decidedly beneficial results in the early stages of mycosis fungoides—an observation which the writer is in a position to confirm from practical experience. Its administration hypodermically is probably advantageous, but is seldom tolerated. Mercurials and iodides appear to be deleterious rather than beneficial.

Externally, ointments containing pyrogallol (10 to 15 per cent.) seem particularly efficacious in the eczematoid stage When tumours are present, the injection of strong carbolic acid into their base has been suggested by Dr. Radcliffe Crocker. If ulceration of the tumours has set in, the most scrupulous cleanliness and careful nursing are required. The horrible fœtor is best controlled by dusting with salol (one part to ten of subnitrate of bismuth), and covering with antiseptic gauze and absorbent wool. Washing with camphorated naphthol has been recommended by Brocq, and lotions of creolin or any other antiseptic are probably useful. Surgical ablation of the tumours has been carried out with success, and without local recurrence, in a few cases in which their number was limited.

J. J. Pringle.

MYDRIASIS (*μυδρίασις*).—This word was used by Galen and other writers to signify an undue enlargement of the pupil; but by Aretæus (*περὶ χρονίων παθῶν*, I. 7) to mean a shrinking or contraction of the pupil. Aretæus employs the word *πλατυκορία* (ibid.) to express dilatation of the pupil. The word is now invariably used to mean a preternatural dilatation, and sluggishness or immobility of the pupil. It is the opposite of myosis. *See* Pupil, Disorders of.

MYELITIS (*μυελός*, the marrow).—Inflammation of the spinal cord. A term that has been much abused, and which is still often wrongly applied to many mere degenerative softenings of this organ. *See* Spinal Cord, Diseases of.

MYELOID
MYELOMA (*μυελός*, the marrow).—A form of sarcoma, characterised by the presence of giant or myeloid cells. *See* Tumours.

MYOCARDITIS (*μῦς*, a muscle; and *καρδία*, the heart).—Inflammation of the walls of the heart. *See* Heart, Inflammation of.

MYOCLONUS MULTIPLEX.—*See* Paramyoclonus Multiplex.

MYOPIA (*μύωψ*; from *μύω*, I close or blink; and *ὤψ*, the eye).—That form of *ametropia*, or error of refraction, in which, owing to a high refractive index of the dioptric media, or excessive convexity of the refracting surfaces, or abnormal elongation of the antero-posterior axis of the eyeball, parallel rays of light converge to a focus in front of the retina, and form therefore circles of diffusion upon the retina. It is the opposite of hypermetropia (*see* Hypermetropia), and is sometimes called *brachymetropia* (*βραχύς*, short; *μέτρον*, a measure; and *ὤψ*, the eye), or *hypometropia* (*ὑπόμετρος*, below the measure). *See* Vision Disorders of.

MYOSIS (*μύω*, I shut).—A preternatural contraction and sluggishness or immobility of the pupil. The opposite of mydriasis. *See* Pupil, Disorders of.

MYOSITIS (*μῦς*, a muscle).—Inflammation of a muscle. *See* Muscles, Diseases of.

MYOTATIC (*μῦς*, a muscle; and *τατικός*, extended, tense).—Tense-muscle irritability or action. 'Myotatic irritability' and 'myotatic action' are terms introduced by Dr. Gowers, and occasionally employed as designations for the phenomena termed 'tendon-reflex,' or the conditions under which they occur. The term 'myotatic' was proposed as involving no theory of the nature of these phenomena, but merely the unquestionable fact that they can only be elicited when the muscles are in a state of moderate extension, usually passive. *See* Spinal Cord, Diseases of.

MYXŒDEMA (μύξα, mucus; and οἴδημα, a swelling).

Definition. Myxœdema is a name given by the writer to a progressive disease, in which the tissues of the body are invaded by jelly-like mucus-yielding dropsy, unaccompanied by albuminuria or other signs of primary affection of the kidneys. The condition gives rise to remarkable changes in physiognomy, and is associated with many signs of nervous disorder.

Ætiology. The original article on myxœdema in this *Dictionary* was founded on sixteen cases. Since then more than 100 cases have been recorded, and have been analysed by a Committee of the Clinical Society of London. From the report of this Committee it appears that the direct cause of myxœdema is the destruction, or loss of the function, of the thyroid gland. In the cases reported the disease affected men as well as women, in the proportion of fifteen to ninety-four (about one to six). Myxœdema appears to be identical with *cachexia strumipriva* (Kocher) and *sporadic cretinism* (Curling). The ultimate cause of the obsolescence of the thyroid gland does not at present appear; but it is in a certain proportion of cases preceded by enlargement of the gland. The disease is, in a small degree, hereditary.

Anatomical Characters.—The first, and, as at present believed, the most important, is the change in the structure of the thyroid gland. This change appears to be of one kind in the very large majority of cases. An early stage of small-celled infiltration of the walls of the vesicles is followed by epithelial proliferation in the vesicles themselves. Later on, the gland becomes converted into a delicate fibrous tissue in which clumps of small round cells, clearly the remains of the vesicles, are scattered. And, still later, the gland-structure is almost entirely replaced by fibrous tissue, the organ itself being greatly reduced in size. The changes in the skin and tissues which bring about the striking physiognomy of the disease are probably secondary to the affection of the thyroid. A remarkable overgrowth, consisting in part of hyperplasia, in part of retrograde degeneration of connective tissue, is found in several or all parts of the body. The fibrillar constituent of ordinary connective tissue is everywhere increased, and its elements unnaturally defined; the corpuscles are enlarged and multiplied; the interstitial cement enormously augmented. In normal tissue this latter element yields some mucin. The skin in myxœdema yields, in some cases, many hundreds of times as much mucin as ordinary or anasarcous skin.

To such amplification and mucous infiltration the skin owes its swelling, its translucency, and its defect of secretion. The same sort of interstitial expansion is found in the mucous membranes, in glands of all kinds, in muscles, and in the central ganglia of the nervous system, subjecting the proper structural elements of each tissue to destructive pressure. It is most developed of all, perhaps, in the outer coat of arteries. The diminution of the thyroid is associated with an almost complete annihilation of the proper gland-structure by this stuff; and the late occurrence of albuminuria marks the advanced progress of its inroads on the Malpighian bodies and tubules. Whether the mental failure of the last stage be due to the operation of similar changes in the brain, is not a matter upon which a decision is at present possible. In some cases there appears to be a general increase of neuroglia, and a very considerable development of the connective tissue around all the vessels. It must be observed that the appearances and chemical changes just described are, as indeed might be expected, not uniform. They are present in the case of persons dying in the full development of the disease; but are less marked in a larger number where the characters of the disease have been altered by changes preceding death.

Symptoms.—In myxœdema the physiognomy is the first characteristic. The face is swollen in every feature, so as to suggest the existence of renal disease. But while the negative results of a complete examination dispel this idea, the distribution and quality of the swelling are different from what is observed in common dropsy. The swollen skin is singularly waxy-looking and anæmic; and the swelling affects dependent and non-dependent features equally. Thus the upper and lower eyelids, and the upper and lower lips are uniformly enlarged; the alæ nasi are thickened and broadened; the ridges of expression are blurred and coarsened, or the lines obliterated. The œdema is resilient; does not pit on pressure; and shows, as the foregoing statement indicates, no tendency to shift by gravitation. The cheeks are overspread with a dull pink flush, abruptly limited towards the orbits, and standing in vivid contrast with the anæmic skin around.

The conditions observed in the face prevail throughout the body. The skin is everywhere thickened, translucent, dry, and rough to the touch; perspiration being infrequent or absent. The hairs begin early to fall out, and are ragged and broken. Similarly the teeth decay, or without decay become loosened and have to be removed, or fall out. The hands, in particular, lose all shapeliness and expression, and received from the late Sir William Gull the appropriate epithet, 'spade-like.' All visible and tangible mucous membrane is similarly amplified. Late in the disease ordinary anasarca is often added to the mucoid œdema. A noteworthy phenomenon is the occurrence of tumefaction, with marked resilience of the skin, in the lower triangle of the neck, above the clavicle. A similar tumefaction is met with also in sporadic cretinism.

An affection of the nervous system as well marked as that of the skin, belongs to myxœdema. In the earlier stages an ever-increasing hebetude involves sensation, voluntary movement, and intellect; in the later stages aberration of mind often supervenes. The face wears a fixed, heavy, and withal most sad expression; the speech is slow and laboured, though not slurred or slovenly; the voice monotonous, like that of an automaton, and leathery in tone. Sensation is slow, yet finally sure. The movements of the limbs are slow and languid; the maintenance of fixed attitudes requires much effort; and sudden falls are not infrequent. It appears as if the muscles were toneless and excessively relaxed during rest, so that a considerable initial contraction is necessary before they bear on their attachments; and as if the muscular sense were also torpid. The result is that while there is neither jerking nor tremor of the legs in walking, the balance of the body is painfully maintained, as the weight is thrown on each leg in succession; and a quiver often runs through the body at the moment of raising one foot from the ground and balancing the body on the other. This tardiness of coördination is altogether different from the vague staggerings and jerks of locomotor ataxy, and from the rhythmical tremors of disseminated sclerosis. It must be remembered that there is no real loss of muscular power, no wasting of muscles, and no loss of sensation. Laxity of muscles at rest gives rise to drooping of the head on the chest in some cases; in others it has led to fracture of the patella, by allowing, first, a yielding of the extensors of the leg, followed by a delayed and vigorous contraction to avert the impending fall.

In the operations of the intellect, thought and volition are again slow. All the patients observed have complained of being unable to perform any of the daily actions of life with their natural expedition. Yet whatever they actually do is well done, and they are acutely conscious of their shortcoming in activity. In conversation ideas come deliberately, and are tardily expressed. To write a letter occupies an hour where it would before have taken ten minutes. Yet the language is correct, and the caligraphy unchanged. There is, in fact, an unwieldy state of mind as of body. The difficulty of collecting thoughts gives an early impression of loss of memory. This, in fact, occurs late in the disease, when other aberrations are developed. In a few cases paroxysms of maniacal delirium have occurred, mostly in the advanced stage of the disease. But in one case such an attack came on as early as fourteen months after the first appearance of the general symptoms. This patient afterwards completely regained a sane state of mind. Signs of bulbar disease have been recorded in a small number of cases, ending in fatal result.

Two affections of the special senses apparently related with changes of the periphery are often noticed—one a persistent unpleasant taste, sometimes of bitterness, sometimes of sweetness, &c.; the other a persistent unpleasant smell. Otherwise the special senses show no defect save tardiness.

The heat of the body is almost always lower than normal, ranging between 98° and 94° F., or even less. Most patients complain of constant chilliness, without appearing to estimate at all readily changes of external temperature. The viscera give no signs of organic affection in the beginning of the disease. The urine is usually increased in quantity; lowered in specific gravity; and contains no albumen, sugar, or casts. The uterine functions go on as in health. As the affection advances various indications of damage to viscera are declared, and the urine is generally albuminous in the last stage. We may note here that a decided tendency to hæmorrhages has been found to prevail, and is not an unimportant character of the disease. The extraction of a tooth is often followed by prolonged irrepressible bleeding from the socket and gums. In further advance, together with all the indications of great general debility, the mind often becomes unhinged. Lethargic good temper is exchanged for moroseness, fretfulness, suspicion, irritability; delusions or hallucinations often follow; and there is a speedy lapse into coma. Death comes either by coma, or asphyxia, or with the signs of uræmic poisoning, or by inanition, unless by intercurrent disease.

Prognosis.—The progress of the disease appears to be far from uniform. The first cases observed, naturally very marked cases, went on steadily from bad to worse without fluctuations. But a wider observation shows that there may be many alterations in the symptoms, that the swelling of the skin and the nervous disorder may vary considerably from time to time, so that occasionally the disease may seem to disappear. But in the main the ultimate prognosis is not favourable. The disease has now been known to last in some cases as long as fifteen years, but even then life has been far shorter than the average.

Treatment.—In Mr. Horsley's valuable experimental investigations on the lower animals it was found that the appearance of the symptoms of myxœdema after the removal of the thyroid body was greatly delayed when the subjects were kept in a well-maintained warm temperature. Experiment with myxœdematous patients accords with this observation, and probably the most important part of treatment is to keep the patient carefully sheltered from the cold. In fact the writer's personal observations show that prolonged residence in warm climates will nearly always remove much discomfort, and delay the progress of the disease. In some cases the effect has appeared to be actually curative. A second point in treatment consists in the endeavour to restore healthy action of the skin. Vapour baths and hot-air baths have sometimes been found very useful. The baths of Aix-les-Bains and Royat have also been of great help in early cases. In addition to the use of baths, jaborandi may with advantage be given regularly. The writer has records of more than a dozen cases in which the steady administration of jaborandi during several months has been followed by great benefit, sometimes even by the complete disappearance of the symptoms. The practice has been to give doses of from ten to sixty drops of the tincture of jaborandi in warm water three times a day. Frictions of the skin and massage are reported to have done great good in some cases. Quite recently a well-marked case has been reported to be completely cured by vigorous friction of the whole of the body with olive oil, frequently repeated over a period of more than a year. As regards drugs, iron and arsenic have their place in the treatment of the anæmia; iodide of potassium has been reported as very useful in some early cases.

Lastly, the possibility of effecting something like a radical cure of myxœdema has to be entertained. This, as performed by Boecher, consists in implanting in the tissues of the patient either a thyroid gland taken from one of the lower animals or a portion of a goître. Improvement appears to have followed the operation, but not to have been permanent. Enough has been done to justify the hope that with improved methods of operation enduring benefit may be attained.

The preceding paragraph has since been abundantly justified. Dr. G. R. Murray of Newcastle-on-Tyne has conceived the idea of injecting hypodermically the juice of the fresh thyroid gland of the sheep in the form of a glycerin extract. It is obvious that such a method, wherein repetition of doses is practicable, offers a great improvement upon implantation. Dr. Murray's brilliant suggestion has been followed by remarkable results. In many cases the symptoms of myxœdema have entirely disappeared under the use of injections corresponding to one-half or one-third of the gland of a sheep administered twice or thrice a week. Later, Dr. Hector Mackenzie has used the raw thyroid gland of the sheep as a food in myxœdema. The results here are even more remarkable. It is probable that the symptoms of myxœdema will yield readily to the administration by the mouth of the fresh thyroid gland of the sheep, of the glycerin extract, of the ferment precipitated by a process devised by Mr. White of St. Thomas's Hospital, or of other active preparations of the gland. But it is important to note that the gland administered in these several ways is a drug of great power, and must be used with caution, in moderate doses and over long periods. It is evident that in respect of myxœdema we have an effective cure in our hands, not as yet fully worked out, but even now constituting a very remarkable instance of the advancement of medical science. It is evident also that a new method of therapeutics, the extension of which to other organs than the thyroid body offers great possibilities, is hereby added to the science and art of medicine.

William M. Ord.

N

NÆVUS.—*See* Tumours.

NAILS, Diseases of.—Synon.: Fr. *Maladies des Ongles*; Ger. *Krankheiten der Nägel.*

It has been usual to divide the morbid affections of the nails into two groups: A. *Diseases of the Nails proper*; B. *Diseases of the Soft Parts in immediate relation with the Nail.* This division, although it may be retained, is of no great practical value, because diseases of the nails mainly result from those of the soft tissues immediately connected with them.

Description.—Affections of the nail proper belong, for the most part, to those of defective nutrition, and resolve themselves into the various forms of hypertrophy, atrophy, and malformation. For example, we meet with the well-known lateral hypertrophy, where the borders curve inwards and press into the cutis, thus forming the painful 'ingrowing nail.' Again, we have a different form of hypertrophy, where the central part of the nail becomes thickened into an irregular shapeless mass, more or less covered with ridges or furrows, and altered in texture, so that it becomes opaque, brittle, and discoloured. Atrophy of the nail is less common than hypertrophy; it occurs, however, occasionally from injury, and also in connexion with certain diseases. Malformation of the nail is occasionally met with in ichthyosis. A congenital arrest of development of the nails is sometimes associated with a similar condition of the hair.

We may expect to meet with alterations in the growth of the nails from blows and injuries, or from undue pressure; and also from various diseases which interfere with the nutrition of the nail, such as eczema and psoriasis, but especially in pityriasis rubra, leprosy, and syphilis. Whenever any of these chronic diseases attacks the nail-matrix an alteration in the growth of the nail occurs, and an irregular hypertrophy or atrophy of the nail is the result. In very acute inflammatory affections, such as erysipelas and acute onychia, a complete shedding of the nail may take place. In all those chronic diseases in which the nails are apt to be affected, the matrix and bed of the nail are usually the first to suffer, and hence we generally see the changes apparently originating in the lunula. Sometimes, however, the altered condition of the nail is first noticed at the margin or anterior border. In these cases it is probable that changes have been going on gradually, though unperceived, for a considerable time, and that they are not really confined to the edges, the whole nail being more or less altered in texture.

A. Diseases of the Nail proper.—1. *Colour.*—The nails, which are naturally translucent, may become brown or grey, of a dirty appearance, or opaque with small roundish white spots, which are due to the presence of air, as in the white scales of psoriasis; in rare instances the nail assumes a general opaque whiteness. These changes may occur without any apparent disease in the surrounding tissues, and are of themselves of no great importance.

2. *Texture.*—Alterations in the texture of the nail-substance are not very uncommon. Nails are sometimes too soft, and bend too easily under pressure; much more frequently they are too brittle, and crack and break from the slightest cause. Associated with this latter condition, the surface of the nail usually loses its smooth and polished appearance, and becomes rough and eroded as if superficially worm-eaten.

3. *Form and growth of the nail.*—Any considerable alteration in the form of the nail is generally associated either with injury, or with some severe disease of the skin. In some instances the alteration is so great that the nails become twisted into thick curved cylinders, and resemble horns rather than nails, presenting a claw-like appearance. A very different alteration in the form of the nail is sometimes met with in cyanosis and some other diseases, in which the top of the finger becomes enlarged, and the nail club-shaped. The growth of the nail is much influenced by the general state of health, and during a period of illness there may be a deficient formation of horny matter, which results in the production of a groove across the nail; the breadth of the groove will roughly indicate the period and duration of the illness.

4. *Development.*—Congenital malformation of the nails is rare. As already stated, there may be congenital absence of nails. There is also occasionally met with the bifid or double nail, which is associated with a broadening and a tendency to bifurcation of the distal phalanx.

5. *Parasitic affections of the nails.*—*See* Tinea.

B. Diseases of the Soft Parts in immediate relation with the Nail.—These may be divided into three principal groups: (1) Those forms of simple skin-diseases which are especially liable to attack the fingers, such as eczema, psoriasis, and pityriasis rubra; (2) the various forms of onychia, including those which result from particular occupations or from syphilis; and (3) paronychia.

1. All diseases of the skin which affect the tissues in immediate relationship to the nails are apt to alter the growth of the nail itself, and lead to those changes which have already been referred to; moreover, as these maladies are fully described elsewhere, it is scarcely necessary to do more than merely refer to them here.

2. *Onychia.*—Onychia is an inflammation of the matrix. It is met with of a somewhat severe but non-syphilitic type in manufacturing towns, and is said to be especially prevalent in the flax-spinning mills of Belfast. The best known form of the disease, however, is of syphilitic origin. It is met with in two common varieties. The first or *subacute* form is often seen in congenital syphilis, and is attended with pain, redness, and discharge of pus around the nail, and more or less ulceration of the matrix. (2) The second variety is met with *in adults.* The nail first becomes spotted and furrowed, then gets rotten and brittle and crumbles away at the root, so as to leave a ragged border attached to the distal portion; the free edge and margins of the nail also suffer, and become broken and fissured.

3. *Paronychia.*—Paronychia or whitlow is an acute inflammation of the tissues around the nail. It is attended with considerable pain.

Two forms are usually described, but they do not differ essentially the one from the other. Both are really traumatic, and depend on the inoculation of pus or some septic matter through a scratch or slight injury to the skin. As a consequence of this inoculation the distal phalanx becomes swollen and painful, and a bulla or pustule may form. Very frequently the inflammation of one finger is followed by that of others, probably also from inoculation.

In the more severe form of the disease, when septic matter has been introduced, the inflammation may spread up the finger, and affect the lymphatics and the lymphatic glands. In another form of whitlow the inflammation begins in the sheath of the flexor tendon, but this variety belongs to the department of surgery.

Treatment.—As diseases of the nails are for the most part produced by various affections of the skin attacking the soft tissues in their immediate neighbourhood, the indication for treatment will, of course, be the cure of the primary disease. Although, the changes of the nail being slow, the defects will not pass away directly the disease giving rise to them has been cured, yet in course of time the nail will assume its normal appearance. In almost all acute inflammations water-dressings or poultices are suitable at an early stage; this may be followed up by soothing antiseptic lotions and ointments. In chronic inflammation round the edge of the nail, daily painting with a solution of nitrate of silver (gr. 10 ad fl. ℥j.) will be found one of the most useful kinds of treatment.

Where an ingrowing nail keeps up a paronychial inflammation, the body of the nail should be thinned by scraping, so as to diminish the pressure, and then a minute compress of cotton wool should be so passed beneath the adjoining part of the nail as to direct the ingrowing part upwards and outwards. The plan of scraping the nail thin is also useful when a splinter or some similar foreign body has run immediately behind the nail and broken off, and thus become embedded under it; in this case the nail should be scraped very thin immediately over the splinter, and then cut through. If this is done carefully, the foreign body may be removed almost without giving pain.

In subacute onychia, attended with ulceration, a dressing of powdered nitrate of lead has been strongly recommended. The treatment of syphilitic onychia is similar to that adopted for syphilitic inflammations in other parts of the body. *See* Syphilis.

In all the milder forms of whitlow the arm should be placed in a sling, and the finger constantly dressed with lint kept moist with some weak antiseptic lotion—a boric-acid lotion answers the purpose very well. When the inflammation has a little subsided, the finger may be dressed with boric-acid ointment. Tonics, especially cinchona bark or quinine, should be given internally. All the more severe forms of whitlow require surgical treatment.

Robert Liveing.

NAPLES, in South Italy.—Changeable climate. Mean temperature, winter, 48° F. Cold winds in spring. *See* Climate, Treatment of Disease by.

NARCOSIS
NARCOTISM (*ναρκόω*, I benumb).—A condition of profound insensibility, due to the introduction of certain poisons, or excessive doses of certain drugs, into the system, such as opium, chloroform, ether, or alcohol; or to the retention in the blood of certain effete alkaloidal and extractive elements which should have been excreted by the liver or kidneys, *e.g.* in uræmia, or of other morbid poisons. *See* Consciousness, Disorders of; Narcotics; and Uræmia.

NARCOTICS (*ναρκόω*, I benumb).—Synon.: Fr. *Narcotiques*; Ger. *Narkotische Mittel.*—Definition.—Remedies which promote or artificially imitate the natural physiological processes of sleep; but which in large quantity produce complete insensibility.

Enumeration.—A convenient division of narcotics, in the limited sense of hypnotics, may be made into (1) *indirect* narcotics, which include many soothing and hygienic conditions, anodynes, Conium, &c.; and (2) *direct* narcotics, of which Opium, Chloral Hydrate, Butyl Chloral Hydrate, the Bromides of Potassium, Ammonium and Sodium, Hyoscyamus, Stramonium, Belladonna, Hop, Indian Hemp, Alcohol, Digitalis, Sulphonal, Paraldehyde, Amylene Hydrate, Methylal, and the anæsthetic vapours are in most general use.

Action.—The *indirect* class of narcotics have no primary influence over the cerebral circulation, but act either by supplying warmth, quiet, and other tranquillising elements, or by removing some disturbing cause which renders sleep impossible. We know how powerfully sleep is under the influence of habit and regularity; how an excess of heat or cold, an inconveniently placed pillow, or a penetrating beam of morning light may often produce more or less restlessness; and the insomnia of feebleness or exhaustion may readily yield to a little nourishment, or to a well-timed dose of alcohol.

Pain is probably the most frequent cause of want of sleep; and if we can remove this, sleep usually follows. This we can do by removing the direct cause—extracting an aching tooth, opening an abscess, giving a dose of quinine, or checking the conductivity of sensory nerves by local anæsthetics or opium, by heat or cold, by electricity, or by forcible stretching of the nerve itself. Or we may interfere with the reception and registration of the painful impression at headquarters, by the use of some of the direct narcotics, which either produce some specific effect upon the cerebral grey matter, or have a decided action on the blood-supply of the brain, by constricting its vessels, and producing that degree of anæmia which more or less suspends its functions, and causes sleep. In larger doses, however, an opposite effect results, and we then see the cerebral congestion, the livid face, and the gradually deepening coma, which too surely indicate the fatal termination of opium-poisoning.

Uses.—Enough has been already said regarding the general principles on which we employ indirect narcotics; but the tact and ingenuity of the physician will often be severely taxed to discover the precise cause on which the want of sleep depends. When remedies, however, of the more domestic class have been exhausted, we must have recourse to drugs, and a brief *résumé* may now be given of the advantages and disadvantages of those remedial agents the soporific qualities of which have been established by experiment and experience.

Opium and morphine naturally stand first, and still hold their place as our most potent and reliable narcotics, all the more valuable because, almost alone in their class, they are also endowed with powerful anodyne action, in virtue of which they may relieve pain without causing sleep. Valuable as it is in all forms of insomnia, opium is especially indicated in typhus fever and other acute disorders, when delirium and prolonged wakefulness seem to endanger life. The principal drawback to opium are the disturbances of digestion and of the secretions and excretions attending its use, and the fact that as toleration is rapidly established, increasing doses are needed to check the counteracting influence of habit.

Chloral hydrate is less to be recommended in acute diseases, on account of its tendency to cause cardiac failure. but it is of essential service in simple insomnia, in chronic affections where the prolonged use of narcotics is required, and in delirium tremens. In prescribing it we must not forget its weakening action on the heart, and on the respiratory centre, nor the petechial and other skin-eruptions which have been described as following its use.

Bromide of potassium is peculiarly well fitted to soothe the brain when rendered irritable by over-work, but we must remember that it is very uncertain as a narcotic, and is apt to produce eruptions and muscular weakness. *See* Bromism.

Digitalis is of use when flaccid vessels permit a free flow of blood to the brain, thus effectually preventing sleep when the patient occupies the recumbent posture, the tonic influence of the drug enabling a due amount of cerebral anæmia to be obtained.

Conium may prove narcotic, by stilling the disorderly movements of chorea or of acute mania.

The other narcotics may be tried when the more potent remedies of the class fail or lose their power. Of those which have been more recently introduced, sulphonal seems the most worthy of confidence. Under certain circumstances a combination may succeed better than simplicity. Thus chloral hydrate and bromide of potassium are more valuable in acute mania when given together than alone; and opium and tartar-emetic are well known to form one of our most effectual means of dealing with some of those very intractable forms of sleeplessness which occur in the course of typhus.

Robert Farquharson.

NATAL, in South Africa.—Warm, but healthy climate, with hot, wet summers, and dry, clear winters. High winds from S.E. and N.W. Soil, sandstone and granite. *See* Climate, Treatment of Disease by.

NAUHEIM, in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

NAUSEA (*ναῦς*, a ship, in relation to sea-sickness).—A feeling of sickness or inclination to vomit, generally accompanied by a sense of disgust or loathing, and sometimes by a feeling of great depression. *See* Sea-sickness; and Vomiting.

NAUSEANTS (*ναῦς*, a ship).—Definition.—Agents which produce the feeling of nausea.

Enumeration.—The principal nauseants are Warm Water, Tartar Emetic, Ipecacuanha, Tobacco, Squill, and Apomorphine.

Action.—These substances produce irritation of the stomach, loss of appetite, general malaise, enfeebled circulation, muscular weakness, and frequently also salivation and sweating.

Uses.—Nauseants have been employed to diminish appetite, in the hope of causing absorption of fatty accumulations, or of pathological deposits. They are also used in producing relaxation of involuntary muscular fibre, and thus accelerating the passage of calculi through the bile-duct or the ureters; and occasionally they have been employed to relax rigidity of the os uteri in labour. They were formerly used to produce relaxation of voluntary muscles, in order to facilitate the reduction of dislocations, or to subdue the paroxysms of delirium or mania. For such purposes, however, they are now replaced by anæsthetics or other sedative measures. They are still used to excite sweating. *See* Diaphoretics; and Emetics.

T. Lauder Brunton.

NEAR-SIGHTEDNESS.—*See* Myopia; and Vision, Disorders of.

NECROBIOSIS (*νεκρός*, a dead body; and *βίος*, life).—Molecular death of a tissue without loss of continuity, especially seen in the various forms of atrophy and degeneration. *See* Atrophy; and Degeneration.

NECROPSY (*νεκρός*, a dead body; and *ὄψις*, a view).—Synon.: Fr. *Nécropsie*; Ger. *Leichenschau*.

Definition.—The inspection and examination of the body after death.

Method.—After making a complete inspection of the body externally, and noticing the general appearance, *rigor mortis*, change of colour—whether partial or general, œdema, marks of injury, and other points, a *post-mortem* examination should begin with the head, or, if the spinal cord is to be examined, with the spine.

Head.—To open the head, make an incision down to the bone, across the vertex from the base of one mastoid process to the other, and reflect the scalp backwards and forwards; then divide the bone all round with the saw, beginning in front a little above the level of the superciliary ridge. The posterior half of this section should make an angle with the anterior half by being brought over the occipital bone, a little behind the apex of the lambdoidal suture. By this means the skull-cap will, when replaced, rest firmly in its position without slipping back, and so causing disfigurement of the forehead. In cases of fracture of the skull the section should be completed with the saw, care being taken not to wound the dura mater. Under other circumstances the inner table may be conveniently divided with a chisel and mallet. The skull-cap must now be forcibly dragged off; if very adherent to the dura mater, a long flexible spatula may be introduced between them, and separation thus effected.

In young subjects before the sutures and fontanelles are united, it is better to remove the dura mater and skull-cap together, by dividing the former with blunt-pointed scissors in a line with the section through the bone, and then cutting through the falx at its anterior and posterior attachments.

The longitudinal sinus may now be opened and examined. The dura mater should next be divided on each side with blunt-pointed scissors, or on the level of the section through the bone, and the two lateral flaps turned up; then the falx should be cut near its anterior attachment, and the whole membrane drawn backwards off the hemispheres. The brain must now be removed; a long narrow scalpel being used to cut through the nerves and vessels, whilst the tentorium is most safely divided with blunt-pointed scissors. The spinal cord should be cut across as low as possible. Any fluid present at the base of the skull should be drawn off with a syringe and measured.

Brain.—After examining the pia mater, it should be entirely stripped off, and the surface of the brain examined. It should then be placed on its base, and, if very soft, supported by a towel wrapped round it. A horizontal incision should be carried through each cerebral hemisphere, on a level with the upper surface of the corpus callosum, from within outwards, not quite reaching the surface, so as to leave the hemispheres still attached to the rest of the brain. These should be turned aside, and numerous vertical incisions made in the upturned surface. Each lateral ventricle should then be opened by a vertical incision through its roof, and any fluid contents withdrawn by a syringe. The fornix should now be divided in front, and with the septum and corpus callosum turned backwards. The velum interpositum and choroid plexus being reflected in a similar manner, numerous longitudinal incisions should be made in the corpora striata and thalami optici, and in the corpora quadrigemina. An incision should now be made through the superior vermiform process of the cerebellum, so as to lay open the fourth ventricle. The cerebellum may be examined by making parallel incisions on each side through its lobes, not quite detaching the sections. The brain may now be folded together again, and the under surface turned up and examined. Incisions should be made into the under surface of the cerebral lobes, and into the crura and pons; and the medulla divided transversely at different levels. Softened portions should be tested with a stream of water; and parts reserved for microscopical examination at once placed in a hardening solution, such as chromic acid (1 per cent.).

A method of examining the cerebrum preferable to the above, when it is desired to determine accurately the exact seat of lesions, is the one recommended by Dr. Pitres.

The cerebral hemispheres, having been separated and stripped of their pia mater, are divided into three portions by two transverse vertical incisions, the first passing about two inches in front of the fissure of Rolando, the second a little less than half an inch in front of the internal perpendicular fissure, the occipito-parietal fissure of Huxley, which divides the parietal from the occipital lobe of the cerebrum. The cerebrum will thus be divided into three portions, an anterior or prefrontal, a middle or fronto-parietal, and a posterior or occipital. The first and last portions correspond to the non-excitable parts of the cerebrum, lesions of which do not cause either motor or sensory disturbances. The middle region, on the contrary, comprises the corpus striatum and optic thalamus, and the cortical motor zone.

This central portion may be best examined by making four vertical sections by incisions parallel to the fissure of Rolando. The first, or pediculo-frontal section, is made by an incision about three-quarters of an inch in front of the fissure of Rolando, dividing the second and third frontal convolutions close to their insertion into the ascending frontal convolution. This section will especially comprise the third frontal convolution. On its surface are seen sections of the three frontal convolutions, the anterior extremity of the island of Reil, the posterior extremity of the orbitar convolutions, the caudate and lenticular nuclei of the corpus striatum separated by the internal capsule.

The second, or frontal section, is made by an incision at the level of the ascending frontal convolution. Its surface displays a section of the ascending frontal convolution in all its extent, the convolutions of the sphenoidal lobe, the island of Reil, the external capsule and the claustrum, the caudate nucleus, the lenticular nucleus at its thickest part, and the optic thalamus.

The third, or parietal section, is made by an incision carried through the ascending parietal convolution. It much resembles the former, but the lenticular nucleus and the claustrum are divided where they are smaller.

The fourth, or pediculo-parietal section, is made by an incision about an inch behind the fissure of Rolando at the level of the foot of the parietal lobules, and passes through the posterior extremity of the optic thalamus. The lenticular ganglion is no longer visible; the corona radiata is divided in the region where lesions produce hemianæsthesia.

By means of these sections the exact relations of lesions of the cerebrum can be made out with much greater accuracy than by the ordinary methods of examination.

Base of Skull, Orbit, and Internal Ear.—The base of the skull and its sinuses may now be examined. In cases of fracture, the dura mater should be carefully stripped off, so as to expose the surface of the bone. The contents of the orbit may be examined by removing its roof. The tympanum can be opened by cutting through with a chisel the plate of bone forming its roof. This is situated on the anterior surface of the petrous bone, just in front of the eminence of the superior semicircular canal. To examine the internal ear the petrous bone must be removed. This is best done by two converging incisions made with a saw, and then separating its apex from the sphenoid and occipital bones with the chisel.

Spinal Cord.—To examine the spinal cord the body must be turned on its face, with the head hanging over the table, and a block placed under the chest. An incision must be made over the vertebral spines from the top of the sacrum to the occiput, and the vertebral arches laid bare. These are best divided with the rachitome, a double semicircular saw, in the absence of which a short common saw may be used, or a chisel and mallet or a bone forceps. The cord should be removed in its tube of dura mater, the latter being held by the forceps, and care taken not to bend the cord abruptly. The dura mater should then be slit open with blunt-pointed scissors along its anterior and posterior surfaces, and the cord examined, with as little handling as possible, by means of transverse sections made with a sharp scalpel. For microscopical examination the cord may be placed in spirit for about twenty-four hours; and then, after removal of its membranes, cut into lengths, and transferred to a 1 per cent. solution of chromic acid.

A method of opening the spinal canal from the front, preferable in many respects to the above, is practised at Vienna and many places on the Continent. The instruments used are a strong knife-shaped chisel, with a cutting beak, and a mallet. After the removal of the thoracic and abdominal viscera, the beak of the chisel is introduced into the lowest intervertebral foramen, and by successive blows of the mallet the pedicles of the vertebræ are cut through on each side and the canal exposed by removing the bodies. In this way great disfigurement of the body and soiling of the table and linen are avoided, and the spinal ganglia are more easily examined.

Thorax and Abdomen.—The thorax and abdomen should now be examined. It is better to lay the abdominal cavity fully open before removing the sternum. In cutting through the first rib, and disarticulating the clavicle, care should be taken not to wound the innominate vein. By using cutting pliers, which should be directed so as to cut obliquely through the rib into the articulation, all danger is avoided.

If much ascites is present, the belly should be tapped before laying open the peritoneal cavity. So, if either pleura be full of fluid, which will be shown by its pouring out when the cartilages of the ribs are cut through, sufficient should be drawn off with a syringe to prevent any overflow when the sternum is removed.

The lungs should now be drawn out of the chest, adhesions separated, and their posterior surfaces examined. The contents of the mediastinum should next be inspected, and the pericardium opened. If the case be one of thoracic aneurysm, mediastinal tumour, or malformation of the heart or great vessels, the heart and lungs should be removed together. Otherwise, the heart may be first removed and examined.

Heart.—The auricles should be laid freely open with a pair of scissors, by an incision joining the mouths of the great veins and carried to the extremity of the auricular appendage. The competency of the valves may then be tested. All clots must first be removed, the heart held in an upright position, and water poured into the aorta and pulmonary artery successively, the semilunar valves being held back with the handle of a scalpel to allow the ventricle to become filled; on looking into the auricles the competency of the auriculo-ventricular valves may be estimated. To test the semilunar valves an opening must be made into each ventricle; the pulmonary artery and aorta cut sufficiently short to enable the valves to be clearly seen; and then water poured into these two vessels successively, and the valves looked at from above. The right ventricle may now be opened. The left forefinger should be introduced through the pulmonary artery, and the anterior wall of the ventricle divided with blunt-pointed scissors into the artery, the point of the scissors being guided by the left forefinger to the junction of the valves. The pulmonary artery and aorta should then be separated as much as possible, and the left ventricle opened in a similar manner along its anterior wall, the left forefinger as before guiding the scissors to the point of junction of the semilunar valves. The incision must be carried close to the ventricular septum, and the septum between the aorta and pulmonary artery, but without cutting the latter. The most accurate way of measuring the capacity of the orifices is to pass through them graduated balls fixed on rods, in default of which the fingers may be used.

Lungs.—To remove the lungs, the trachea must be cut across at the root of the neck, and well drawn forwards by inserting the middle finger into the lower end, and the other fingers on each side behind the bifurcation, care being taken not to cut the œsophagus.

To examine the lungs, if the lobes are firmly bound together by adhesions, it is best to carry an incision in a vertical transverse plane from the outer border inwards towards the root. Further incisions may be made parallel to the first, in front and behind it. Cuts made in this direction lie in the plane of the large vessels and air-tubes.

If the lobes are separate, the incisions should be so managed as to give the largest possible sectional area. The lower lobe, as before, should be cut from without inwards, but it is usually more convenient to commence the incision for the upper lobe by entering the knife in the septum between it and the lower, and carrying the incision midway between its root and its external surface. The vessels and bronchi should be slit up by probe-pointed scissors.

Larynx and Pharynx.—To remove the larynx and pharynx, the incision in the neck must be carried up to the chin; the floor of the mouth opened from below; the left forefinger introduced, and used to depress the tongue; a long narrow scalpel introduced above the finger, and carried along each side of the ramus of the jaw; the tongue then drawn down under the chin; and the soft palate and pharynx divided transversely. The pharynx and larynx should then be opened along their posterior walls.

Intestines.—In examining the abdomen it is most convenient to begin with the intestines. The large intestines should be divided between two ligatures below the sigmoid flexure, and drawn out, cutting the mesentery close to the bowel. This process should be continued till the duodenum is reached, when it may be again tied and cut. The intestine should be opened along the line of attachment of the mesentery.

Spleen.—The spleen may next be examined. It should be drawn forwards out of the abdomen, and the gastro-splenic omentum cut through. It should then be laid on its hilum and bisected by a cut carried through the organ midway between this and its outer aspect.

Stomach.—The stomach should next be removed. A double ligature should be placed round the duodenum about two inches below the pylorus, and another one round the lower end of the œsophagus, and these tubes cut through, so as to remove the stomach without the escape of its contents. If required for chemical analysis, the contents should be emptied into a glass vessel, by removing the œsophageal ligature.

The usual practice is to lay open the stomach along its lesser curvature, from the œsophagus to the duodenum; but in many cases it is better to carry the incision along the greater curvature, for, as ulcers and cancers are more frequently situated near the lesser curvature, this incision is more likely to avoid cutting through them.

Unless required for chemical analysis, the mucous membrane may be washed by a gentle stream of water and then examined.

Pancreas. — After the removal of the stomach the pancreas may be conveniently examined. Before separating it from the duodenum the condition of its duct should be ascertained.

Liver.—In all cases of jaundice the liver and duodenum should be removed together, so as to obtain the bile-duct intact. In removing the liver care should be taken not to injure the right suprarenal capsule, which is in close contact and often adherent. In testing the perviousness of the bile-ducts it is better not to squeeze the gall-bladder, as this will often overcome an obstruction, but to open the duct with scissors, and observe the colour of the lining membrane below an obstruction. This will be found unstained by bile.

To examine the interior of the liver a number of vertical incisions should be made through the organ, extending nearly to the posterior border. The thickness of the capsule, appearance of the surface, and condition of the vessels and ducts on section should be carefully noted. The gall-bladder should also be opened up, and its contents and inner surface observed.

Suprarenal Capsules.—In cases of Addison's disease the suprarenal capsules should be removed united with the semilunar ganglia and solar plexus.

Genito-urinary Organs.—In all cases of urinary obstruction the kidneys, ureters, and bladder should be removed in connexion. The pelvic organs may be removed *en masse* by carrying a large knife all round the pelvic walls, and drawing the viscera upwards and backwards. As much of the urethra as may be required can be pulled back under the pubic arch. The urethra and bladder should be opened with scissors along their upper wall.

The uterus may be examined by introducing one blade of a pair of probe-pointed scissors through the os; making an incision through the anterior or posterior wall to the fundus; and carrying this on each side to the entrance of the Fallopian tubes, which will be studied along with the ovaries.

The kidney may be bisected by an incision through it from the convex border to the hilum; the capsule should then be stripped off, its thickness and degree of adhesion being noticed; and the state of the surface of the kidney, both external and on section, carefully observed. W. CAYLEY.

NECROSIS (νεκρός, a dead body).—The absolute death of a circumscribed portion of any tissue; but the phrase is usually associated with death of bone. *See* BONE, Diseases of.

NEGRO LETHARGY.—SYNON.: The Sleeping Sickness of the Congo; *Maladie du Sommeil*; *Nélavane*; *Dâdane*.

DEFINITION.—An endemic disease of the West Coast of Africa, affecting the central nervous system; characterised by slowly developed and increasing muscular debility, torpor and somnolence; and terminating, after a variable period of months or years, in death.

GEOGRAPHICAL DISTRIBUTION.—This disease is confined to certain circumscribed districts of the hot, damp part of the West Coast of Africa lying between Senegambia and Loanda. How far it extends into the interior of the country is not known; that it occurs as high up the Congo as the hilly district below Stanley Pool is well ascertained. Formerly it was common as an imported disease among the negroes in the West India Islands; since the abolition of the slave trade it is unknown there. Cases have occurred in England also in West Coast negroes. A striking peculiarity about the disease is that it may remain latent for a very long time, and not declare itself until years after the endemic area has been quitted. According to the natives, the liability continues for seven years.

ÆTIOLOGY.—Sleeping sickness has been attributed, on very insufficient grounds, to a variety of causes, such as excessive venery, excessive spirit-drinking, particular kinds of food, poisoning, malaria, hereditary and racial proclivity, and so forth. None of these, on investigation, can be found to account for it. There are some grounds, however, for suspecting that it is in some way connected with the recently discovered blood-worm, *Filaria sanguinis-hominis perstans*. Certain it is that this parasite has been found in the blood in a large proportion of the cases in which it has been properly searched for. Such a cause would explain the peculiarities of the endemicity of the disease, and also the singular liability to its development years after the victim has left the endemic area.

ANATOMICAL CHARACTERS. — Records of *post-mortem* examinations are contradictory; and hitherto nothing has been discovered in the brain or elsewhere to explain the symptoms.

SYMPTOMS.—Negro lethargy attacks both sexes and all ages; it is stated to have a predilection for the young, vigorous, and intelligent of about eighteen or twenty. It commences insidiously with lassitude, muscular and intellectual debility, often moroseness, and an irresistible tendency to fall asleep at unwonted times and even while at work. Dull headache is sometimes complained of, but not always. A tottering and unsteady gait, as if from weakness, is a frequent and early symptom, as is also a peculiar and pathognomonic *facies*: the upper eyelids droop as if weighed down by sleep, the eyes are lustreless and the face puffy, and the expression is sad or taciturn. The memory becomes weak and the senses dull. Little by little, sometimes interrupted by deceptive periods of arrest or improvement, the state of torpor becomes intensified, so that after a time sleep is nearly continuous; or, if not asleep, the patient will lie with closed eyes in an apathetic condition from which he can be roused with difficulty. He may generally be got to reply to questions, but he is unable to sustain a conversation, and speedily relapses into his habitual state of lethargy. At this stage, were he not roused to take food he would starve to death; even after being roused up, so great is the somnolence that he may fall asleep again in the act of conveying food to his mouth or during mastication. There may be some evening rise of temperature; but for the most part the skin is abnormally cold, the patient evidently feeling chilly and liking to lie asleep in the hot sun. Examination fails to detect any disease of the thoracic or abdominal viscera; the fundus oculi is healthy; and the superficial and deep reflexes are preserved. Although appetite and digestion generally continue unimpaired, towards the end of the disease the body wastes; the sphincters may fail to act; and extensive bedsores may form. Limited areas of skin may become anæsthetic. Muscular tremor is frequently noted; and as the disease advances, localised muscular spasms or more general convulsions may supervene. Death may occur during one of these convulsions, or it may be brought about by simple inanition or by some intercurrent disease. A certain proportion of cases exhibit maniacal symptoms at an early stage; these may subside, or recur, or persist for a variable period before the development of the characteristic somnolence. Enlargement of the cervical glands, of the salivary glands with a degree of salivation, and an itching papular or papulo-vesicular eruption on the chest and limbs are common occurrences.

The symptoms described are not all present in every case, and the individual features vary much in different instances, in degree and combination and rate of progress. Progress may be rapid or slow, so that the duration of sleeping sickness is variously stated at from four or five months to as many years. Cases are on record in which recovery seemed to take place, to be followed, however, almost invariably, sooner or later, by relapse and death. It is doubtful, indeed, if permanent recovery ever really does take place. The negro smitten with sleeping sickness considers himself and is looked on by his companions as doomed.

In the districts in which this disease occurs the distribution of the cases appears to be most capricious. A dozen negroes may be sleeping to death in one village, whilst the neighbouring villages are, and continue to be, entirely exempt or only slightly affected. Similarly, it seems to cling to particular houses and families, and thereby acquires a false appearance of heredity. So terrible are its visitations, that whole villages are decimated by it, and entire districts abandoned from the fear of it by their panic-stricken inhabitants.

Diagnosis.—Negro lethargy has been confounded with beriberi, a disease also endemic on the West Coast. Attention to the following points should prevent this mistake. Beriberi is characterised by a more rapid incidence; by pre-tibial œdema or varying degrees of general anasarca; numbness over the tibiæ and elsewhere; muscular hyperæsthesia, especially of the calves of the legs; breathlessness and palpitation; irregular bruits over the heart; more or less of a straddling gait; usually absence of knee-jerk; quickly developed atrophy of groups of muscles; and other symptoms which point to its being dependent on a multiple peripheral neuritis. In sleeping sickness, on the contrary, these symptoms are absent; and the characteristic somnolence and lethargy and other features clearly indicate that it is a disease affecting only the central nervous system.

Treatment.—No treatment has been found to be of any real and lasting service in negro lethargy. If in the future it should turn out that Filaria perstans is in ætiological relationship to the disease, much may be expected from an intelligent prophylaxis; for, in this case, attention to the water-supply, boiling or filtration of suspected water, and the thorough cooking of everything likely to convey the parasite, would be rewarded by immunity from the disease and perhaps its disappearance from the districts at present affected.

Patrick Manson.

NENNDORF, in Prussia (Hesse).—Cold sulphur waters.

NEOPLASMS (*νέος*, new; and *πλάσσω*, I mould).—A term for new-growths. *See* Tumours.

NEPHRALGIA (*νεφρός*, the kidney; and *ἄλγος*, pain).—Definition.—An affection of the nerves of the kidney, unattended by any evident anatomical lesion; characterised by the occurrence of pain in the region of the kidney, sometimes periodic, often accompanying exhaustion, but without any morbid changes in the urine.

Ætiology.—Exhaustion, exposure to cold, malarious poison, and the nervous, rheumatic, or gouty constitutions, are to be ranked amongst the chief causes of nephralgia. It is probable that the pains in the kidney due to the presence of calculi in its pelvis are at times of a purely neuralgic character.

Symptoms.—Neuralgic pain in the region of the kidney is sometimes paroxysmal and very intense, at other times more continued and less severe. It is frequently periodic, and is apt to occur when the patient is exhausted, or in a state of nervous depression. It is unattended by any change in the quantity or appearance of the urine, and the pain does not tend to dart down in the direction of the ureter, while tender spots may generally be discovered in the neighbourhood of the spinal column.

Diagnosis.—The disease with which nephralgia is most apt to be confounded is renal calculus. The points upon which reliance is to be placed in making the diagnosis are the exact seat of the pain, and the direction in which it spreads; the presence or absence of tender spots in the lumbar region; and the condition of the urine. In renal calculus the urine is commonly, or at least occasionally, bloody, and contains crystals or groups of crystals, or minute calculi, while in nephralgia it is natural.

Prognosis.—The prognosis of nephralgia is favourable.

Treatment.—The severity of the pain may be such as to demand subcutaneous injection of morphine. The most valuable remedy for cure is quinine, which may be given in doses of five, ten, or even twenty grains two or three times in the course of the day. Iron, arsenic, chloride of ammonium, acupuncture, or Corrigan's cautery may be employed in suitable cases, if the quinine fail.

T. Grainger Stewart.

NEPHRITIC COLIC (*νεφρός*, the kidney).—A synonym for renal colic, an affection which is usually due to the presence or passage of a renal calculus. *See* Renal Calculus.

NEPHRITIS (*νεφρός*, the kidney).—A general term for inflammation of the kidney. *See* Bright's Disease; and Kidneys, Diseases of.

NERIS, in France (Allier).—Feebly mineralised, alkaline, saline thermal waters. *See* Mineral Waters.

NERVES, Diseases of.—Synon.: Fr. *Maladies des Nerfs*; Ger. *Nervenkrankheiten.*—Nerves, in their origin, course, and distribution, are connected with the several organs and tissues of the body, and are consequently affected in various ways when such parts are disordered or diseased. But, besides such *secondary* derangements, nerves are subject to many morbid conditions which affect them *primarily.* In the case of certain classes of nerves, connected with special functions, the effects produced by disease are at once so distinct and so important, that they require separate consideration. Such, for example, are the glosso-pharyngeal, hypoglossal, olfactory, optic, phrenic, pneumogastric, spinal-accessory, sixth and third cranial nerves, the morbid conditions of which will be found fully discussed under their respective headings. Again, certain forms of congestion or inflammation (whether occurring in the subjects of gout, rheumatism, malaria, plumbism, syphilis, or in other states), when they affect important nerves, cause symptoms of a character so marked, either in their progress or distribution or by their severity, as to deserve a special designation, and to demand separate description (*see* Intercostal Neuralgia; Neuritis; Sciatica; and Tic-Douloureux). In these and in other allied instances the prominent symptoms are referable to functional disturbances of the nerves. In another class of cases similar phenomena originate in interference with the general nutrition, in disease of the nervous centres, or by reflex action; and these phenomena will be found discussed in the articles upon Convulsions, Neuralgia, &c.

In this place there remain for special consideration the following subjects: (1) the effects of *injuries* of nerves; (2) the most common morbid growths involving nerves, which are generally known as *neuromata*; and (3) the effect of cutting or stretching nerves regarded as a means of *treatment.*

1. **Nerves, Injuries of.**—Nerves may be divided accidentally either by tearing or cutting, or surgically during an operation, or for the relief of pain or resection of tumours. The nerves most frequently divided accidentally are those of the upper extremity, especially the ulnar, and the median just above the wrist-joint. The injury is very often caused by broken glass.

Sometimes, besides being wholly or partially divided, nerves may be bruised, or have embedded in their substance particles of friable foreign bodies, such as glass or slate. Fractures of the humerus at the upper or lower third are not uncommonly complicated with injury of the musculo-spiral nerve by the sharp edge of one of the fragments; for the nerve passes spirally round and in close contact with the humerus, first on the inner, then on the hinder, and near the elbow at the outer aspect of the bone.

Symptoms.—The symptoms of the division of a nerve are loss of power in the muscles, and of sensation in the skin, supplied by the branches of the injured nerve. The complete or the partial division may be diagnosed by the more or less complete interruption of their functions. It should, however, be remembered that there is often not complete anæsthesia, and that the state of the muscles is more important than is the loss of sensation.

In addition to the paralysis of motion and sensation, various changes soon occur in the parts cut off from the nerve-centres, and supply further and valuable information as to the extent of the injury.

The *muscles* atrophy with great rapidity, and in many cases shrink so as to cause various deformities. In other cases deformity results from the unbalanced active contraction of the neighbouring healthy muscles. Examined electrically, faradic contractility is found to be diminished as early as the second day, and completely lost from the third to the sixth. The galvanic contractility remains for from three to twelve weeks, but abnormally strong currents are required to produce contractions in proportion as the muscular tissue disappears.

The so-called 'reaction of degeneration' is evident within a week or two of the section, and indicates with certainty that the muscle is for the time separated from its nerve-centre.

The *skin* and its appendages also suffer. At first, on account of the section of the vaso-motor nerves the parts are flushed and hot; but, within a fortnight or three weeks, there is established a spasm of the small arterioles, resulting in diminished blood-supply and coldness of the paralysed parts. In many cases the skin becomes red, shiny, and glossy; and ulcers or whitlows may form painlessly, originating in some cases from injury to an anæsthetic part, in other cases being apparently spontaneous. The *nails* become fibrous and brittle, with ridges and fissures on them, and in some cases are shed. The *hair* breaks off short or else falls out. The *joints* are at first swollen and painful, but later on are liable to become stiff and ankylosed. The *fat* and *subcutaneous tissues* atrophy.

Changes in the divided nerve.—The lower end of the divided nerve undergoes rapid atrophy and degeneration, the myelin being broken up and absorbed and the axis-cylinders quickly destroyed. This degeneration affects simultaneously the whole of the lower end and its branches, but is in all cases succeeded after an interval of some months by imperfect attempts at repair, and the formations of new axis-cylinders from the nuclei of the sheath of Schwann. The proximal end as a whole undergoes no change, except for a slow atrophy which ensues after a lapse of years. Its cut extremity, however, soon increases in size, and on it a bulbous swelling forms, which, in a nerve the size of the median, is about half an inch in length by a third of an inch in diameter. This bulb is formed of fibrous tissue and young nerve-fibres. If the cut ends are in apposition, *union* occurs by a growth of nerve-tissue from the nuclei of the sheath; but the process is generally a slow one, and is usually preceded by degeneration of the lower end as already described. If good apposition is not maintained, union either does not occur at all or else it is very imperfect.

Treatment.—In the treatment of nerves accidentally divided all foreign bodies are, in the first place, to be carefully removed by means of a thoroughly aseptic sponge or forceps, with as little further injury to the nerve-tissue as possible; and the wound, if practicable, is to be treated antiseptically. Then the limb should be fixed upon splints in a position which will bring most easily and closely the cut ends of the divided nerve into apposition. Chromicised catgut sutures should then be passed completely through the nerve about a quarter of an inch from the cut surfaces, and tied tightly enough to obtain good apposition, but not so as to crush the nerve-fibres. Two sutures are usually sufficient. If possible, none of the nerve-fibres should be cut away, although a slight trimming off of jagged ends may be advisable. Passive motion of the paralysed muscles should be employed as soon as the wound is united; and afterwards weak galvanism should be applied to the limb, to promote nutrition and stimulate nerve-currents. It is also of much importance to keep the parts sufficiently warm. In most of the cases so treated a good result is ultimately obtained, although it may be delayed as much as one or even two years. Sensation commonly returns before motor power, and voluntary power before electrical excitability.

In cases where a nerve has been for long divided and has not united on account of want of proper treatment by suture, the operation of secondary suture should be performed. The limb should be rendered bloodless by an Esmarch's bandage, and the separated ends exposed by a careful dissection. The greater part of the bulb should then be cut cleanly off, and the lower end should be refreshed. Sutures should then be passed as described above. The operation is sometimes tedious and difficult.

2. **Nerves, Tumours of.** Synon.: Neuromata.

The tumours which affect nerve-structure, although no doubt varying in essential character, as they do in other parts of the body, have usually been grouped indiscriminately under the head of Neuromata. They may be divided into two classes—(*a*) *true*; (*b*) *false*.

A *true* neuroma is one which is composed of nervous tissue, and may contain medullated or non-medullated fibres, and in addition ganglion cells; all such tumours are exceedingly rare.

A *false* neuroma is a tumour situated on a nerve and not itself containing any nerve-elements. Such growths are usually composed of fibrous tissue; but myxomatous, gliomatous, and sarcomatous tumours have also been described. All neuromata are most common on the nerve-trunks of the extremities, and are generally in great measure separable from the nerve-tubules amongst which they lie. This is especially the case with the fibrous growths. The so-called *traumatic neuromata* have just been described as 'bulbs' on the proximal end of injured nerves.

Numerous cases of multiple neuromata are on record. In one case, recorded by R. W. Smith, upwards of 2,000 tumours were found. In most instances they are confined to one particular set of nerves and their branches. For instance, they have been found in the posterior tibial and plantar nerves, as in a case recorded by Van der Byl (*Path. Soc. Trans.*, vol. vi.), where the growth may have been round-celled sarcoma or cancer. In another remarkable case of multiple neuromata, recorded by Dr. Wilks (*op. cit.*, vol. x.), perhaps of syphilitic origin, a simple fibroid deposit was found within the neurilemma, causing in some places hardening and contraction, and in others neuromatous tumours. One of these had formed in the substance of the pneumogastric nerve, and was thought by Dr. Wilks to have caused the disease of the lung which proved fatal. In another case, recorded by Mr. F. Smith, multiple tumours affected the internal cutaneous and interosseous nerves of the arm, and the larger tumours were found to have undergone calcareous degeneration (*op. cit.*, vol. xii.).

Symptoms and Diagnosis.—The chief symptom is pain, and this is felt not only at the seat of growth, but also in the parts to which the diseased nerve is distributed. The pain is often of an aching character, but is also at times shooting or neuralgic. Hyperæsthesia or anæsthesia of definite cutaneous areas are less common phenomena, and muscular weakness or paralysis is comparatively seldom complained of. On clinical examination a neuroma will be found as a smooth, oval, or rounded swelling, varying in size, and situated in the course of a nerve-trunk. The tumour is more movable in the transverse diameter of the limb than in its long axis. Handling and pressure cause pain both locally and in the course of the affected nerve.

Treatment.—Neuromata on the continuity of a nerve, if painful or situated so as to be easily accessible, and liable to injury, may be dissected out carefully. Sometimes it will be found that the tumour can be extirpated without taking away the entire thickness and destroying the continuity of the nerve, which, when a large one (as for instance the great sciatic), it is important to preserve. In case this cannot be done, the whole section of the nerve-trunk may be taken away, and the smoothly cut ends brought together with fine chromicised catgut sutures, the limb being placed in a position to relax the nerve and lessen tension to the utmost. If approximation be impossible, union may be obtained by grafting a portion of nerve, taken from an animal or from a recently amputated limb, between the separated ends.

In cases of neuromata in stumps excision is sometimes available and effective. Opening the cicatrix and dissecting out the tumour or tumours may be all that is required, and this operation should in all cases be combined with thorough stretching of the affected trunks. But in other instances the pain and tenderness are so diffused, and the growths so numerous, that re-amputation a few inches higher up gives more complete and satisfactory results. Special care should be taken that the nerve-ends are cut short, so that they may not be included in or compressed by the scar.

3. Nerves, Surgical Division and Stretching of.

(*a*) *Nerve-section.*—Synon.: Neurotomy.—Surgical division of nerves has been employed for the cure of painful affections, such as neuralgia, and for obstinate and sustained spasmodic movements. It has been usually performed subcutaneously, and most frequently in the case of the branches of the trifacial nerve, at their exit from the bony foramina, such as the supra-orbital, the infra-orbital, and the mental branches. Efforts have been directed to prevent the union of the cut nerve, by taking away a considerable portion, so as absolutely to prevent contact of the ends; and the operation then must necessarily lose its subcutaneous character. When the nerve spreads out to its distribution in all directions, it is difficult to secure this absolute removal, and a good deal of the adjacent soft parts must be excised to insure its being done thoroughly. The operation has to a great extent been given up since the introduction of nerve-stretching, and should never be performed until the latter method has been given a thorough trial. It is now generally recognised that nerve-section is useless in cases of tetanus.

(*b*) *Nerve-stretching.*—This is one of the modern modes of the treatment of disease, which has so far achieved a certain amount of success.

Method.—Nerve-stretching is effected by cutting down upon the nerve-trunk, detaching it from its connexions for the space of a few inches, laying hold of it with the fingers, or passing an aneurysm-needle beneath it, forcibly stretching the whole nerve from its origin to such an extent as to affect powerfully its functions, and then closing up the wound. In some instances a certain amount of loss of sensation or muscular power in parts to which the nerve is distributed is the immediate result; this, however, passes away after a certain interval, and the nerve-function becomes more or less completely restored.

Applications.—The most useful application of nerve-stretching is its employment for the relief of neuralgia. In many cases of facial neuralgia temporary benefit at least is secured, whilst in some a permanent cure results. It is specially indicated in the epileptiform variety of facial neuralgia, and in intractable sciatica. The sciatic nerve can also be efficiently stretched without any incision, by what is known as the 'bloodless method.' For this purpose the patient is placed under an anæsthetic, and, the leg being maintained in a position of extension, the thigh is flexed upon the pelvis, and thus all the structures passing from the pelvis to the posterior aspect of the thigh are put on the stretch. This condition of tension should be maintained for about ten minutes, and the limb should then be thoroughly massaged, the region of the sciatic nerve being especially kneaded and rubbed.

In cases of old nerve-injury or of implications of nerve-trunks in scar-tissue, the operation of nerve-stretching is most useful, but in all such cases the nerve should be exposed at the seat of injury or of thickening, and should be thoroughly freed with the knife before stretching is commenced.

In cases of motor spasm, nerve-stretching has also been employed, but with less success. Thus, it has been used for the treatment of spasmodic wry-neck, and facial tic or *tic convulsif.* In some cases also of tonic spasm and contracture the operation has appeared to be of benefit.

In tabes dorsalis, nerve-stretching was at one time much employed on the Continent, but is now fallen into disuse. It is, however, certain that some patients derived considerable benefit from its application; and although it is not to be expected that the motor incoordination will be cured, yet in cases where the lightning-pains are specially severe the operation is certainly worthy of trial.

For chronic neuritis, and especially for ascending neuritis, with thickening of the nerve-trunk, nerve-stretching is sometimes of much use, and should always be given a trial.

Nerve-stretching has also been employed with benefit for anæsthetic leprosy, and for reflex epilepsy. It does not appear to be of any benefit in tetanus, although at one time it was much advocated for the cure of this disease.

John Wood. Anthony A. Bowlby.

NERVI, in the Eastern Italian Riviera.—Warm, moist, winter climate. *See* CLIMATE, Treatment of Disease by.

NERVOUS.—A term used variously in reference to persons, to temperaments, or to morbid conditions. A person is said to be nervous, or of a nervous *temperament*, who seems to present a special susceptibility to pain, or who exhibits an undue mobility, as it is termed, of the nervous system—that is to say, when the person starts or shakes on the occasion of abrupt or intense sensorial impressions, or when he exhibits a proneness to convulsions, or manifests an exalted emotional susceptibility. An organisation of this kind characterises children rather than adults, and, amongst the latter, females more than males. Nevertheless, in persons of both sexes such a bodily disposition is frequently to be met with, varying not only in degree, but also in kind or type. As one of the most important and peculiar of these varieties, we must include the as yet very imperfectly understood condition known as hysteria (*see* HYSTERIA). A nervous disposition may be either inherited, or acquired during the life of the individual, and it then ensues as a sequence of some severe illness, of some grave anxiety, or of some physical or moral shock.

In reference to *disease*, the term 'nervous' is used with different significations in different cases. Sometimes it is used in more general terms to signify that the disease is one implicating the nervous system rather than any other part of the body. At other times the use of the term is very variable. Thus, by the term 'nervous aphonia' we imply that the voicelessness is due to some functional nervous inhibition, rather than to any distinct paralytic condition caused by structural disease; while, by the term 'nervous deafness' we should imply that the deafness is due to disease, functional or organic, of the auditory nerve or its centres, rather than to an inflammatory or other affection of the middle ear.

H. CHARLTON BASTIAN.

NERVOUSNESS.—A term applied to the state of, or to the conditions manifested by, a person coming within the description of 'nervous' as above defined. *See* NERVOUS.

NERVOUS SYSTEM, Diseases of. The complexity of the nervous system, its manifold functions, and its extensive distribution, render its diseases more varied than those of any other system of the body.

From the manner in which the nervous and vascular systems interlock, their diseases or pathological conditions are to some extent inseparably related to each other. The modes of interference with the functions of the vascular system through altered nervous action are comparatively few and simple. The heart may, under the influence of modified nervous stimulation depart from its customary order and rate of contraction, or in extreme cases cease to beat; the smaller arteries over a greater or less extent of the body may diminish in their calibre, or become dilated; but, save for such events as these and their direct consequences, the work of the vascular system is habitually carried on without variations impressed upon it by abnormal states of the nervous system.

On the other hand, the diseases of the nervous system which may be induced by altered quality of blood, or by alteration of function in the heart or some part of the vascular system, are numerous and varied. The functional activity of the system as a whole may be degraded, owing to the fact of its receiving an inadequate amount of blood from a feeble or slowly acting heart. Or the functions of a part of the system may be interfered with by an undue contraction or dilatation in its small arteries, or by an impediment to the outflow of blood, inducing a mechanical congestion. Again the complete or partial arrest of the blood-flow in the vessels of some important region (owing to thrombosis or embolism therein), or the rupture of one of the branches of such a vessel, with extravasation of blood into the organ—either of these events may impair or destroy the functions of that particular part, even if it cause no more general disturbance of nerve-function. In short, both local perversions of function, and structural changes in the nervous system, are far more frequently initiated by altered quality of blood, or unnatural phenomena in the vessels of the part, than by primary morbid changes in either of the other two components of nerve-tissue, namely, the nerve-elements themselves or their interstitial connective tissue.

But, as already intimated, the number of different nervous diseases is referable principally to the great complexity of this system. It is now a familiar fact that the same kind of morbid change existing in different parts of the nervous system tends to give rise to wholly dissimilar groups of symptoms. Hence the importance, from a clinical point of view, of studying the varied functions and functional relationships of the several parts of the nervous system.

The most practical and useful classification of the principal component parts of the nervous system is as follows:—

1. THE CEREBRO-SPINAL DIVISION (or *Nervous system of animal life*).
    - ***a.*** The Encephalon (Cerebrum and Cerebellum).
    - ***b.*** The Spinal Cord.
    - ***c.*** The Cerebral and Spinal Nerves.

2. The Organic Division (or *Nervous system of vegetative life*).
    - *a.* The Pneumogastric or Vagus Nerves.
    - *b.* The Great Sympathetic System (with which is included the 'Vaso-Motor' System of Nerves).

This classification, though in part natural, is in other respects purely artificial. The cerebro-spinal and the organic nerve-centres are structurally continuous at many points. The vagus nerves, and the vaso-motor system of fibres in part, have an encephalic origin, though the latter are distributed almost throughout with the sympathetic system, of which it constitutes by far the most important part. This sympathetic system is connected at intervals with the whole length of the cerebro-spinal system, from the lumbar enlargement to the base of the brain, chiefly by connecting filaments passing between it and the anterior spinal nerves. Some of these connecting filaments are afferent, others are efferent. The brain again is brought into immediate relation with the sympathetic system through the widespread filaments of the pneumogastric nerves, which mingle with almost all the visceral plexuses, both of the thorax and of the abdomen. The spinal accessories seem to be the motor nerves through which the more direct impressions brought to the medulla by the pneumogastrics are reflected upon some of the viscera. Similarly, the transference of motor stimuli direct from the spinal cord to the viscera, in response to afferent impressions conveyed to it by certain nerves of the sympathetic system, takes place through motor fibrils in the filaments connecting the anterior spinal nerves with this system. The sympathetic system also possesses its own intrinsic motor fibres and vaso-motor centres. Other intrinsic motor centres probably exist amongst the sympathetic ganglia, which, like those of the heart, may be capable of bringing about muscular contractions in the parts with which they are severally in relation.

The direct consequence of the close relationship between the viscera and the fibres of the pneumogastric and spinal accessory, as well as between the spinal motor nerves and those emanating from the central connexions of the vaso-motor system, is that we find lesions of some portions of the cerebro-spinal system frequently involving altered actions in parts under the immediate influence of the nervous system of organic life—as when diseases of the bulb and its neighbourhood disturb the action of the heart or the respiratory processes, when vomiting is produced by cerebral or spinal disease, when diabetes or polyuria is induced by irritations of the fourth ventricle. Such effects, again, are illustrated by the flow of tears under the influence of grief, by the arrest of the salivary secretion under the influence of fear, or by the occasional production of an increased flow of the same fluid at the thought of savoury food. Or, the action of the two nervous systems upon one another may take place in an opposite direction, as when in a neurotic subject an irritant in the intestine, or the passage of a renal calculus down the ureter, gives rise to convulsions; when, according to some authorities, forms of 'reflex' paralysis are produced; when the 'spirits' are depressed under the influence of visceral disease, sometimes to such an extent as to induce melancholia; or when, on the other hand, irritative states of the ovary lead to that form of insanity known as nymphomania.

Sympathetic disturbances are also apt to show themselves in the functions of certain parts comprised within the sphere of the cerebro-spinal system itself, when some other portion of it becomes the seat of disease, though the extent to which this occurs is still involved in much doubt. Brown-Séquard believed that hemiplegia itself is often induced by an 'inhibitory' influence, emanating from some morbid portion of the brain and acting upon certain motor-cells in the spinal cord. Similarly we find an irritation occurring in one portion of the organic nervous system entailing morbid manifestations in some other and perhaps distant part of this system, as when the early stage of pregnancy or when ovarian or uterine disease leads to vomiting; when certain irritations of the stomach excite the act of coughing; or when irritations of the bronchial mucous membrane lead to vomiting. Essentially similar phenomena are seen when suprarenal-capsular disease leads to sickness; or when a blow on the epigastrium, by conveying a shock to the semilunar ganglia, causes an arrest of respiration or of the heart's action. *See* Sympathetic System, Disorders of.

This tendency to the establishment of sympathetic or related disturbance of distant parts in local diseases of the nervous system is one of the principal sources of the great complexity of the problems of diagnosis in these affections. Thus, though a lesion in the brain may give rise to a certain set of *direct* effects, the consequences of the same lesion may also, and mostly do, become multiplied by the production of what are called *indirect* effects. Such indirect effects may show themselves either in the direction of arrest or of exaltation of function in other parts of the brain or spinal cord, and in the former case they are often said to be brought about by 'inhibition.'

The proportion between the direct and the indirect effects resulting from an injury to nervous tissue varies greatly in different cases, according to the seat, extent, and nature of the lesions, as well as according to the age, sex, and general health of the patients. Hence it often happens that the same kind of lesion seems at different times to give rise to different sets of clinical phenomena.

In regard to *diseases of the organic nervous system* our knowledge is at present extremely defective. The recognition of the diseases of this system—that is, as diseases having such or such a pathological starting-point—is beset with peculiar difficulties. This is in part attributable to the free connexions existing between the organic and the cerebro-spinal nervous system, and the consequent difficulty, so frequently arising, which opposes itself to our settlement of the question as to whether any particular group of symptoms, possibly due to some primary disease of a portion of the organic nervous system, really owns such a cause, or whether it is rather due to some disordered condition of the cerebro-spinal centres, which induces indirect effects on the side of the nervous system of organic life. Then, again, in other cases, disease of some portion of the organic nervous system may really exist, which, by reason merely of our present defective physiological and pathological knowledge, remains unsuspected as a disease having that particular nature and origin.

The nature of the functions performed by the organic nervous system sufficiently explains this difficulty. In part it serves to link the functional activity of certain viscera with sensory impressions or motor acts referable to the cerebro-spinal system, as in the processes of ordinary or disturbed respiration, parturition, &c.; in part also it brings different organs into co-ordinated activity, as when the presence of food in the alimentary canal excites the simultaneous activity of the pancreas, the liver, and other glandular organs. And how well such functions as those last-named are performed we are often only able to estimate vaguely, if at all, since the actions of those portions of the nervous system on which they depend do not reveal themselves either by sensible impressions, or by movements of parts of which we are conscious.

Other functions of the 'sympathetic' nervous system, such as those which have to do with the maintenance and regulation of the functional activity of the blood-making or ductless glands—namely, the liver, the spleen, the suprarenal capsules, the thyroid gland and the lymphatic glands—are even still further beyond the pale of recognisable phenomena. Yet disturbances of these purely organic functions may give rise to certain general affections, which we are unable to refer to morbid states or actions of this portion of the nervous system. Suprarenal-capsular disease, leucocythæmia, azoturia, diabetes, chlorosis, various forms of anæmia, and other conditions of general malnutrition, are instances of diseases possibly due to deficient or perverted action of some of these blood-making organs, immediately occasioned by morbid conditions of the sympathetic nerve-centres in relation therewith. And it may be fairly presumed that the functional activity of these organs is influenced by the nerves and nerve-centres with which they are in connexion—just as that of ordinary secretory glands (such as the parotid and sub-maxillary) is known to be under the influence of the nerves with which they are supplied.

The true pathology of such general diseases as have been named, we may hope, will be ultimately elucidated by the application of the same means as have led to our present knowledge concerning the symptomatology of local diseases in the cerebro-spinal portion of the nervous system. This means, therefore, would consist in a more searching and habitual examination of the several parts of the nervous system of organic life, so as to endeavour to connect morbid appearances in its several centres with appreciable pathological states of ductless glands and other organs, and the still further endeavour to correlate these morbid appearances with the respective states of health or symptoms exhibited by the patients during life. Slow and difficult as this method is, it is the only one (apart from the experimental method with lower animals, which is here available only to a very limited extent) that would appear to hold out any probability of ultimate success.

The obscurity prevailing in reference to diseases of the *cerebro-spinal nervous system* is not to be compared in extent with that relating to the nervous system of organic life. The reason of this is obvious. Deviations from its proper functions come much more easily under the ken of the physician and of the patient; whilst, in addition, morbid changes in this part are a few degrees less difficult to detect; and as they are situated in parts which are also much more frequently scrutinised in the *post-mortem* room, such changes are in reality far more frequently recognised than when they occur in one or other of the more scattered centres of the nervous system of organic life.

For some general remarks on the diseases of the cerebro-spinal nervous system, the reader is referred to the articles, BRAIN, Diseases of; and SPINAL CORD, Diseases of.

ÆTIOLOGY AND PATHOLOGY.—The proper and well-balanced working of the nervous system, as a whole, depends upon the maintenance of the accustomed degree of excitability in its different nerve-centres; and the proper nutrition of such centres, upon which their normal molecular mobility depends, is certainly largely dependent upon their habitually receiving a supply of blood which is definite in amount, and uniform in quality. But the amount of blood going to any tissue or part is subject to the regulating influence of the local vaso-motor centre, with which the vaso-motor nerves supplying the blood-vessels in question are in relation. By the influence of other parts of the nervous system, or owing to the condition of these vaso-motor nerve-centres, the vessels dependent upon them may be either unduly contracted or unduly dilated. Again, the proper quality of blood is subject to much alteration in different diseases; for instance, it may be thin and poor in anæmic states, it may contain poisonous ingredients in workers with lead and mercury, whilst it may contain varied noxious constituents in those suffering from grave hepatic and renal disease, from septicæmia, and from the acute specific fevers. In this latter group there is, however, reason to believe that some of the abnormal nervous phenomena which are apt to manifest themselves may be due, not so much to the direct toxic influence of altered blood, as to the fact that in such states of the system the blood may be, at times, more prone than natural to coagulate in the minute vessels of the nervous system. Such undue proneness to coagulate sometimes depends upon the existence of an increased number of white blood-corpuscles, which, either from the state of the blood-plasma, or from the condition of the tissues outside, show a more than usual amœboid activity. Or an undue proneness of the blood to coagulate in some of the small vessels of the nervous system, during or after certain of the acute specific diseases, may be due to an unnatural tendency of the fibrin to separate from such altered blood. The nutritive changes taking place in different tissues are chemical changes, differing from one another in exact nature, and therefore capable of reacting differently upon the blood circulating through such parts. These facts suffice to show how difficult it is to draw the line between what are probably mere toxic effects of an altered blood, and those which are due in the main to minute and almost inappreciable changes in the condition of the smaller blood-vessels of a nerve-centre.

But whenever variations take place in the nutritive condition of any centre, these variations are apt to involve not only an altered action in that particular part, but a perverted functional activity of other related parts. It often happens, therefore, that an exaltation or diminution of functional activity in some one part of the nervous system causes a diminution, exaltation, or other perverted activity in distant parts of the system. Thus, owing to the many possible permutations and combinations, we may get the most varied grouping of abnormal phenomena traceable to altered actions in the nervous system, and having for a starting-point some perverted functioning of one or more nerve-centres. We have here some of the modes of production of what are commonly called *functional diseases.* Diseases of this type are specially apt to manifest themselves after some unusual strain has been thrown upon the nervous system, especially if the general health was at the same time lowered. The strain may have arisen from prolonged overwork and deficient sleep, or from some sudden mental shock, whether of joy or terror, but more especially the latter. At other times such functional diseases appear without any assignable cause, more especially in persons of a neurotic habit of body. Great differences exist amongst different individuals in this respect—that is, in their proclivity to diseases of the nervous system, though it is a matter of common observation that children and females are, as a rule, much more prone than men to become affected by nervous diseases of this type.

It is now a well-established fact that persons who are endowed with a neurotic habit of body, very frequently *transmit* a similar tendency to their children. It is not a tendency to any one particular disease, but a vulnerability of the nervous system as a whole which is transmitted, so that under the influence of even a comparatively slight strain, this weakness may manifest itself in one or other of various ways. It may reveal itself by mere general nervousness or tremors, by attacks of chorea, by epilepsy, or by one or other of the forms of insanity. When the neurotic habit of body exists to a well-marked extent, either in one or in both parents, different children may be affected in several of these modes; yet it is not necessarily so, for the inherent vigour of some of their progeny may cause such tendencies to be dwarfed and practically blotted out.

Other diseases of the nervous system are induced by definite and easily recognisable structural changes belonging to one or other of the following varieties. Rupture of blood-vessels often happens, causing *hæmorrhage* either into or upon the brain or spinal cord; though hæmorrhage into the latter organ is an extremely rare event. Or changes may occur in the vessels of some part of the nervous system, leading to their narrowing or actual occlusion by the combined influence of degenerations and thrombosis; or a similar result may be brought about by the lodgment of an embolus, and in each case the consequence, if the patient lives long enough, is the establishment of a focus of *softening* in the brain or spinal cord. In addition to these changes we have others of an irritative or *inflammatory* nature. These may affect the surface of the brain, when they are associated with *simple* or with *tubercular meningitis*; or they may implicate some deeper portion of its substance, though unfortunately we are at present only very imperfectly able to separate these inflammatory affections from the more simple degenerative softenings, either at the bedside or in the *post-mortem* room. If, however, the inflammatory focus should subsequently become the seat of an *abscess*, the latter difficulty would disappear. In the nerve-trunks an inflammatory condition, affecting principally their connective-tissue envelopes, is not infrequently met with, and goes by the name of *neuritis*. Again, *tumours* may be found, either arising in or pressing upon some portion of the nervous system. These may have been produced under the influence of tuberculosis or syphilis, or they may be cancerous, or wholly unrelated to any general diathetic state. *Acephalocysts* or *cysticerci* are also occasionally met with pressing upon the surface, or within the substance of the brain; or fluid may accumulate within the ventricles, as in *hydrocephalus*. But a far more frequent morbid condition consists of an overgrowth of the interstitial connective tissue, leading to the formation of patches or tracts of *sclerosis* in the brain and spinal cord. This change constitutes the basis of several well-recognised morbid conditions of a progressive type. Lastly, we may have certain special forms of *atrophy* and *degeneration*, showing themselves more especially in the nerve-cells of various parts of the brain, spinal cord, or sympathetic ganglia.

TREATMENT.—For the treatment of nervous diseases we have at our disposal a number of invaluable remedies, the action of which is more or less special. Thus, we have strychnine and bromide of potassium, possessing the opposite properties of increasing and diminishing the reflex excitability of the nervous system, in addition to other beneficial modes of action. We have chloral, morphine, sulphonal, chloralamid, and other drugs, acting either directly or indirectly as hypnotics, and thus allowing the curative action of rest to come into play. We have opium and Indian hemp, subcutaneous injections of morphine, antifebrin, and the constant galvanic current as pain-subduers. We have drugs like ergot, belladonna, nitro-glycerine, and nitrite of amyl, capable of influencing the calibre of the smaller arteries. We have in conium and chloroform most powerful agents for relaxing the whole muscular system. We have iodide of potassium, which in syphilis and other cachectic states of the system seems to act as a direct antidote for the dispersion of gummatous or other connective-tissue overgrowths. Whilst in the various forms of electricity we have special agents of the highest value, not only for mitigating pain, but for allaying spasm, for improving the nutrition of wasted muscles, and for facilitating the bringing of them again under the influence of the will in cases of paralysis.

The above are only some of the chief special remedies which we employ in the treatment of nervous diseases. We have, as more general remedies—so-called nervine tonics—the preparations of arsenic, iron, quinine, zinc, phosphorus, cod-liver oil, &c.; whilst we have also frequent occasion to call to our aid ordinary tonics, purgatives, emmenagogues, anthelmintics, and counter-irritants, together with cold or tepid douches, and the shampooing or massage of paralysed limbs.

The manifestations of nervous disease are immensely influenced by the general state of health of the patient, and this not only in so-called functional, but even in the gravest of structural diseases. There is indeed no class of affections in which more good may result from a minute regard to change of air, diet, rest and exercise, amount and kind of labour, and that general attention to all hygienic details upon which those most skilled in the treatment of these diseases always largely rely. There are few chronic diseases of the nervous system, even of the most obstinate and progressive type, in which very much may not be done either to arrest or to stay their progress, by careful attention to such hygienic details, by the judicious administration of drugs, and by maintaining the general health of the patient at the highest possible standard.

H. CHARLTON BASTIAN.

NERVOUS TEMPERAMENT.—*See* NERVOUS; and TEMPERAMENT.

NETTLE RASH.—A popular synonym for urticaria. *See* URTICARIA.

NEUENAHR, in Germany.—Thermal alkaline waters. *See* MINERAL WATERS.

NEU RAGOCZI, in Prussia (Saxony).—Muriated saline waters.

NEURALGIA (*νεῦρον*, nerve; and *ἀλγέω*, I suffer pain).—SYNON.: Fr. *Névralgie*; Ger. *Neuralgie*.—This is a term applied to a disease of the nervous sensory apparatus, marked by paroxysmal pain, which is for the most part unilateral, and in the course of nerves. In many cases no evidence of change in the periphery of the nerve is discoverable, and to these the term *neuralgic* is perhaps most properly applied; in others, however, there is reason to think that inflammation of the nerve is at least the starting-point of the disorder. The diagnostic points are as yet not sufficiently certain for these cases of neuritis to be absolutely separated from those of simple neuralgia, and they may so far be considered together. Relative constancy in the pain, with paresis and atrophy of muscles supplied by the affected nerve, and swelling of the nerve-trunk, point to neuritis. *See* NEURITIS.

ÆTIOLOGY.—Neuralgia is prone to occur in families marked by neurosal tendencies, not necessarily of neuralgic character, but which display themselves in various phases of psychical disturbance, as insanity, hysteria, hypochondriasis, or in the shape of epilepsy and chorea. Rare before puberty, that crisis has a strong predisposing influence. In the middle period of life, though first attacks are not very common, revivals of old-standing disease are apt to occur, as a result apparently of the depression occasioned by the wear and tear of life. Premature agedness (marked by atheromatous changes in the vessels, arcus senilis, permanent greyness of hair, bagging of the cheeks, pulmonary emphysema) conduces to severe and intractable neuralgias. Malaria is a potent cause. The presence of sewer-gas in a house may occasion persistent neuralgia. Anæmia and malnutrition generally, however brought about, play an important part. So also do sexual excesses, and perhaps likewise a state of celibacy. Pregnancy, over-lactation, and menorrhagia are each predisposing causes. The most frequent exciting causes are cold, especially damp cold; injury to the nerve by violence, or by the encroachment of morbid growths; syphilis; gout; and the presence of lead or mercury in the system. Irritation of peripheric organs may excite neuralgia in nerves nearly or remotely associated. So dental caries may induce supra-orbital neuralgia; indigestion may excite anginous symptoms; uterine disease may excite neuralgia of distant nerve-trunks—as, for example, the occipital; and the presence of intestinal worms may explain the occurrence of neuralgia in parts quite unconnected with the bowels. Neuralgia is a common sequel of relapsing fever and of influenza.

ANATOMICAL CHARACTERS.—In simple neuralgia no definite lesions are discoverable—at least, none that are constant enough to deserve the place of necessary accompaniments or factors of the disease. As a result of neuritis or perineuritis the nerve-trunk is sometimes found swollen and hyperæmic; or, in a later stage, it may be atrophied and its fibres degenerated.

SYMPTOMS.—After some little preceding numbness, cutaneous anæsthesia, or other abnormality of sensation, the import of which gets to be well understood by persons liable to neuralgia, the patient is seized with pain, which at first is not severe, and ceases quickly, but returns in a few seconds or minutes, lasting for a short time, and then remitting. These darts revive with shorter and shorter intervals, so that in a little time the pain appears to be almost continuous, or interrupted only by waves of intensity, and it will last for some seconds or more than a minute together. Then comes a respite, to be followed by recurrence, and these alternations may continue for a few minutes or as many hours. In attacks of long duration where no treatment is applied, the pains gradually get less acute, the intermissions longer, and the outbreak slides off into a confused feeling of discomfort and bruising about the seat of pain, coupled with a sense of exhaustion and desire for sleep. The character of the pain varies: it is described as darting like a knife or like lightning, crushing, hammering, boring, and sometimes burning. In neuralgia about the head the patient will often be seen to cringe and recede before the plunges of pain, as though he were receiving blows. When the pain is at its worst there is often a radiation of it to other nerves, and especially to those placed symmetrically with the one affected; but this secondary pain never attains anything like the severity of the original. Not always, but very commonly, certain definite points where pressure is exceedingly painful may be found by palpation. These, the *points douloureux* of Valleix, have a certain diagnostic importance. Rare in first attacks, they are much more common in patients who have been subject to recurrences during many years. There is always a nerve-branch under the skin at these points; and more often than not they correspond with the point of emergence of a nerve from a bony groove or opening, or its passage through a muscular aponeurosis. Pallor of the skin, followed by intense redness, horripilation, and other evidences of vaso-motor disturbance, are common. In the case of nerves being attacked which preside over glands there is often increased secretion. The tactile sensibility of the skin is almost always diminished after a time in the neighbourhood of the affected nerve, though at first there is some hyperæsthesia.

LOCAL VARIETIES.—The varieties of neuralgia are divided into two primary groups, namely: I. **Superficial**; and II. **Visceral.**

I. **Superficial.**—These include the following:—

(*a*) *Trigeminal neuralgia. See* TIC DOULOUREUX.

(*b*) *Cervico-occipital neuralgia.*—The posterior branches of the first four pairs of spinal nerves may be affected, but it is that of the second, the great occipital, which is most important, from its size, and the frequency with which it is attacked. Shooting pains start from just below the occiput, and run over the back and top of the head, sometimes into the external meatus, and often to the front of the head and face. Giddiness, noise in the ears, and some confusion of ideas are often associated, and frequently cause cervico-occipital neuralgia to be mistaken for commencing organic disease of the brain. It may begin by such acute tenderness of the scalp as makes it an agony to brush the hair.

(*c*) *Cervico-brachial neuralgia.*—The nerves of the brachial plexus and the posterior branches of the four lower cervical nerves are here concerned. The pains affect the neck and shoulders, or shoot down the arm to the hand, in the course of one or more of the nerve-trunks. Painful points may be found in the axilla, over the upper part of the deltoid, at the bend of the elbow, three inches above it externally, in the groove between the inner condyle of the humerus and the olecranon, at the ulnar side of the annular ligament, and where the radial nerve becomes superficial. The ulnar nerve is that most often affected, but the neuralgia usually spreads to other trunks. This form of neuralgia is sometimes associated with the presence of carious teeth.

(d) *Dorso-intercostal neuralgia. See* Intercostal Neuralgia.

(e) *Lumbo-abdominal neuralgia.* Here the superficial branches of the lumbar plexus to the abdominal walls are affected. It is less common than intercostal neuralgia, but resembles it generally. The female sex is apt to be most affected. Tender points may be found close to the spine, at the middle of the crest of the ilium, in the hypogastric region, in the groin, and on the scrotum.

(f) *Crural neuralgia.*—This variety is almost always met with as a complication of sciatica, being rare by itself. Pain occurs in the front of the thigh and knee, and inner surface of the leg and foot. The long saphenous branch of the anterior crural nerve is most commonly affected. This form of neuralgia is not infrequent in hip-joint disease, where it is secondary to irritation of the branches of the obturator nerve supplying the joint.

(g) *Obturator neuralgia* affects the inner side of the thigh.

(h) *Femoro-popliteal neuralgia. See* Sciatica.

(i) *Coccydynia.*—Pain in the neighbourhood of the coccyx, more properly called *coccygodynia*, especially apt to occur in women, is sometimes, but by no means always, due to neuralgia of the coccygeal plexus. *See* Coccygodynia.

II. **Visceral.**—(a) *Cardiac.*—A certain portion of the class of cases called angina pectoris depends upon cardiac neuralgia (*see* Angina Pectoris). There is sudden severe pain at the lower end of the sternum, darting to the back and down the left arm, or it may be diffused over the chest and affect both arms. The heart feels as though it were grasped, the face loses colour, the pulse becomes altered in character, there is cold sweating, and generally the aspect and feeling of approaching death. Such attacks may be confined to two or three repetitions, or there may be a constant tendency to their recurrence under circumstances of fatigue or strong emotion.

(b) *Uterine and ovarian neuralgia.*—Pain attendant upon menstruation, independent of any mechanical difficulty, is thus named. It may be excited by such sources of peripheral irritation as ascarides, leucorrhœa, renal calculus, prolapsus uteri, tumours, ulceration of the cervix, or impaction of fæces; or the sources may be in some distant part of the body. Ovarian neuralgia may be accompanied by congestion of the ovary.

(c) The *urethra*, *bladder*, *rectum*, *kidney*, and *testis* may each be affected by neuralgia. The last-named may result from self-abuse, or be consequent upon renal concretion. *See* Nephralgia.

(d) *Gastralgia.*—Abdominal neuralgia is characterised by intensity of colicky pain, occurring in paroxysms, in circumstances differing from those which induce ordinary dyspepsia. There is nearly always a history of neuralgia in some other part of the body. Vomiting sometimes, and constipation invariably, accompanies the attacks. *See* Gastralgia.

Complications and Sequelæ.—Neuralgia when it attacks mixed nerves may produce muscular powerlessness, which is not merely a shrinking from making muscular effort because of the pain attending it, but a temporary paralysis. Or there may be spasm of muscles. Long-continued neuralgia is attended by more or less atrophy of the muscles supplied by the affected nerves, which may be temporary, or, in cases where frequent recurrences of the attack take place, may be permanent. Certain forms of neuralgia, especially that of the first division of the fifth, intercostal, and sciatic nerves, are liable to be accompanied by a herpetic eruption. It is probable that these are cases of neuritis (*see* Herpes). Anæsthesia of a portion of the skin will often persist, though the pain itself may be absent.

Diagnosis.—It may be said perhaps that for pain to be strictly accounted *neuralgic* there should be no obvious cause for it, such as fever, local inflammation, tumour, or injury; it should be intermittent, or at least liable to great exacerbations, and independent of movement or any external agency; it should take the course of one or more nerves; and there should be spots painful to pressure in some of the localities already indicated. Neuralgia is distinguished from myalgia by the latter involving the attachments of a muscle, not occurring in paroxysms, but dependent upon movement; from aneurysm by careful physical examination, which is especially necessary when the pain is about the chest and loins. In chronic rheumatism the pain is diffused, and influenced by movement; and it does not affect the district of a particular nerve. Acute rheumatism is accompanied by elevation of temperature, sweating, and swelling of joints. The thermometer, and the known symptoms and signs of the several diseases, will usually at once exclude pleurisy, pneumonia, and peritonitis. Syphilitic periostitis is evidenced by the sight and touch, as well as (if it occur early in the disease) by the presence of febrile movement. Where pain in the back is supposed to be of neuralgic origin it is important to exclude the presence of hernia. Examination should be made *per vaginam* to exclude flexions or tumours of the uterus, and *per anum* for the presence of abscess about the rectum or of malignant disease. Organic disease of the brain must be excluded by the absence of local palsy, vomiting, intellectual disturbance, and optic neuritis. The pains of Bright's disease must be carefully excluded by search for albumen, signs of arterial thickening, and cardiac hypertrophy. Spinal irritation is accompanied by pains, which, however, fail to mark the district of particular nerves, and are vague and shifting. There is hyperæsthesia of the skin over some of the vertebral spines. Locomotor ataxy is characterised by pains of lightning-like rapidity, and neuralgic in character; but they shift, and are often accompanied by a staggering gait, sometimes by diplopia. Absence of the patellar tendon reflex (the quadriceps extensor muscle at the same time responding freely to faradisation and blows), observed along with shifting neuralgic pains, is a strong indication of locomotor ataxy. The pains of syphilis in its second stage may be distinguished by the presence of fever, usually also of a rash, and by the fact that they affect many parts at once.

Prognosis.—Youth, the absence of a strongly marked history of hereditary neurosis, the fact that neuralgia has followed exposures to unusual strain, violence, severe weather, or transient defects of nutrition, and that its attacks are influenced readily by treatment, afford a favourable prognosis. The onset of the disease after middle life, and its concurrence with signs of arterial degeneration, are unfavourable as regards cure. Neuralgia of itself can scarcely be said to affect the duration of life. On the whole, neuralgia of the fifth nerve is the most persistent.

Treatment.—In patients suffering from malnutrition the diet should be ample and nutritious, and should include a fair amount of the fatty element, in the form of cod-liver oil, butter, or cream. A little stimulant may sometimes be necessary—enough to promote primary digestion; but no attempt should be made to relieve pain by its direct agency.

Where rheumatism is suspected as a cause of the neuralgia it should be treated by salicylate of sodium in twenty-grain doses three or four times a day. Two or three grains of iodide of potassium with fifteen of carbonate of sodium, taken every four hours, will often remove neuralgic pain connected with rheumatism. When malaria is suspected, it is well to follow up this treatment by quinine in doses of from five to ten or twenty grains twice a day. A mercurial purgative may be usefully combined with a dose of quinine. If there be syphilis, iodide of potassium in ten-grain doses three times a day must be had recourse to; if gout, the acetic extract of colchicum may be given in one-grain doses twice daily, coupled with saline purgatives, especially Carlsbad natural salts. The salicylate of sodium is even more useful in gout than in rheumatism. It should be given in doses of twenty or thirty grains repeated two or three times a day. Even where there is no history of malaria quinine will often be very useful, especially in neuralgia of the first division of the fifth (*see* Tic-Douloureux). The liquor arsenicalis, in doses of ♏iij, increased cautiously to ♏viij or ♏x, and the tincture of steel, in doses of ♏xxx, largely diluted with water, may sometimes be used with advantage; and the latter will occasionally succeed even when there are no ordinary signs of chlorosis. As anæmia may exist with a well-coloured face, the state of the gums and inner surface of the lower eyelid should be examined for undue pallor. Strychnine, in ♏iij to ♏v doses of the solution three or four times daily, is especially useful in gastralgia; and belladonna, in $\frac{1}{4}$ gr. doses of the extract or ♏x doses of the tincture, in neuralgia of the pelvic viscera. Seclusion from irritation of various kinds—movement, cold, noise, dazzling light, worry—should be carefully maintained in cases of trigeminal neuralgia. All sources of peripheral irritation, of which decayed teeth, foreign bodies under the skin, intestinal worms, and imperfectly fitting boots are examples, should be carefully searched for, and where practicable removed. If lead be suspected, the drinking-water should be tested, and if the mineral be found iodide of potassium may be administered. Removal from imperfectly ventilated rooms, or from exposure to noxious gases, is essential. A warm, dry climate, such as Egypt or Algeria, will often cure when all other remedies have failed. For immediate relief morphine may be injected hypodermically, either near the seat of pain, or in an indifferent part of the body. It is best used pretty freely diluted, ♏iij of a solution of acetate of morphine, 1 to 30, being commenced with, and repeated, if necessary, when the pain returns. This dose may be gradually increased to one of ♏xv, but an effort should be made to do with as little as possible and to avoid narcotic effects. The following pill is often useful: ℞ Quininæ Sulphatis gr. j, Ferri Tartarati gr. ij, Morphinæ Acetatis gr. $\frac{1}{12}$; repeated every hour or two when the onset is expected.

In all forms of neuralgia considerable relief may often be obtained by the use of small blisters (size of a florin), applied in the neighbourhood of the principal focus of pain, one following another at intervals of two days, not on but near the already blistered surface. The continuous current, derived from a sufficient number of cells of a battery to cause a characteristic feeling of burning, may be so applied that the affected nerve is as completely as possible included in the voltaic circuit. Sponges, or leather-covered metallic disc electrodes, moistened with warm salt water, should convey the current, and be kept firmly pressed upon the skin for about ten minutes; or, whilst one is still, the other may be slid along so as to linger in turn upon each focus of pain. To avoid shock the circuit should not be broken by the lifting of an electrode till the battery is 'let down' to zero. If relief be afforded, the application may be repeated many times a day. No notice need be taken of the position of the poles (+ and −), the object of the proceeding being simply to alter the electric tension of the tissues which are made to form part of the circuit. The method is often disappointing in its results.

In rare instances, but especially in ovarian neuralgia, the hypodermic injection of atropine ($\frac{1}{120}$ gr. to $\frac{1}{60}$ gr. of the sulphate) may prove serviceable. Where there is great restlessness and irritability of the nervous system, bromide of potassium in thirty-grain doses two or three times a day should be used. Relief, in slight cases of neuralgia, is obtained by applying to the skin such liniments as the following: ℞ Chloroformi ʒss, Tincturæ Opii ʒss, Linimenti Belladonnæ ad ℥iij; or ℞ Spiritûs Ammoniæ Aromatici, Ætheris, Tincturæ Opii, Spiritûs Vini Rectificati āā ʒj. Aconite and veratrine benumb the sensory nerves, but they are uncertain remedies and very apt to cause irritation.

Phenazone in doses of five grains every half-hour, or from ten to twenty grains every four hours, is often very useful in neuralgia. An injection of from half to a grain of hydrochlorate of cocaine at the seat of pain will scarcely ever fail to produce at least temporary relief. Phenacetin in doses of from four to ten grains in cachets will frequently be of service. Exalgin may also be tried in doses of from two to four grains. The extract of cannabis indica, in doses of $\frac{1}{4}$ gr. frequently repeated, will sometimes produce great assuagement of suffering.

In unusually severe cases, which have lasted over years, a portion of the nerve may be excised; or, what is better, the nerve, which has been exposed by an incision, may be lifted from its bed and so firmly pulled upon as to be stretched (*see* NERVES, Diseases of). Very satisfactory results have sometimes followed this procedure. In a case, treated by the writer, of terribly severe neuralgia of the first two divisions of the fifth nerve, the operation was performed on each division of the nerve in turn, with immediate and, as far as is known, permanent relief from pain. Some time after the cure of a neuralgia there may be threatenings of a revival (dull heaviness, with tenderness of the part) following great fatigue or worry, but not immediately amounting to anything. Sleep is the best remedy for this condition, and this, if necessary, may be aided by giving ten grains of chloral hydrate.

For the treatment of coccygodynia, *see* COCCYGODYNIA.

T. BUZZARD.

NEURASTHENIA (*νεῦρον*, nerve; *ἀ* priv.; and *σθένος*, strength).

DEFINITION.—A term coming lately into use to describe a peculiar form of disease, sometimes spoken of as 'nervous exhaustion,' which has been comparatively little studied, is hardly described in our text-books, but which is of immense importance, and gradually increasing frequency. The name has, and with good reason, been objected to on account of its associations, and yet no better one has been proposed. The thing itself is a very stern reality; it leads to untold misery to the patient and to all connected with her, and it requires laborious clinical investigation. Provisionally, therefore, since some name is essential, this must be used until a better is suggested.

SYMPTOMS.—The symptoms are protean, and vary so much in different cases that no accurate description of them can be given. They are very different, in the majority of cases, from those of 'hysteria' as it is generally understood, although no doubt 'hysterical' symptoms often co-exist. Many of the cases occur in clever, emotional, but not fanciful women, who would give all they possess to be well, and heartily long for good health, if they only knew how to obtain it; and in such cases the disease is as far removed as possible from the condition known as 'hysterical.'

In a large proportion of cases the origin of the illness can be distinctly traced to some cause injuriously affecting the nervous system, such as the loss of a near relative, monetary reverses, disappointments in love, or overstrain—of late so common in the modern system of high-class education in women. In the cases, comparatively rare, but still occurring from time to time in men, a similar origin from the vexations and strains of business affairs is often observed.

The disease is not, as a rule, suddenly established, but is the gradual outcome of deteriorated health. No distinctive or invariable symptom can be mentioned, but eventually there is a continuous inability for any exertion, a constant feeling of weariness and fatigue, until at last all effort is given up, and the patient gradually lapses into a bed-ridden or sofa-ridden invalid.

The appetite fails, all sorts of vague dyspeptic discomforts—flatulence, constipation, and the like—develop; and general, often excessive, emaciation is a common condition. There is, however, a well-marked, although less common, class of case, in which, along with all the symptoms of general weakness above referred to, there is a deposit of much unwholesome fat in the subcutaneous tissues, giving the patient a bloated, anæmic, and very unhealthy appearance. The urine is pale, of low specific gravity, loaded with phosphates, with a diminished amount of urea, and sometimes a slight trace of albumen. Other vague nervous symptoms are present, especially sleeplessness, and various vaso-motor disturbances, such as palpitation and the like. Mental and emotional symptoms are pretty sure to be developed sooner or later, and are generally fostered by the use of drugs, constant fruitless attempts at cure, the habitual resort to chloral and other sedatives, and above all by the well-meant but often highly injudicious attentions of over-anxious relatives, nurses, and, it must be added, doctors, which are rarely wanting.

Closely allied to this form of illness, and more properly termed hysterical, are a most important class of cases, in which there is a distinct imitation of real disease. Amongst these may be mentioned the so-called 'hysterical apepsia' of young girls, associated with most marked emaciation, loathing of food, and a strange unrest, leading to exhaustion of the ill-nourished muscles, or various forms of mimetic disease, such as paresis of the limbs, actual hysterical paralysis, hysterical vomiting, and the like. These, however, it is beyond the province of this article to dwell upon (*see* HYSTERIA). If the history of such cases be studied, it will be found that they shew a lamentable record of fruitless attempts at cure. The patients have exhausted the merits of all sorts of health resorts, hydropathic establishments, and medicines; they have consulted a whole phalanx of doctors; and in spite of all this they have gone steadily down-hill.

TREATMENT. — To Dr. Weir Mitchell of Philadelphia undoubtedly belongs the merit of systematising a method of dealing with such cases, based on a common-sense appreciation of their causes, which renders them no longer an *opprobrium medicinæ*, but makes their recovery as nearly certain as anything medical can be, provided only that the cases are properly selected, and the treatment is intelligently and thoroughly carried out. About this 'Weir-Mitchell' treatment, as it is often called, there is no mystery. It is essentially a systematised plan by which the weakened body is placed in thorough condition, by means of continuous rest, enforced feeding, and regular muscular waste produced by massage, which enables food to be taken and assimilated.

The essentials of this method are :—

1. Complete rest, the patient being placed in bed and kept there during treatment; and it should be a *sine quâ non* that this rest should not be in the patient's own house, but in a medical home or in lodgings, the friends and relatives, whose influence is often most injurious, being strictly excluded.

2. Regular muscular exercise to produce tissue-waste, by means of massage of the whole body, at first for ten minutes or a quarter of an hour twice daily, soon increased to an hour or an hour and a half. The influence of this is often misunderstood, and this treatment is frequently erroneously talked of as a 'massage treatment.' It should be borne in mind that massage is nothing more than a remedial agent, used for a specific purpose; that it is not the most important part of the cure; and that, used alone, and without enforced rest and over-feeding, as is unfortunately so often done, it cannot possibly be productive of any real good.

3. Feeding, which is *the most essential* part of the treatment. At first the patient should be placed on milk alone, about five ounces every third hour. Within a few days this is increased to ten ounces, so that at least two quarts are taken in twenty-four hours. Then, by degrees, solid food is added, so that within a fortnight the patient should be taking three large mixed solid meals daily, in addition to the milk, and often a cup of strong soup, with two teaspoonfuls of beef peptonoids added, twice daily as well. This exaggerated diet is continued for six weeks or two months, when it is gradually lessened, the massage also being discontinued, and the patient allowed to get up. In an average case the patient should gain from fourteen to twenty-three pounds during this time. It is strange to see how, with returning health, all invalid habits are lost, sleep becomes regular without drugs, the bowels cease to require assistance, and the whole appearance, and apparently even the nature, of the patient is altered.

At the end of the treatment, in most cases, it is advisable that the patient should go for a change, either on a sea voyage or abroad, so as to complete the cure. At any rate, she should not return to her family until her health is re-established.

It is obviously impossible to do more here than give the baldest outline of a method of treatment, the proper conduct of which requires much experience and involves great patience and trouble, but which gives results which are generally thoroughly satisfactory.

The essential point to remember is that no half-measures should be permitted: if this treatment is not carried out thoroughly and completely, it had much better not be tried at all.

W. S. PLAYFAIR.

NEURITIS (νεῦρον, a nerve).—SYNON.: Peripheral Neuritis; Perineuritis; Interstitial Neuritis; Fr. *Névrite*; Ger. *Nervenentzündung*.

DEFINITION.—Inflammation of a nerve, or of the fibrous sheath of a nerve.

Ætiology and Pathology. This process occurs sometimes as an idiopathic change, the origin of which is altogether obscure, as where it implicates some of the intercostal or other spinal nerves, and is then often associated with an eruption of *herpes zoster* in related regions of the skin. At other times, as in some of the cases when it attacks the facial especially, or the sciatic nerve, neuritis seems to be set up as a result of local exposure to cold (*see* Facial Paralysis; and Sciatica). Such forms of neuritis as these are commonly spoken of as 'rheumatic inflammations' of the respective nerves. Sometimes this appellation may be distinctly justified; but whether such changes have necessarily to do either with rheumatism or with a rheumatic predisposition seems, in many other cases, fully open to doubt.

Contusions or traumatic causes of various kinds may also set up inflammation in nerves. At other times a neuritis may be set up and spread along the nerves leading from some wound or sloughing sore. This latter condition of things has been found to exist in some cases of traumatic tetanus (*see* Tetanus). Or an inflammation already existing may spread from some contiguous structure to adjacent nerves, as when cranial or spinal nerve-roots become involved in the course of a meningitis.

The apparently idiopathic forms of neuritis, as well as those following upon exposure to cold, are specially prone to show themselves when certain predisposing causes have been for some time in operation. Among these some of the best known and most frequently operative are the gouty diathesis, the syphilitic cachexia, and the presence of diabetes; in each of which neuritis in some form or other is of common occurrence. Other more specific predisposing causes of neuritis exist in the presence of tuberculosis, of leprosy, of epidemic influenza, or of poisoning by lead or arsenic. Many of the toxic causes, in fact, which are most effective in the production of a multiple symmetrical neuritis of parenchymatous type (*see* Neuritis, Multiple) are also capable of inducing a localised neuritis of peripheral or interstitial type, such as we are now considering—and this may vary much in intensity and also in its degree of acuteness or chronicity.

Anatomical Characters.—Strictly speaking, we have mostly to do in this pathological state with inflammation of the sheath of the nerve, or of its interstitial tissues, rather than with changes in the nerve-fibres themselves. It is possible, of course, that the nerve-fibres in this condition may undergo some distinctive pathological changes; but what is at present known is, that the neurilemma, or connective-tissue sheath of the nerve (including its minute prolongations between and around separate bundles of nerve-fibrils), becomes much more hyperæmic than natural, and that on microscopical examination there is to be found, in addition to the increased vascularity, a multiplication of new tissue-elements and the presence of migrated leucocytes. These changes may cause considerable swelling of the nerve-sheath and of its prolongations, and thus may produce either mere irritation or more or less compression of the nerve-tubules, according to the amount of new elements which accumulate in or are produced within the nerve-sheath. So that degenerative or sub-inflammatory changes in the nerve-fibres may, at least, often be found co-existing as secondary or induced phenomena.

All such changes may be localised to particular regions, or they may extend more or less diffusely along the whole length of a nerve.

These ordinary inflammatory changes in nerves pass, in syphilis, by insensible gradations, to closely allied conditions in which nerves in the neighbourhood of some new-growth become actually infiltrated therewith, as in cancer, sarcoma, or leucocythæmia.

Symptoms.—The symptoms of neuritis will necessarily vary much according to the functions with which the affected nerve is concerned. There may be impairment of special or common sensibility, or pain may exist (referred to the peripheral distribution of the nerve), with more or less distinct tenderness along its course or at its point of emergence from some bony canal. In these cases the pain is generally paroxysmal and neuralgic in character, whilst the skin is hyperæsthetic, and perhaps shows some vasomotor or trophic changes. All these phenomena are well illustrated in diseases of the trigeminus (*see* Trifacial Nerve, Diseases of), and therefore need not be dwelt upon further here. Where a strictly motor nerve is implicated, there may be twitchings of the muscles to which it is distributed, followed by more or less distinct paralysis, and subsequently marked wasting of the affected muscles — conditions which are well exemplified in inflammations of the facial nerve (*see* Facial Paralysis). In the case of a mixed nerve being involved, both kinds of symptoms present themselves—that is, more or less severe pains and tenderness, with trophic symptoms, and distinct paresis or paralysis, with subsequent atrophy of the muscles to which the nerve is distributed. A detailed consideration of such phenomena would be needless here, as they are set forth in relation to inflammation in the sciatic nerve, under the article Sciatica; and also because all such symptoms and changes are likewise considered under the article Neuritis, Multiple.

There is, undoubtedly, an intimate relationship in many cases between different forms of neuritis and neuralgia affecting similar sites; the reader may, therefore, be further referred to the article NEURALGIA for additional information.

TREATMENT.—The treatment of neuritis is both general and local. The general treatment is of especial importance in cases where the condition seems attributable to the influence of syphilis, and then the administration of small doses of perchloride of mercury, in combination with large doses of iodide of potassium, will often produce marvellously beneficial results. Smaller doses of iodide of potassium alone, or with colchicum, are to be given in other cases, in which rheumatism or gout may seem to be one of the factors in exciting the nerve-inflammation. But in these cases, and also in those which are simple results of exposure to cold, the cure may be often expedited, and the patient also temporarily relieved, by local treatment, such as the application of a few leeches (especially in the early stages), hot fomentations, or small flying blisters.

During the course of the treatment special symptoms may become all-important. Thus, pain may become so agonising as imperatively to demand measures for its relief; and, where paralysis is one of the symptoms, galvanism or massage (or perhaps both) must be employed daily, or two or three times a week, in order to prevent as much as possible the muscles from degenerating whilst the pathological condition in the nerve is being cured —that is, in cases in which a cure is possible. All these indications, however, will be found more fully considered under the articles SCIATICA; and NEURITIS, MULTIPLE.

H. CHARLTON BASTIAN.

NEURITIS, MULTIPLE.—SYNON.: Polyneuritis; Peripheral Neuritis; Fr. *Paralysies Périphériques*; Ger. *Multiplex Neuritis*; *Neuritis Acuta Progressiva.*

DEFINITION.—A nervous affection characterised by various motor, sensory, and trophic symptoms; dependent upon disease occurring simultaneously, or in rapid succession, in the peripheral terminations of nerves in various parts of the body, under the influence of extrinsic or intrinsically derived toxic agents of one or other kind.

This is a very important affection, concerning which our knowledge has been very greatly increased during the last twelve years. On its clinical side only the affection has, however, been much longer recognised. The first to describe the symptoms of its most common form seems to have been Lettsom, in his *History of Some of the Effects of Hard Drinking*, published in 1789. Other merely clinical descriptions of different forms of the disease were given by J. J. Jackson of Boston, in 1822, and by Chomel in Paris, in 1828; but the first case in which a widespread disease of peripheral nerves was found at a necropsy as a cause of sensory, motor, and trophic troubles was not recorded till 1864, and then by Duménil of Rouen. After an interval other cases were published, and in 1881 an important memoir was issued by Leyden, since which date our knowledge of the whole subject has rapidly increased. The gain thereby to practical medicine has been great, since it has enabled us to recognise many frequently recurring affections which were formerly either not at all or very imperfectly understood, and which were for the most part vaguely referred to affections of the spinal cord. It has shown us, further, how to recognise the symptoms due to peripheral neuritis, which occur not infrequently as complicating conditions in the course of such affections of the spinal cord as locomotor ataxy or acute spinal paralysis. The great diversity of the symptoms met with in multiple neuritis was doubtless one of the main causes accounting for the late recognition of the real nature of affections which are now found to be of such common occurrence. Moreover, as our knowledge of affections of the spinal cord became more complete, there was also naturally a disposition to look beyond it for the causes of symptoms which, in spite of our present highly refined methods of examination, could not be traced to changes in that organ.

ANATOMICAL CHARACTERS.—The morbid changes that occur in the nerves in this disease are met with principally at their finer terminations, or, it may be, even exclusively there. Where the larger branches of the nerves are also involved, the intensity of the process generally diminishes as we recede from the periphery. A second peculiarity is that the changes are most frequently symmetrical on the two sides of the body, whether the nerves affected be in the limbs, where they are by far the most frequently involved, or in other parts. A third peculiarity is that the inflammatory or degenerative changes are found to occur essentially in the nerve-fibres themselves, rather than in their sheaths or interstitial tissues: or, in other words, that the inflammatory changes are in the main parenchymatous, rather than interstitial as they are in simple neuritis. Of course these two kinds of change do not occur singly in either case, but in multiple neuritis it seems plain that the parenchymatous changes are distinctly in excess, and they are believed also to be primary rather than secondary degenerative changes due to strangulation of the nerve-fibres higher up, as some have imagined. Though primary parenchymatous changes may be the rule, we may still admit the occurrence also of secondary degenerative changes in the nerve-fibres.

The naked-eye changes in the appearance of the nerves may not be great: that depends in part upon the amount of co-existing inflammation in their connective-tissue envelopes, and in part also upon the severity and duration of the inflammatory process in the nerve as a whole. But even where they are not notably swollen and hyperæmic, the nerves may be deficient in their proper lustre, and irregular in contour, owing to accumulations of fat derived from degenerated myeline; or, in later stages still, they may be wasted and reduced to mere connective-tissue strands. It may often happen, however, that no very appreciable changes are to be detected by the naked eye, and that, in order to establish the existence of multiple neuritis, the finer branches of the nerves have to be dissected out and submitted to careful microscopical examination.

Where changes exist in the sheath and interstitial tissues of the nerves, they are such as have already been described in the article NEURITIS, consisting in the main of increased vascularity, some amount of exudation of serum, migration of leucocytes, and multiplication of nuclei in the sheath of Schwann and elsewhere. The distinctive changes that occur in multiple neuritis are, however, those which take place in the nerve-fibres themselves. These agree in almost all respects with the changes that occur in the 'secondary degeneration' of a nerve on the distal side of a section or other severe injury. The myeline first becomes cloudy and granular, and then undergoes segmentation—first into large and subsequently into smaller and smaller masses, until at last there is left only a number of fatty-looking globules and particles surrounding the swollen and altered axis-cylinder. As this process advances, the sheath of the nerve gives way here and there; surrounding cells swell, and, taking up the fatty particles, become converted into 'granulation-corpuscles'; whilst ultimately the axis-cylinder may be more or less completely destroyed. These changes may be most easily displayed by Ranvier's process, which consists in soaking some of the slightly teased or dissociated nerve-fibres in a 1 or 2 per cent. solution of osmic acid, which colours the myeline black and fixes it. The nerves are then to be placed for some hours in a solution of picro-carminate of ammonium, which will colour the nuclei and axis-cylinders left unstained by the osmic acid. Larger branches of nerves may be best examined when hardened and embedded, so that transverse sections can be cut. Then the two kinds of change will come well into view with the aid of the microscope—that is, more or less of alteration in the sheath and interstitial tissues, together with the atrophic conditions of the nerve-fibres themselves. Comparison with sections of a healthy nerve will help to render these changes very obvious.

However extreme the changes in the nerves may be, it is now certain that, in periods of from six to twelve months or more, complete regeneration may take place, just as it has been observed to occur in experimental lesions in the lower animals. New axis-cylinders become formed in continuity with the old, and these subsequently become surrounded with sheaths of myeline. Thus it is that the prognosis in a given set of symptoms caused by peripheral neuritis is so very much better than it would be if the symptoms had been dependent upon similarly severe lesions occurring in the spinal cord itself.

Atrophic degeneration of muscles, in relation with the affected nerve, progresses *pari passu* with the changes in the latter. The muscle-fibres waste from the occurrence of fatty and granular degeneration, while the nuclei of their sheaths multiply, and hyperplasia of tissue-elements also takes place in the intervening connective tissue.

Occasionally in some of the worst cases, in which death has occurred, it has been established that small changes of different kinds occur also in the spinal cord. Such changes have been found more especially in the cases of multiple neuritis caused by alcohol, lead, arsenic, diphtheria, and chill; but they may well occur also where multiple neuritis follows in the wake of other causes. The changes met with have, for the most part, consisted of atrophic conditions in the great ganglion-cells of the anterior cornua, together with some amount of overgrowth in the surrounding neuroglia.

In addition to these more or less essential changes, other morbid conditions might be expected in internal organs, varying widely in their nature in different cases, in accordance with the varying conditions under the influence of which the multiple neuritis has been established; that is, we may meet with visceral changes due to previous alcoholism, to malarial poisoning, or to some antecedent acute specific disease, as the case may be.

ÆTIOLOGY AND PATHOLOGY. — The best-known forms of this disease are undoubtedly due to the action of poisons circulating in the blood upon the peripheral terminations of nerves in different parts of the body, and especially upon those of the extremities. The evidence of this mode of causation is so strong for so many forms of the affection, that it is now pretty legitimately conjectured to be, in one way or another, applicable to all of them that they are, in fact, all toxic forms of paralysis, though capable of being arranged into different groups according to the nature, or the mode of production, of the toxic agencies in question. From this point of view the best-attested causes of multiple neuritis may be roughly classified in the following manner:—

A. *Poisons of Extrinsic Origin.*—Alcohol; Bisulphide of Carbon; Arsenic; Lead.

B. *Poisons evolved by Microbes associated with various Infective or Endemic Diseases.*—Diphtheria; Variola; Typhoid;

Fever; Typhus Fever; Measles; Beriberi; Septicæmia; Malaria; Influenza; Tuberculosis; Syphilis; Leprosy.

C. *Poisons evolved during Metabolic Processes occurring in some of the Organs and Tissues of the Body itself.*—Chill; Excessive Muscular Exercise; Diabetes mellitus; Gout; Cachectic states; Idiopathic or 'Spontaneous' Cases.

The cases belonging to (A) the first category supply, of course, the clearest evidence that multiple neuritis is due to the presence of poisonous substances circulating with the blood, and thus exerting an irritative influence on the peripheral nerves. The diseases comprised in (B) the second category, in the course of which, or as sequences of which, multiple neuritis has been found to occur more or less frequently, are all of them associated with the growth and multiplication of micro-organisms either in the blood or in some parts of the body. Under such circumstances it is well known that alkaloidal substances of a poisonous nature (toxines) are more or less abundantly produced, as excreted products, during the life-activity of the micro-organisms, which substances, finding their way into the blood, may act upon the peripheral nerves in much the same manner that alcohol does. It is well known that such effects do not occur in all cases, but only in a comparatively small proportion of the cases of each of these diseases. We must, therefore, suppose that, in the cases in which multiple neuritis is produced, there has either been some variation in the nature of the poisons finding their way into the blood, or else that the ordinary poisons associated with the several diseases are aided by the co-existence of one or more favouring conditions. In regard to the third category (C) of cases, in two of them at least it is known that the blood is especially apt to be altered in composition, and to contain products which may exercise an irritative influence upon the peripheral nerves in some parts of the body. The excess of uric acid in the blood may operate in this way in gout; while in diabetes the irritative effects upon the nerves are not supposed to be due to the presence of an excess of sugar in the blood (since the frequency of the association of the disease with neuritis bears no regular relation to the amount of sugar contained therein), but rather to the presence in the blood of some other acid or ethereal products (derivatives of β-oxybutric acid), such as are known to occur at times in association with diabetes. It seems perfectly certain, also, that some of the cases of multiple neuritis are set up after exposure to chill and cold; just as, in other subjects, acute spinal paralysis may be engendered under similar conditions. These are the cases of so-called 'rheumatic' origin; and it is conjectured that in them some poisonous product is formed within the system, as a result of the chill, which, according to individual proclivity or the nature of the products engendered, excites either multiple neuritis or acute spinal paralysis, or it may be both; just as, under other individual conditions, the malady excited is an acute articular affection, or an acute inflammation of some other internal organ. Lastly, in certain cachectic or anæmic states of the system there is a tendency to the occurrence of neuritis; and perhaps it is principally to this kind of causation or to the occurrence of slight exposure to cold that we may ascribe the so-called idiopathic or 'spontaneous' cases of multiple neuritis—that is, cases for which no very distinct cause of a toxæmic character can be assigned.

If we omit the ætiologically obscure cases last referred to, it will be seen that all the conditions under which multiple neuritis is prone to occur are states of the system in which poisons of one or other kind would be circulating with the blood; and such a mode of origin for the inflammatory condition of the nerves is rather confirmed by the fact of the remarkably symmetrical distribution of the neuritis that is so commonly met with in these cases, and to which reference has already been made.

We must not omit to mention, moreover, the fact of the relation supposed to exist between Raynaud's disease and peripheral neuritis. Whilst referring to the article on that disease (*see* RAYNAUD'S DISEASE) for further information, it need only be said here that multiple neuritis may or may not show itself as an epiphenomenon rather than as an essential constituent of this remarkable morbid condition.

Then, again, it should be said that 'acute ascending paralysis' (Landry) has been held by some, and especially by the late Dr. Ross, to be one of the idiopathic forms of multiple neuritis. From the clinical point of view there is undoubtedly much to be said in support of this doctrine, but the proof of this position has yet to be established by future clinico-pathological investigation. *See* SPINAL CORD, Special Diseases of.

Multiple neuritis occurs with all degrees of severity, not only at different times under the operation of the same kind of cause, but also very notably under the influence of the different causes that have been above enumerated. The latter difference is so striking that the several causes above referred to may, from the point of view of the average intensity of the multiple neuritis that they are prone to cause, be divided into two classes, as follows:—

Causes of more Intense Forms of Multiple Neuritis.—Beriberi; Alcohol; Chill; Diphtheria; Variola; Excessive Muscular Exercise; Typhus Fever; Typhoid Fever; Measles; Influenza.

Causes of Slighter Forms of Multiple

Neuritis.—Bisulphide of Carbon; Lead; Arsenic; Malaria; Septicæmia; Tuberculosis; Syphilis; Leprosy; Diabetes Mellitus; Gout; Cachectic states.

The cases of multiple neuritis that occur under either of the first class of causes may be, and often are, well-developed typical forms of the malady; those, on the other hand, which occur from one or other of the second class of causes are much more habitually ill-developed and more or less localised forms of the affection, and in some of these cases (especially those associated with leprosy, syphilis, or gout) it is the sheath and interstitial tissues of the nerve, rather than the nerve-fibres themselves, which are most prone to be affected. In these cases, also, the inflammation is often not limited to the peripheral twigs, but may involve the main trunks and the roots of the nerves. In all respects, indeed, there is in these cases often more the characters of a local neuritis than of the more general affection.

It should be borne in mind, again, that in many of the cases of multiple neuritis there may have been more than one cause in operation; thus, alcohol and anæmic conditions of the system or syphilis may co-operate with tuberculosis; chill or lead with alcohol; or local exposure to wet and cold may reinforce syphilis or gout in the production of some of the more localised forms of multiple neuritis.

In the more intense forms of the affection lesions may occur in the spinal cord as well as in the peripheral nerves. This is notably the case in some of the 'rheumatic' forms of the disease, and in some of the cases due to lead, diphtheria, or some other of the acute specific diseases. Neither in the more intense nor in the more localised forms of the disease are we able definitely to bridge the gap which lies between our knowledge of the ætiology and that of the morbid anatomy of this affection—we are unable to say anything definite, that is, as to the exact pathogenesis of the changes in the peripheral terminations of the nerves or in the spinal cord. No light whatever is really thrown upon this obscure subject by the hypothesis that functional changes in spinal trophic centres first occur, which lead secondarily to the observed failure or perversion of nutrition in the peripheral nerves. It would only shift the difficulty farther back, even if this hypothesis explained (which it does not) the localisation of the changes in the nerves to their peripheral terminations. As it is, we can only suppose that the tissues affected, and the particular parts of them, are, by their individual constitution, especially prone to be irritated by the presence in the blood of the various poisons to which we have referred.

Multiple neuritis from one or other of the causes mentioned may occur at almost any age; but the disease is by far the most frequently met with some time between the twentieth and the fiftieth year.

Some separate description or mention must now be made of the different forms of multiple neuritis.

A. **Cases due to Common Poisons.**—*Multiple neuritis due to Alcohol.*—This is the commonest of all the forms of multiple neuritis, and it is met with also much more frequently in women than in men. Spirit-drinking seems to be most prone to excite it, and especially when spirit is taken in small or moderate quantities continuously over long periods, and when at the same time there has been little exercise in the open air. Whilst alcoholic neuritis is more common among women, delirium tremens is more frequent among men—differences which may be dependent partly upon sex, but perhaps more notably upon the different habits of the two sexes, especially in regard to extent of open-air exercise.

Symptoms.—The onset of the affection is generally gradual, being often preceded for months or weeks by gastric symptoms, insomnia, and rapid pulse, together with numbness and tingling, shooting pains, tremors, cramps, and some paresis of the limbs—especially of the lower limbs. Actual loss of power may then come abruptly at any time, at first in the feet and legs, later on in the thighs—though, often before they become involved, the hands and arms also show signs of paralysis, which is most marked in the extensors of the wrists. In many instances the paralysis may stop here; but in the more severe cases it gradually advances so as to involve the nerves supplying the trunk muscles, some of the cranial nerves, and at last perhaps the phrenic nerve.

The 'dropped wrists,' and the 'dropped feet' as the patient lies in the recumbent position, are very characteristic of multiple neuritis; and the paralysis of the limbs is almost always of the flaccid type. The affected muscles speedily become flabby and much wasted. When in this condition they show a more or less modified electrical 'reaction of degeneration.' They usually cease to respond to faradism; and if they respond at all to galvanism, it is only to very strong currents, and that in a slow, sluggish manner, the reaction to A.C.C. being greater than that to C.C.C. In some exceptional cases, and in the early stages of the affection generally, the electrical reactions may be very little altered.

Various disturbances of sensibility cause the greatest distress to the patient. The limbs are often the seat of excruciating pains, the skin is more or less generally hyperæsthetic, and the muscles also in the affected parts are extremely tender, even to slight pressure. There is often, moreover, marked tenderness along the course of the nerves, so that the patient is apt to cry out when touched or moved even in the gentlest manner. In addition, various paræsthesiæ, such as tingling, numbness, and formication in the limbs, are mostly present. In the more severe cases these latter symptoms may disappear during the height of the malady, when anæsthesia becomes developed, but may be expected to return as recovery advances. With cutaneous anæsthesia of the limbs, often localised to the terminal portions or to the areas of particular nerves, there may also be more or less marked loss of muscular sense. Some of the special senses may also be affected, especially vision, leading to amblyopia and contraction of the field for colour-vision. Occasionally, also, inequality and slight contraction of the pupil has been met with, and very rarely optic neuritis. The cutaneous reflexes are often present, but may be lost where the anæsthesia is marked. The knee-jerks are commonly lost at an early stage of the affection; but occasionally, in exceptional cases, they are found to be retained, and even to be slightly exaggerated, for a time.

In many of the slight cases of the disease a certain amount of incoördination as well as paralysis can be recognised; and in the cases in which the involvement of the muscular sense is more than usually marked, a slight ataxic condition is produced in both the arms and the legs, but especially in the latter. This, in combination with other symptoms present, such as the pains in the limbs, the loss of the knee-jerks, unsteadiness when the eyes are closed, and a somewhat peculiar gait, causes the patient's condition to resemble more or less closely that met with in locomotor ataxy. Such cases are now spoken of as *pseudo-tabes*; and, although they may be met with in multiple neuritis from any other cause, they seem to be rather specially frequent in the alcoholic form of the disease. The points which enable us to distinguish these forms from true tabes will be referred to later under the head of 'Diagnosis.'

Vaso-motor and trophic symptoms occur in some cases about the feet and hands, in the form of œdema, lividity, glossy skin, and more or less profuse sweating. Later on, the limbs are still further altered, especially in old neglected cases, by the occurrence of contractures of the fingers and of the calf-muscles, due to weakness of the extensors. Bed-sores are usually absent; and power over the sphincters of the bladder and rectum is commonly retained.

In the early stages of alcoholic neuritis there is another class of symptoms of great importance commonly present, namely, those of cerebral type. These are sometimes most marked, and of a very varied character. There may be loss of memory, loss of ability to concentrate the attention, together with illusions and hallucinations—especially towards evening and at night, when insomnia is often most obstinate and very exhausting to the patient. In some cases there may be distinct delirium continuing for days; and, even where this is not present, there is often a peculiarly active imagination, together with a sort of waking dream-like state. Thus, patients will give circumstantial details of imaginary events in which they have taken part, or of visits which they have paid within the last hour or so, when they have been quite incapable of even leaving their beds. In the course of a week or so, under proper treatment, such symptoms will gradually subside. The patient will then (or earlier where the more acute symptoms are absent) show distinct evidence of a lowered *morale*. Statements about their habits in regard to alcohol are almost always unreliable, often flagrantly untrue, and made even in the face of the strongest evidence to the contrary. We must look to the relatives or the associates of the patient if we are to obtain correct testimony in regard to this matter.

The *course* of the disease in alcoholic neuritis is pretty constant, though its duration is extremely variable, according to the degree of severity of the attack. After a slow or more abrupt onset the symptoms go on increasing up to a certain point; then there is a decline of the more urgent symptoms in a gradual fashion; after this the patient may remain in a more or less stationary condition for many months; finally, a period of slow improvement sets in, during which the tenderness of the muscles abates, and their nutrition and power improve, the anæsthesia diminishes, and with it there is a return of numbness and tingling in the hands and feet. The duration of the disease varies from two or three months to from one to two years.

Multiple neuritis due to Bisulphide of Carbon.—Delpech was the first, and is still the principal, authority concerning the effects of bisulphide of carbon upon the system (*Nouv. recherch. sur l'intoxication spéciale*, Paris, 1860). He showed that the effects of this compound upon the system were somewhat similar to those of alcohol. The symptoms are principally met with in rubber-factory operatives. It appears that intense frontal headaches are common among workers in rubber, even though no further symptoms develop. As the intoxication proceeds, according to F. Peterson, 'giddiness and even actual drunkenness become manifest, the workpeople becoming excitable, talkative, and hilarious. Among later chronic manifestations are multiple paresis, due to a multiple neuritis, mental weakening and apathy, amblyopia, tinnitus, formication, anæsthesia of the feet, muscular cramps, occasionally convulsions, at first increase of sexual appetite, later impotence in men and sterility in women' (*Bost. Med. and*

Surg. Journ. Dec. 6, 1892, p. 325). In this same communication Peterson records three cases of acute mania resulting from inhalation of the fumes from a mixture of bisulphide of carbon and chloride of sulphur. The poisonous effects from the use of these chemicals are now obviated to a considerable extent by maintaining a more thorough ventilation in rubber factories.

Multiple neuritis due to Arsenic.—It has been long known, from experiments by Ortila, that in certain cases paraplegic conditions were induced occasionally after the taking of large doses of arsenic. Of late years it has been ascertained that the poisonous effects of arsenic are sometimes very similar to those produced by alcohol. The paralytic effects thus produced were previously ascribed to changes in the spinal cord; but it has now been ascertained that such changes are only occasional, and that the majority of the effects to which we are referring are due rather to peripheral neuritis. These effects occur sometimes, though only very rarely, after the patient has taken for a prolonged period small doses of arsenic, such doses at last giving rise to symptoms of acute poisoning. Then, after a variable interval—some days, or a week or two—the symptoms of peripheral neuritis begin to develop. In other cases, however, such symptoms may set in a short time after acute poisoning by arsenic, when the drug has been taken in excess either accidentally or with suicidal intent. A typical case of this latter type has recently been brought before the Medical Society of Berlin by H. Jolly. The patient had, in August 1892, taken with a view to suicide, a quantity of Schweinfurth green. There was immediate vomiting, and for two days symptoms of gastritis. She remained very weak, and noticed, when she attempted to rise on the fifth day, some numbness of the feet. Then followed paræsthesiæ simultaneously in feet and hands, with a creeping sensation that was at times very painful. These symptoms continued during the next few weeks, and to them were soon added a more distinct weakness, especially of the lower extremities. After four weeks the patient was unable to walk alone; and when, in the following week, she was admitted into the hospital for nervous diseases, she could only walk when supported on both sides. There was also marked ataxy. The knee-jerks were lost on both sides, and there was great paresis in the legs, with specially impaired movement in the feet and toes. In six weeks the paralysis of the feet and toes was complete; there was atrophy of the muscles of the calves of the legs, and great disturbances of sensibility. The patient was insensible to slight touches, but felt stronger touches well; and there was pronounced hyperalgesia. The tips of the fingers were quite anæsthetic, and there were sharp pains in the hands and in some of the deeper parts of the forearm and arm. In the course of the following week the symptoms became somewhat worse, especially the pains. A feeling of coldness was also complained of in the right upper extremity, and there was profuse sweating in the palms of the hands. From about the twelfth week onwards a decided improvement began to take place in regard to both motor and sensory symptoms.

The superficial reflexes in arsenical polyneuritis are mostly preserved, while the knee-jerks are lost; the legs also are commonly more affected than the arms. There is much variation met with in the symptoms of individual cases, and in some of them distinct impairment or loss of muscular sense and ataxic symptoms are fairly well marked (pseudo-tabes). In almost all respects, in fact, the symptoms of the multiple neuritis due to arsenic are found to accord closely with the alcoholic form of the disease, with the very important exception that the head symptoms, with hallucinations and delirium, are generally absent. Almost all cases ultimately recover, and the duration of arsenical polyneuritis is rather shorter than that of the form due to alcohol.

Multiple neuritis due to Lead.—The effects of the multiple neuritis caused by lead are still more localised. There is not only the absence of the characteristic group of head symptoms, but a still further common limitation of the neuritis to the motor nerves, and especially to those of the upper extremity. The ordinary effects of peripheral neuritis due to lead will be found described under LEAD, POISONING BY. The symptoms closely resemble those due to spinal-cord disease, to which, indeed, some of the effects are often partly attributable. For, though peripheral neuritis is the lesion commonly met with, it happens here even more frequently than with other forms of multiple neuritis that lesions in the anterior cornua of the spinal cord are also produced; and it is to these latter lesions that the symptoms are occasionally, in part at least, attributable.

But although it is the rule for the effects of the multiple neuritis due to lead to be thus limited to a part of the field of distribution of the motor nerves of the upper extremities, it is not invariably so. Thus, muscles about the shoulder and arm (especially the deltoid and brachialis anticus) may be affected as well as those of the forearm; and occasionally even some of the leg muscles, especially the long extensors of the toes and the peronei muscles. Again, in some cases of multiple neuritis due to lead there have been distinct disturbances of sensibility, that is, more or less severe pains, some tenderness of affected muscles, and perhaps also along the affected nerves, together with tingling and numbness in their field of distribution. In certain other cases of multiple neuritis due to lead we may have the association of a more or less marked hemiplegic condition, in which hemianæsthesia is well developed. This latter condition is generally of more or less brief duration, and is supposed to be due to some functional defect in the brain, analogous to that occurring in hysteria. In this connexion, it must not be forgotten, moreover, that intense double optic neuritis and also convulsions may occur in the course of lead poisoning.

B. **Cases due to Microbic Poisons.**—*Multiple neuritis associated with, or sequential to, certain Infective or Endemic Diseases.*—The cases belonging to this category are those forms of multiple neuritis which are associated with, or, as is by far the most common, are sequential to, one or other of the following morbid conditions, namely, diphtheria, variola, typhoid fever, typhus fever, measles, beriberi, septicæmia, malaria, influenza, tuberculosis, syphilis, or leprosy.

Almost all these varieties of the disease were formerly ascribed to morbid conditions, either functional or structural, of the spinal cord. It is true, indeed, that functional diseases as well as certain structural affections of the spinal cord, in the form of indurations (scleroses), softenings, hæmorrhages, together with limited inflammations or atrophic conditions of the anterior cornua, are especially apt to occur occasionally as sequences of one or other of these diseases. But since the clinical characteristics of polyneuritis have been more commonly appreciated, it has been recognised that these particular groups of symptoms occur not infrequently as sequences of one or other of the diseases above mentioned—the truth of this diagnosis having, moreover, been often confirmed by necropsies which have demonstrated the presence of multiple neuritis, mostly alone, but more rarely with some co-existing changes in the spinal cord.

The severity of the disease varies very much indeed in this category of cases. Sometimes it presents itself as an acute progressive affection involving all the limbs, and subsequently the nerves supplying the trunk muscles and those of the face and eyes, together with a well-marked association of sensory symptoms of the usually varied character. At other times, and especially after diphtheria, the motor paralysis is less marked, and symptoms of a more ataxic type present themselves (pseudo-tabes); while, in other cases still, we may have to do with a localised rather than with a more generalised neuritis. The forms of multiple neuritis associated with diphtheria are apt to occur, on different occasions, in each of these types; the severe general cases, however, in which death may occur from paralysis of the diaphragm are rare and exceptional; while localised forms of paralysis limited to the palate, and associated with slight paretic or ataxic conditions are by far the most common (*see* DIPHTHERIA). On the other hand, in beriberi we have to do much more frequently with a generalised form of neuritis, in which speedy death occurs not at all rarely (*see* BERIBERI). In other of these diseases, such as variola, typhus and typhoid fevers, measles, septicæmia, and malaria, polyneuritis supervenes rarely; but in each of these affections it may appear in a well-developed form.

Again, it seems clear that in influenza, tuberculosis, syphilis, and leprosy, in the absence of other co-operating causes, the neuritis that occurs is apt to present itself in a more or less localised form; and, in the case of syphilis and leprosy more especially, the neuritis is principally of the peripheral and interstitial type. These forms of the disease are thus, perhaps, rather more closely allied to ordinary neuritis than to multiple neuritis. Still, it seems probable that both syphilis and tuberculosis may decidedly favour the action of other more potent causes, such as alcohol or chill, in the production of well-marked multiple neuritis.

The only one of these forms of multiple neuritis to which any special reference need be made is that which may be associated with malarial poisoning. Sometimes this, either alone or aided by other causes, such as exposure to cold or excess of alcohol, induces ordinary forms of multiple neuritis of medium severity, affecting the arms and legs, but especially the latter. At other times, however, malaria gives rise to what since the description given by Romberg has been known as 'intermittent paraplegia.' This remarkable affection has been found to occur only in patients suffering from malarial poisoning. It is characterised by the sudden onset of paralysis in the lower extremities, which may or may not be accompanied by some anæsthesia and paralysis of the sphincters. After some hours the paralysis disappears, perhaps accompanied by the appearance of a critical sweat, and reappears in a more or less regular manner, according as the attack assumes a quotidian, tertian, or quartan type. This affection has been found to be very amenable to treatment by quinine. Cases have been recorded by excellent observers, such as Hartwig, Erb, and Westphal, and it is now generally believed that, instead of being due to altered functional conditions of the spinal cord (which was the interpretation formerly given), this remarkable transitory and recurrent form of paralysis is dependent rather upon a peripheral neuritis occasioned by some poison formed during the course of a malarial attack.

C. **Cases due to Autogenetic Poisons.** *Multiple neuritis sequential to Chill.*—The disease from this cause not infrequently supervenes in an acute fashion, and may at the onset be associated with distinct febrile symptoms, the temperature rising to some point between 101° and 103°. There may also be pains in the back, limbs, and joints, so as to give rise to the suspicion perhaps of a commencing attack of rheumatic fever. To such symptoms may be added headache and anorexia, together with tingling and numbness in the fingers and toes, and more or less tenderness over the principal nerves in the limbs. The legs and arms subsequently show an increasing paralysis, commonly beginning first in the legs. Then paralysis may spread to the trunk muscles, and to those of the tongue, palate, and larynx (so as to impair deglutition and articulation), even if it does not extend to other cranial or to the phrenic nerves. The knee-jerks are speedily lost, the paralysed muscles soon waste, and their electrical reactions become altered in the usual manner. At the same time various sensory disturbances become developed, such as tenderness of the muscles and hyperæsthesia of the skin (soon to be followed by, or intermixed with, areas of anæsthesia); while glossy skin, increased sweating, and other trophic symptoms may also make their appearance.

These cases subsequently pursue much the same course as severe cases of alcoholic neuritis. Death may occur in the course of a week or ten days from respiratory or cardiac paralysis; or, all fever having subsided, the patient may remain in a tolerably stationary condition for several weeks, before the usual slow improvement begins to set in.

In other instances the multiple neuritis following chill may be less acute and less severe, and the amount of sensory symptoms is very variable. When the latter are very slight, such cases are apt to be mistaken for those of acute spinal paralysis; and when they are more severe (especially where there is much involvement of the muscular sense) the symptoms are more of an ataxic order, so that the case may present itself as a form of pseudo-tabes.

Multiple neuritis sequential to excessive Muscular Exercise.—Although typical cases have been recorded, verified by necropsy, seemingly referable to this cause, they are nevertheless of extremely rare occurrence. So far as the form and course of this variety of multiple neuritis are concerned, it seems to agree most closely with that induced by chill, and different cases are liable to individual variation in much the same manner.

Multiple neuritis associated with Diabetes, Gout, or with Cachectic States.—Each of these varieties of multiple neuritis is liable, though only very rarely, to occur as a more or less generalised affection. As a rule, however, it is much more common for the neuritis when associated with either of these affections, and when other co-operating causes are absent, to occur in a limited form, affecting only some one or two nerves—the inflammation that is established being also peripheral and interstitial rather than parenchymatous in type. Gout has been long known as a common predisposing and even exciting cause of ordinary interstitial neuritis.

Multiple neuritis of 'spontaneous' origin. Every now and then ordinary attacks of multiple neuritis, sometimes severe and sometimes slight, make their appearance without its being possible to assign them to any of the known causes of the disease, and for which, in fact, no distinct cause can be traced. These are the so-called 'spontaneous' or idiopathic cases of multiple neuritis.

Complications.—Looking to the varied conditions under which multiple neuritis may arise, it is only natural to expect that the complications should be rather numerous; and this they are found to be. As poisoning by alcohol is the cause of so very large a proportion of the cases of multiple neuritis, we have principally to do with concurrent complications assignable to this cause. Thus the patient may suffer from obstinate symptoms of gastric catarrh, or the liver may be enlarged and hard, or smaller than natural, and other indications of cirrhosis of this organ may exist. It must not be forgotten, moreover, that in the cachectic subjects of chronic malarial poisoning there may be enlargement of spleen as well as of liver. Other complicating effects of alcohol may be due to a chronic or subacute meningitis, the existence of which leads to a great aggravation of the head symptoms in the form of delirium, or even to a chronic maniacal condition; whilst in other cases complicating symptoms, due to chronic or subacute spinal meningitis or degenerative conditions of the spinal cord, may be present. Here also—as where gout, or lead, or both combined, have been operative causes of the multiple neuritis—we may find distinct evidences of co-existing renal disease. Pneumonia and phthisis are also frequently present as complications, the latter supervening even in cases where it does not seem to have been present as a cause.

Diagnosis.—It is the great variety in the symptomatology of multiple neuritis, and the fact that it may be associated with actual disease in the spinal cord, which give rise to the principal difficulties in the way of diagnosis. Very many of the cases, however, are so typical in the combination of symptoms presented, as to allow little room for doubt in regard to the proper diagnosis. Thus, more or less paralysis of both feet and both hands, with 'foot drop' and 'wrist drop,' or more extensive paralysis of all four limbs of a flaccid type, associated with pains, numbness, and tingling; hyperæsthesia of the skin, marked tenderness of the limb muscles and perhaps also along the principal nerves, together with absent knee-jerks and the altered electrical reactions which have been described, form such a typical combination that it should be considered to be indicative of multiple neuritis from some cause. And if with this grouping of symptoms there co-exists the combination of cerebral symptoms previously noted, we may feel just as certain that we have to do with a multiple neuritis caused by chronic alcoholic poisoning, even though no distinct evidence of this be at first forthcoming—nay, even though excess in alcohol may be firmly denied by the patient and her friends.

It will be seen that the diagnosis of multiple neuritis from spinal diseases is in the great majority of the cases easy, because pains in the former are mostly prominent symptoms, and because locomotor ataxy is the only form of spinal disease associated with severe pains that could easily be mistaken for multiple neuritis, and that only with certain exceptional forms of the disease. For there are only four other spinal diseases in which pains in the limbs are apt to constitute prominent symptoms. These are the paralyses associated with cancer of the vertebræ, with scrofulous pachymeningitis, and with cervical hypertrophic pachymeningitis—in each of which (not to mention other characteristic features) there are generally present exaggerated knee-jerks and ankle-clonus—and the somewhat rare affection, syringomyelia, which is almost always characterised by loss of painful and of thermal sensibility in the parts principally affected, whilst in multiple neuritis these are almost always modes of sensibility that remain unaffected.

There are, however, three varieties of polyneuritis which are especially liable to give trouble in regard to diagnosis. These are, in the first place, acute cases due to chill or to over muscular exercise, in which there happens to be an almost complete absence of pains and other sensory symptoms. Here the condition has to be diagnosed from acute spinal paralysis, or even from acute ascending paralysis. The second set comprises those of the pseudo-tabetic type, in which pains are present, and the diagnosis has to be made from locomotor ataxy. The third class consists of mixed cases, in which multiple neuritis is actually complicated with lesions in the spinal cord or its membranes, or in both. Here there may be at times much room for doubt as to the nature of the affection—that is, whether it is in the main spinal, or in the main peripheral, and to what extent the symptoms of the two conditions can be separated from one another.

(1) The cases of acute spinal paralysis may agree with some of the more acute cases of polyneuritis in the rapid mode of onset, with or without slight febrile symptoms, in the existence of an atrophic and flaccid form of paralysis in the limbs, together with a more or less complete electrical 'reaction of degeneration' and abolition of knee-jerks. In other forms of polyneuritis, however, the onset is apt to be more gradual and progressive, even in the most acute cases; there is also much more frequently a bilateral symmetry in the parts affected; and even the cases that are most free from sensory symptoms are almost never quite free from such accompaniments, though this is the rule with cases of acute spinal paralysis. Of course it is only in the early days of these affections that there is room for doubt. After the first few days the progress of the two affections is commonly different. Thus, in acute spinal paralysis the loss of power is at first widespread and simultaneously caused, though after a few days there is a subsidence of the paralysis in some of the parts first attacked. Whilst in multiple neuritis there is a progressive increase in the area of the paralysis during one or more days; and after the paralysis has attained its full development there is no recession of paralytic symptoms till a distinct interval of weeks, or it may be months, has elapsed.

The other disease that may have to be thought of in the early days of one of these acute cases of multiple neuritis is the rare affection known as acute ascending paralysis, concerning which so much doubt exists as to its real nature (*see* SPINAL CORD, Special Diseases of: Acute Ascending Paralysis). This form of disease may be distinguished by the complete absence of sensory symptoms, by the preservation of the knee-jerks, and by the fact that the paralysis does not progress in the same way that it does in multiple neuritis: in the former it is a more strictly ascending disease, affecting the trunk muscles after the legs, and then involving the arms; whilst in the latter the order is almost invariably legs, arms, trunk, and there is also rather less tendency for the bulbar centres to be affected. A little later on, if any doubt should still remain, the absence of muscular atrophy and the preservation of normal electrical reaction would definitely settle the diagnosis in favour of acute ascending paralysis.

(2) In reference to the diagnosis of cases of pseudo-tabes from locomotor ataxy, it should be borne in mind that these exceptional forms of multiple neuritis are met with principally after poisoning by alcohol or arsenic, or in the form that is sequential to diphtheria. And then, in reference to the conditions presented, although there may be many characters common to the two affections, there are generally marked differences in the total symptomatology. Thus, in the more rapidly developed pseudo-tabes there are not the characteristic lightning-pains, but more enduring pains, with much more of tenderness in muscles and nerves, together with numbness and tingling in the hands and feet. There is more frequently hyperæsthesia in the limbs, perhaps mixed with patches in

which there is analgesia as well as anæsthesia; there may also be some amount of atrophy of muscles, with altered electrical reactions in the direction of the 'reaction of degeneration.' Then, again, there is the absence in multiple neuritis of three signs which are commonly present in locomotor ataxy, viz. the Argyll-Robertson condition of pupil, and temporary bladder symptoms, together with loss of sexual desire and power. A girdle sensation is also much more likely to be absent in these forms of multiple neuritis, though it has occasionally been met with; and then, again, the lost knee-jerks may return during recovery from multiple neuritis. There still remains the question of the differences in gait characteristic of the two affections. What is known as the *steppage* gait (or the high-stepping gait) has been described as distinctive of multiple neuritis. Its peculiarity is due to the loss of power in the flexors of the ankle, and the consequent dependent attitude of the toes, so that the patient has to lift the foot high, as though he were stepping over a slight obstacle; whilst in locomotor ataxy, the toes, instead of being dependent, are raised, the heels being generally brought to the ground first, and also in a more irregular and spasmodic manner. Where present the steppage gait is doubtless a sign of value, but it is not always present when it is most wanted in this ataxic class of cases, that is, where paresis of the flexors is, as often happens, present only to a very slight degree.

(3) In other cases, where spinal and peripheral lesions co-exist, it may be much more difficult to recognise the real nature of the affection, or, if this can be done, to say which symptoms belong to the one and which to the other set of lesions. In regard to cases where thrombotic softenings, myelitis, or small hæmorrhages co-exist with multiple neuritis (as they may do, more especially, in some few of the cases sequential to the acute specific diseases), it can only be said that such cases are too complicated to be considered here, and that there are no forms of disease where the aid of an expert is more required in order that a correct diagnosis may be made. It may, however, be added that there are four signs in particular which, when present, may safely be considered to depend in the great majority of cases upon spinal rather than upon peripheral lesions: these are, paralysis of the sphincters, bedsores, exaggerated knee-jerks with ankle-clonus, and, though less certainly, girdle sensations.

It should further be borne in mind that there are two affections especially in which the co-existence of peripheral with spinal-cord symptoms is common, viz. acute spinal paralysis and locomotor ataxy. So that where, by reference to the points already laid down, it can be recognised that we have to do with symptoms of double origin, the point to be considered is, whether the central or the peripheral symptoms are primary, and which are merely complicating phenomena. This is a point of considerable importance in regard both to prognosis and to treatment. It is highly important, for instance, to know, in an affection caused by exposure to cold, whether the symptoms are in the main peripheral, or whether they are in the main spinal but with some complicating peripheral neuritis. So also it should be remembered that the ataxic cases of multiple neuritis (cases of pseudo-tabes) stand at one end of a series of cases, and at the other stand the somewhat rare cases of locomotor ataxy in which symptoms due to peripheral neuritis are altogether absent; whilst between these extremes we have almost every kind of transition, furnished either by cases of locomotor ataxy with an increasing number of peripheral lesions, or by cases of pseudo-tabes due to multiple neuritis complicated perhaps by some spinal lesions. The more the patient's symptoms are of peripheral origin, the greater is the relief that is to be expected from treatment.

Prognosis.—Many indications relating to prognosis have already been given, so that little requires now to be added. It may be said, however, that in the great majority of cases life is not imperilled by multiple neuritis. But exceptions to this rule occur in the case of the severer forms of beriberi, and also in the more acute cases occurring in this country, due either to chill, alcohol, or diphtheria, in which the respiratory muscles (including the diaphragm), and the heart, are apt to become paralysed. Otherwise death takes place in multiple neuritis almost solely from the co-existence of one or other of the complications to which reference has previously been made. As to the question of ultimate cure, this, if the cases are not too old and neglected, may in the majority of instances be effected after a prolonged course of treatment. Slight cases may, of course, be cured in the course of a month or two; but in the more severe forms of the disease twelve or eighteen months at least may be required. It is indeed surprising to see the extent to which recovery occurs in this class of cases, even when they are of the worst type, as compared with the amount of improvement that could alone be expected if a similar amount of paralysis with muscular atrophy had been due to spinal rather than to peripheral disease. The signs of commencing improvement to be looked for during the stationary period of the disease are a return of the tingling and numbness in the hands and feet, increased ability to move these parts, together with a gradual improvement in the electrical reactions and in the firmness and size of the muscles, as well as a progressive diminution of the glossiness of the skin and sweating in the hands and feet. The return of previously lost knee-jerks may also be looked for.

Treatment.—In all cases of multiple neuritis we should, before commencing systematic treatment, have thoroughly decided, as far as it may be possible, what the causal conditions are that have been influential in producing the neuritis, as the first necessity may be to put a stop to some poisoning of the system. It is of the greatest importance to arrive at this knowledge as early as possible, as the longer the poisoning lasts the more protracted and obstinate is the resulting malady. Thus, a rubber-worker should be taken away from his work at once. Steps should be taken to protect the patient from lead or arsenic if either of these have had to do with its development; or, as is most frequently the case, where alcohol is the cause this should at once be cut off completely, whenever the condition of the patient will admit of it. But if too great weakness of the heart be present to permit of this being done, the alcohol should be greatly reduced in quantity at first, and as soon as possible cut off altogether.

In alcoholic cases also, where we have to do with severe pains, mental disturbance, and insomnia, together with gastric symptoms, the greatest care is needed. The latter symptoms may be best checked by keeping the patient upon a strict spoon diet, pancreatising the milk and beef-tea if necessary, and administering only very small quantities at a time In the more urgent cases it may be needful at first to have resort to nutrient suppositories. Sleep should be ensured, and the other symptoms relieved as soon as possible by giving morphine, either by subcutaneous injection or by mouth; or, in cases where the symptoms are less urgent, by the administration of full doses of bromide of potassium. At the same time, we must do our best to relieve the local pains and tenderness, by the application of light warm anodyne fomentations, by wrapping the limb in cotton-wool and oil-silk, or occasionally by the use of cold evaporating lotions, if these seem to give more relief to the patient.

In the acute stage of the disease which follows chill, where there are febrile symptoms and perhaps some slight general pains, relief may be derived from salicylate of sodium or salol, given for a few days in full and frequently repeated doses as for rheumatic fever; bromide of potassium may also be given with these drugs night and morning where the restlessness is great and headache is severe. The patient should be kept upon spoon diet as long as the temperature remains at all elevated; and in all the more severe forms of the disease a water-bed is desirable.

In the less severe cases, to whatsoever cause they may be due, the patients should be kept at rest in bed, partly with a view to warding off any aggravation of the disease, and partly to protect them from cold. In these cases, and also in the more severe forms of the disease, after the acute pains and tenderness have subsided, the diet must be more abundant, though easily digestible and nutritious. Pains may be relieved and sleep favoured by such drugs as acetanilide or phenazone, though where insomnia continues these remedies may be supplemented by bromide of potassium, chloralamid or sulphonal. At the same time, much may be done by means of tonics to improve the appetite and general health, where, as is so often the case, this has been much impaired by the previous causative conditions. When these have taken the form of malaria, gout, or syphilis, some special treatment may be necessary; otherwise we must trust principally to combinations of iron with small doses of arsenic and strychnine, aided by extract of malt and cod-liver oil. In cases where there is no marked anæmia, iodide of potassium in six- to eight-grain doses may be given with arsenic and strychnine instead of the compound of iron, at this stage of the disease, as it may help to allay pains and relieve any accompanying condition of interstitial neuritis. During all this time, in alcoholic cases, alcohol in every form should be entirely forbidden; and to ensure the absolute observance of this order the strictest precautions must be taken. No trust whatever can be placed in the patient in such cases, and injudicious friends (or servants who may be bribed or threatened) should be guarded against. The patient ought to be under the absolute charge of thoroughly reliable nurses, either at home or in some private institution or hospital.

Local treatment must also be assiduously carried on week after week, and month after month, at this stage of the disease. As soon as the tenderness has sufficiently subsided to permit of it, daily massage and gentle passive movements should be had recourse to, and to this very shortly should be added warm or sulphur baths two or three times a week, and the regular application of galvanism to the atrophied muscles. Even if they do not respond much at first to any currents that can be used without causing pain, the galvanism should be persevered with, and after a time the muscles will begin to respond.

From the first, care should be taken to prevent, as far as possible, the limbs getting into a contracted position. Thus, the knees are apt to be drawn up for the relief of pain in the early stages of the affection, and, if allowed to remain in this position, contractures with rigidity will inevitably result. The 'dropped foot' from weakness of the anterior tibial muscles soon becomes associated with slight contraction of the calf muscles and shortening of the tendo Achillis. This defective position of the foot may, however, be obviated to a considerable extent if care be taken from an early stage to prevent the foot falling forward by means of some suitable support. Contractions of the wrist and fingers must also be obviated as far as possible. This is best ensured by an early resort to passive movements and massage; and the same means will generally suffice gradually to overcome contractions that may have occurred at the ankles or the knees. Where the former are obstinate, they will in time generally yield when efforts to stand are commenced, and the weight of the body is day by day brought to bear upon the contracted tendo Achillis. It is very rare indeed that section of tendons becomes necessary.

H. CHARLTON BASTIAN.

NEUROMA (νεῦρον, a nerve).—A tumour connected with a nerve. *See* NERVES, Diseases of.

NEUROSES (νεῦρον, a nerve).—SYNON.: Fr. *Névroses*; Ger. *Nervenleiden.*

DEFINITION.—Affections of the nervous system occurring without any material agent producing them, without inflammation or any other constant structural change which can be detected in the nervous centres: in other words, functional affections of the nervous system.

Many of the disorders which may be included here are characterised by symptoms such as neuralgia, convulsions, &c., which also accompany other disorders associated with morbid changes. It is very necessary, therefore, in inquiring into any particular case, not to rest satisfied with the presumption that the disorder is functional until the condition of the nervous centres has been investigated; lest, regarding the symptom as the disease, the central mischief to which it is due may be overlooked. It is highly probable, moreover, that many of what we now regard as functional diseases will, on further investigation, be found to depend upon some corresponding change in the organ affected—an inference which is being daily verified.

ENUMERATION.—The neuroses may be classified according to the organs or functions involved:—

(*a*) *Visceral neuroses*, namely, those of the respiratory, circulatory, or digestive organs.

(*b*) *Localised paralyses*; for instance, palsy of the facial and other peripheral nerves.

(*c*) *Localised involuntary or reflex movements*, such as spasm of the facial nerve and writer's cramp.

(*d*) *Disorders of general sensibility*, including the various forms of neuralgia—trigeminal, cervico-occipital, sciatic, crural, &c.

(*e*) *General neuroses*, namely, chorea, epilepsy, catalepsy, hysteria, and allied affections.

(*f*) *Disorders of the mental faculties*—hypochondriasis, melancholia, and other forms of mental derangement.

P. W. LATHAM.

NEUSCHMÉCKS.—*See* SCHMÉCKS.

NICE, on the French Riviera.—Warm, dry, bracing, winter climate. Temperature 50° F. *See* CLIMATE, Treatment of Disease by.

NICTATION }
NICTITATION } (*nictito*, I wink often).—A rapid involuntary winking of the eyelids, usually due to some nervous disturbance. *See* CHOREA; and FACIAL SPASM.

NIEDERBRONN, in Lower Alsace. Muriated saline waters. *See* MINERAL WATERS.

NIEDERSELTERS (Selters), **in Nassau.**—The well-known muriated alkaline table waters. *See* MINERAL WATERS.

NIGHT-BLINDNESS.—*See* NYCTALOPIA.

NIGHTMARE.—This is a condition characterised by an abiding sense of discomfort or extreme uneasiness, occurring in the midst of a disturbed sleep, sometimes associated with a feeling of weight at the epigastrium, in conjunction with more or less definitely oppressive dreams. It is principally associated with the taking of a heavy meal or of indigestible food before going to sleep by some persons, especially those of a nervous temperament, whose digestion is weak. A closely allied condition is, however, apt to be met with as a consequence of brain-exhaustion and chronic disturbance of sleep in those who are overworked, by application either to study, business details, or literary pursuits. Such a condition also has its affinities with certain forms of incipient delirium, occurring either in various febrile diseases or as a result of alcoholic excesses. *See* SLEEP, Disorders of.

H. CHARLTON BASTIAN.

NIGHT-SIGHT.—*See* HEMERALOPIA.

NIGRITIES (*niger*, black).—SYNON.: Fr. *Noirceur*; Ger. *Schwärze.*—*Nigrities cutis* signifies blackness of the skin. It may be of various degrees; and results from aberration of deposit of pigment, or, more exactly, from an excess of black pigment in the integument. *See* MELANOPATHIA.

NILE, The.—A very dry winter climate. Mean temperature, winter, 57° F. Unsuitable for cases of active pulmonary disease. *See* CLIMATE, Treatment of Disease by.

NIPPLE, Diseases of.—SYNON.: Fr. *Maladies du Mamelon*; Ger. *Krankheiten der Brustwarze.*—Some of the more ordinary affections of the nipple will be found described under BREAST, Diseases of; and

Lactation, Disorders of. Here it is proposed to treat of certain graver diseases, which claim a separate consideration.

Malignant Disease.—The nipple may be the seat of epithelioma, which commonly commences as a crack or fissure, with an indurated base, often in the areola or at its junction with the nipple. It presents no special features which distinguish it from similar disease of the integument of adjoining parts. Hard carcinoma too may attack the nipple, involving its deeper structures, and producing general induration and enlargement, so that the diseased mass projects from the summit of the breast like a knob or large nut. The disease probably originates in the epithelium of the galactophorous ducts, or in that of the sebaceous glands.

Of greater interest than either of these is an affection frequently associated with malignant disease of the breast, to which Sir James Paget has drawn attention—an *eczematous* condition of the nipple and areola. It may occur in the form of a dry, scaly, or branny eruption, affecting the entire surface of the areola and nipple, which is darker coloured, a little firmer, and less pliant and elastic than its fellow. Or, with more characteristic signs of inflammation, small vesicles or pustules may form, and, breaking or being rubbed off, may leave behind them tiny scabs or ulcers, or a surface raw and red. Either condition may exist for many months or even years with little alteration, and with scarcely any tendency to spread beyond the margin of the areola. But the second form, causing more irritation than the first, is often subjected to treatment; and being very difficult to cure, is sometimes so severely treated with caustics that destruction ensues, not of the disease, but of the nipple, which appears to have been gradually eaten away by the eczematous affection. Both forms are uncommon, but they are rare before the middle age. A study of their clinical and pathological characters leads to the conclusion that they are due to inflammation. The disease has been noticed in men as well as women.

Treatment.—This disease may be treated by protecting the parts with a carefully adjusted, ventilated shield, and by the application of vaseline. or liniment of lead and oil, or similar soothing dressing. But it is very intractable, in some cases apparently incurable. It might seem as if an affection so trivial were not worthy of so much attention; but unfortunately there appears the strongest reason to believe that these conditions of the nipple and areola are not infrequently the precursors of carcinoma of the breast, sometimes by only a few months, more often by a period of years. It is probable, too, that the carcinoma is directly due to the eczematous disease; for it induces changes in the epithelium of the ducts which can be traced deeply into the substance of the breast, whose acini become at length distended with proliferating epithelium. On this account it has been proposed, when all the lesser methods of treatment have been used in vain, to remove the entire breast. Opinions, which are divided on the necessity of this measure, so severe, are united in its favour when, with the superficial inflammation, there exists an appreciable induration, however slight, within the breast. Care must be taken not to confound these eczematous affections of the nipple and areola with those more widely diffused surface inflammations of the breast, with which they have little in common, either in the obstinacy with which they resist treatment, or in the deeper disease to which they may give rise.

Henry T. Butlin.

NOCTAMBULATION (*nocte*, in the night; and *ambulo*, I walk).—A term for sleep-walking. *See* Sleep. Disorders of.

NOCTURNAL EMISSIONS.—Involuntary emissions of semen occurring during sleep. *See* Sexual Functions in the Male, Disorders of.

NOCTURNAL INCONTINENCE. Involuntary escape of urine during sleep. *See* Micturition, Disorders of.

NODE (*nodus*, a swelling).—A circumscribed swelling on the surface of a bone, connected with the periosteum, and usually due to syphilis. *See* Bone, Diseases of; and Syphilis.

NODI DIGITORUM (Latin).—Swellings of the distal phalanges of the fingers, usually supposed to be associated with gout. *See* Gout.

NOMA (νομή, a corroding sore; from νέμω, I devour).—Synon.: Fr. *Nome*; Ger. *Wasserkrebs*.—A synonym for cancrum oris. *See* Cancrum Oris.

NOSE, Diseases of.—Synon.: Fr. *Maladies du Nez*; Ger. *Nasenkrankheiten.*

The diseases affecting the external and more superficial structures of the nose are described separately under their respective heads. *See* Acne; Acne Rosacea; Comedones; Eczema; &c.

The present article will be mainly devoted to the diseases of the nasal fossæ, septum nasi, and the accessory nasal cavities, namely, (1) Acute Rhinitis; (2) Chronic Rhinitis; (3) Hypertrophic Rhinitis; (4) Atrophic Rhinitis, with (4*a*) Ozæna; (5) Diseases of the Septum; (6) Diseases of the Accessory Nasal Cavities; (7) Syphilis; (8) Lupus and Tuberculosis; (9) Rhinoscleroma; (10) Diphtheria; (11) Glanders; (12) Foreign Bodies in the Nose; (13) Parasites; (14) Tumours; and (15) Post-nasal Adenoid Growths.

1. Acute Rhinitis.—Synon.: Acute Nasal Catarrh; Coryza.

Ætiology.—Among the exciting causes of acute congestion and inflammation of the nares are direct local irritants, such as the inhalation of pungent vapours, or contact with acrid substances. Acute rhinitis is also associated with specific eruptive fevers. It is seen as a special catarrh in measles, it is combined occasionally with the pharyngeal inflammation of scarlet fever; it occurs sometimes in small-pox; and it often forms a prominent symptom in epidemic influenza. Certain drugs induce an acute nasal catarrh, more especially iodide of potassium.

When excretion is defective, the circulation in the blood of irritant products is another potent cause. So attacks of acute nasal congestion are met with among the many phases of gout. There is, moreover, in certain persons an individual and special susceptibility to nasal catarrh, which is often seen as a distinct family trait, affecting many members, and running through different branches.

Acute nasal catarrh is more commonly met with in the form of coryza or febrile rhinitis, of abrupt onset and limited course. This is generally ascribed to chilling of the surface by exposure to cold. The immediate cause, however, which provokes any individual attack cannot always be clearly determined. Cold is the most palpable exciting influence in many cases; while in others the vitiated air of crowded rooms, with defective ventilation, may be the initial irritant. It is not unreasonable to infer that the vaso-motor disturbance which dominates the invasion stage of this affection may in different instances be incited by any sudden extremes of temperature, whether the quick transition be from warmth to cold or from cold to excessive heat.

Symptoms and Course.—The symptoms accompanying the onset of coryza are a sense of chilliness, irritation of the nares, dryness, tingling, itching, and sneezing. The nose soon becomes blocked, due to rapid swelling of the mucosa and engorgement of the erectile tissue. The sudden obstruction to nasal respiration produces a sense of oppression with mouth-breathing, which intensifies the already commencing dryness of the throat and post-nasal space. A serous discharge now makes its appearance; the swelling temporarily subsides, and freer breathing is restored. Alternations of this thin watery flow with fluctuating nasal obstruction, sneezing, frontal headache from venous congestion or extension of the catarrh to the frontal sinuses, impairment or loss of smell, conjunctivitis, tinnitus, or deafness from obstruction of the Eustachian tubes, characterise the course of the affection. There is slight rise of temperature during the first day or two, and always a feeling of dulness and lassitude. The duration of the attack is brief, being generally limited to a week, and often ending in a few days.

Treatment.—The attack may sometimes be cut short at the invasion by rest and sedatives. Confinement to bed is advisable during the acute period. Among abortive remedies, opium is one of the most effectual. To quickly arrest the catarrh, and relieve the local irritation, five minims of laudanum or of the wine of opium, given every hour for two or three doses, will often afford more prompt relief than a full dose of Dover's powder taken at night after a hot foot-bath, which plan is better adapted to the later febrile stage. Thirty grains of bromide of potassium, or ten grains of hydrochlorate of quinine with a quarter of a grain of hydrochlorate of morphine, if given at the first stage of seizure, may stop its progress. When the catarrh is fully developed symptomatic treatment only is necessary. It is well to commence with a mild purgative. Saline diaphoretics suffice during the febrile period. Phenazone or phenacetin may be given every two or three hours to relieve headache and allay any acute congestion of the pharynx and larynx that may be present. Frontal pain calls for nasal inhalation of vapours containing benzoin or conium. The surface-irritation and obstructive swelling may be reduced by cocaine spray (3 per cent. solution), which should be used with caution; or by the use of smelling-salts containing ammonia combined with pine oil, iodine, and carbolic acid.

In infants, in whom the nasal space is proportionately narrower than in the adult, coryza always gives rise to greater difficulty of breathing; and sudden and intense intranasal swelling may lead to attacks of grave dyspnœa with laryngeal spasm, usually during the first few hours of sleep. The best means of quickly reducing the swelling is to pencil the anterior nares with a few drops of cocaine solution (4 per cent.), together with steam inhalations, either plain or medicated. Small doses of bromide of potassium every three or four hours, added to other appropriate general treatment during the acute stage, will reduce the tendency to spasm, especially in rickety children.

2. Chronic Rhinitis.—Synon.: Chronic Catarrhal Rhinitis; Chronic Coryza; Chronic Rhinorrhœa.

Ætiology.—The various influences that induce acute rhinitis may cause the more protracted affection, but there is no clear proof that simple coryza may often lead to intractable catarrh. The stubborn so-called 'colds' of childhood are more often of some specific origin, and are frequently but a symptom of post-nasal adenoid growths.

Local irritants, atmospheric or mechanical, frequently excite and keep up the disease in those more exposed to such influences.

Chronic rhinitis with epistaxis may also be due to excitement or obstruction of the general circulation, as in disease of the heart, liver, or kidneys, as well as in functional derangements of these and other organs, dependent upon irregularities of diet, abuse of stimulants, or neglect of exercise.

There is some evidence to show that the sudden fluctuations of the nasal circulation which occur at puberty, in the menstrual period, during sexual intercourse, or in connexion with pathological conditions of the reproductive organs, may lead to more persistent vascular disturbance, and chronic intranasal congestion.

Anatomical Characters.—The morbid appearances in this affection are of the same character as those met with in acute nasal catarrh, but differ from them in degree and chronicity. Loss of tone occurs in the blood-vessels, with more chronic distension of the erectile tissue, and epithelial thickening as the outcome of an irritation more prolonged. Redness of the mucous membrane is less intense as a rule, and less extensive, but there is more or less constant tumefaction, especially over the turbinated bones. The swelling is soft and yielding; it pits on pressure with a probe, and if cocaine be applied it completely subsides for a time, differing in this respect from hypertrophic rhinitis.

Symptoms.—Persistent irritation, occasional blocking of the nose, and a constant nasal discharge, either thin and watery or mucoid and muco-purulent, are the prominent symptoms. There are also a chronic congestion of the post-nasal space, pharynx, and larynx, accumulation of viscid secretion, sore-throat, hoarseness or cough, and intercurrent deafness. The rhinoscopic appearances just described are more characteristic of this affection than the symptoms.

Treatment.—*See* 3. Hypertrophic Rhinitis.

3. Hypertrophic Rhinitis. — Synon.: Chronic Hypertrophic Nasal Catarrh; Rhinitis Hypertrophica.

Definition.—A further stage of chronic rhinitis characterised by proliferation of the submucous cellular tissue, progressive hypertrophy, thickening of the vascular coats, and dilatation of the vascular sinuses of the erectile bodies of the nasal mucous membrane.

Anatomical Characters.—These can be recognised by means of the rhinoscope, and include irregularly distributed outgrowths, septal deflection, narrowing of the nares, surface-redness (often most intense over the septum), and swelling. Looking from before backwards, the inferior turbinated bodies are first seen as prominent tumefactions blocking the entrance to the inferior meatus. The anterior turbinated hypertrophies are not as a rule symmetrically developed, and the cartilaginous septum is deflected in the direction of least resistance. Hypertrophic changes, affecting the septum itself, give rise to more extended and irregular deviation, with angular projections, spurs, and sometimes dense adhesions with the opposed surfaces; and both nares may be found blocked over different areas and at different levels. Mechanical dilatation (best effected with plugs of cotton-wool soaked in a weak solution of cocaine) is generally requisite to obtain a further rhinoscopic view of the deeper-seated and upper portions. The inferior turbinated tissue will then be found hypertrophied in its whole extent; while erectile tumours also form at the posterior extremity of the bone, pale or dusky red, with uneven surface, blocking up the posterior nares on a level with the lower meatus, and encroaching upon the Eustachian orifices. Ovoid growths on the posterior border of the septum are also met with.

The presenting portions of the middle turbinated bone exhibit a red granulated surface, and the inferior border is bent inwards upon the septum. At a more advanced stage polypi, and cysts of the middle turbinated bone are associated conditions.

Persistent congestion and thickening in the post-nasal space, hypertrophy of the glandular tissue at the pharyngeal vault, chronic follicular pharyngitis, and congestion of the larynx, occur as co-existent and essentially interdependent conditions.

Symptoms.—While in hypertrophic rhinitis, as in the preceding type, surface-irritation, sneezing, nasal discharge, anosmia, headache, pharyngeal irritation, and deafness are the symptoms which constantly occur and interchange during its course, the most characteristic feature is dyspnœa. Obstruction to nasal breathing is present to some extent always, and respiration is very oppressive at intervals from sudden engorgement of the erectile tissue. Any irritation, direct or reflected, may excite these spasmodic suffocative attacks. Fatigue, mental worry, nervous prostration, and all such debilitating conditions, are also active and immediately predisposing influences. The intense blocking of the nose is frequently induced in recumbency, and corresponds generally to the side upon which the patient is lying. The attacks of dyspnœa are therefore very apt to occur at night, and then are a source of much distress. In certain individuals they excite asthmatic seizures and other reflex symptoms—so-called nasal neuroses.

Treatment.—Local measures, to cleanse the surface from irritating secretion, and to control the discharge, are called for in both forms of chronic rhinitis so far described, whether 'simple' or 'hypertrophied.' The nares should be sprayed two or three times a day with alkaline, astringent, and antiseptic lotions, such as a solution of bicarbonate of sodium, borax, and carbolic acid in glycerine and water. 'Listerine' (containing thyme, eucalyptus, and benzo-boric acid) diluted with water—one part in six—controls fœtor. It may be associated with solution of the chloride of aluminium as an astringent. Chronic indolent swelling of the anterior portion of the inferior turbinated tissue may be reduced by the application of glacial acetic acid on a fine wooden spatula, great care being taken to limit this to the affected part. When these anterior swellings are associated with more active congestion, free scarification of the surface sometimes affords immediate relief and permanent benefit. Glycerine of iodine, or a 10 per cent. solution of chromic acid, is an effectual local remedy for moderate degrees of thickening.

In the more advanced stages of hypertrophic rhinitis, operative treatment may be required.

The treatment of acute intercurrent symptoms is the same as that which has been noticed under Acute Nasal Catarrh.

The general management of each individual case will depend upon those associated constitutional conditions, or special complications, which have been already referred to.

4. **Atrophic Rhinitis.**—Synon.: Rhinitis Atrophica; Dry Nasal Catarrh.

Description.—The special characteristics of this very important affection are dwindling of the soft tissues lining the nasal fossæ and of the underlying bony structures — more particularly the turbinated bones, atrophy of the glands, fatty degeneration of their epithelium, and perverted and essential diminution of the secretion.

The typical rhinoscopic appearances are strikingly wide nares, in which the normal outlines of the turbinated bodies may be almost effaced; an exceptionally free view of the upper pharynx by anterior rhinoscopy; a dry, wrinkled, and pallid surface, with adherent crusts; and accumulated purulent discharge in the upper meatuses and at the vault of the pharynx. Congestion, swelling, and redness may be met with at first, but more often the earliest stage of atrophic rhinitis is associated with a scanty mucopurulent flux. Its course differs markedly from that of chronic rhinitis as usually seen, in which protracted congestion ends in redundancy of tissue, possibly with areas of *localised* contraction. In atrophic rhinitis progressive and *diffuse* wasting is the essential feature; and it is to be regarded as a distinct type rather than merely a terminal phase of prolonged inflammatory processes. Its most important bearing is in association with ozæna.

4a. **Ozæna.**—Synon.: Fr. *Ozène*; Ger. *Stinknase*.

The term 'ozæna' has been applied to every condition of chronic nasal disease in which ulceration is associated with fœtor as a prominent symptom, and ulceration with diseased bone was regarded as the essential element of the disease. 'Ozæna' has thus been used to designate a symptom rather than a disease. So the foul stench accompanying syphilitic disease of the nose—dependent upon caries—is spoken of as syphilitic ozæna. Indeed, syphilis and scrofula have been commonly cited as the chief causes of the affection; in the same way, the fœtid discharge of malignant ulceration of the nose, with necrosis, might be termed 'cancerous ozæna.' Their local signs and course, however, serve to differentiate these symptomatic forms of fœtid rhinitis from the idiopathic affection which we are now considering. This may be defined as a distinct and specific fœtid catarrh, essentially chronic, in which, when it is fully developed, atrophy is the most striking structural change, associated with tenacious purulent discharge, forming greenish-brown adherent crusts, sometimes covering superficial erosions. It is a disease intimately associated with atrophic nasal catarrh, though not absolutely identical with it, unaccompanied by any ulceration or necrosis to account for the odour. This is now generally attributed to the decomposition of retained secretions; it is a fœtor *sui generis*, as distinctive as the greasy smell of suppurating small-pox eruption, and in no way to be confounded with the fœtor of caries. True ozæna in its progress is always associated with intranasal atrophy, but atrophic rhinitis is not invariably fœtid, and the two terms cannot be considered as convertible. The writer has met with typical and even extended wasting of the nares in which there was never any fœtor. The atrophy, however, in these instances developed in adults past middle age. Ozæna dates, as a rule, from childhood or early life. Inflammatory redness and *swelling*, with purulent catarrh, may be the earliest signs in these cases. Fœtor is noted almost from the beginning; wasting is not so evident at the incipient stage, but the tendency to atrophy is soon seen as the disease progresses, and it marks its subsequent course throughout. The affection has been spoken of as 'atrophic rhinitis ending in ozæna;' but there is more reason to regard the disease as of specific nature, and the atrophic degeneration as an associated condition, not the causative one.

More than one micro-organism has been found in the discharge of ozæna, and described as the cause of the odour, and possibly even of the disease. More extended research is, however, required to justify such conclusions.

Symptoms. — The usual symptoms of atrophic rhinitis include irritation arising from deficient lubrication of the mucous membrane, with constant efforts to dislodge the tough and adherent crusts; at times a scanty sanious discharge; a sense of harsh dryness in the nose and throat, with special sensitiveness of these surfaces to cold, dull aching in the nose, frontal headache, anosmia, and proneness to laryngeal congestion and hoarseness.

In ozæna, which is the more common of the two forms, these symptoms are associated with the characteristic stench which is here the dominant feature.

Treatment.—Thorough cleansing of the nares and post-nasal space is of prime necessity. The several spray solutions recommended for this are mentioned under the treatment of chronic rhinitis. Inunction is one of the best means of relieving the troublesome dryness; lead and mercury ointments serve very well. Sprays of paroleine, applied by special atomisers, act very beneficially, and control fœtor when combined with eucalyptus and menthol. So also does an ointment containing twenty grains of aristol to one ounce of lanolin, rubbed down with a sufficient quantity of almond oil to render it soft. Iodoform is a more powerful antiseptic, but its odour is almost as offensive as that of ozæna. Iodol is less potent, but it has the advantage of being odourless; and as a substitute for iodoform it may be applied by insufflations. Methyl violet in solution or ointment has also been used with advantage in ozæna. Vapour of creasote inhaled through the nose, by means of a specially adapted nasal inhaler, is one of the best local means (supplementing detergent and antiseptic lotions) to overcome fœtor, diminish the formation of crusts, and relieve dryness of the surface.

For the associated general treatment, cod-liver oil, iron, and arsenic are specially indicated.

5. **Affections of the Septum.**—The chief affections of the septum nasi are: (*a*) Acute inflammation; (*b*) Ulceration; (*c*) Abscess; (*d*) Chronic thickening; (*e*) Deviations and spurs; and (*f*) Hæmatoma.

(*a*) *Acute Inflammation.*—This somewhat rare condition is usually the result of the constant inhalation of irritant vapours, especially the vapours of arsenic, mercury, bichromate of potassium, in the manufacture of artificial flowers, wall papers, mirrors, &c.

Though not limited to the septum, it is here that the inflammation is most intense, with epistaxis, ulceration, sloughing, and even perforation. The destruction of tissue, though it may be extensive, is not, however, apt to lead to deformity from shrinking of the tip of the nose, since the front part of the cartilage does not usually suffer.

Like the nasal mucous membrane generally, the septum may also become inflamed in scarlatina, small-pox, measles, diphtheria, and syphilis.

(*b*) *Ulceration.*—Ulceration of the septum occurs in connexion with various inflammatory processes and new-growths, including syphilis and tubercle, lupus, traumatic inflammation, more rarely chronic nasal catarrh, zymotic diseases, and malignant growths.

Syphilitic, lupoid, and tubercular ulcerations are described in other sections.

In scarlatina, measles, and typhoid fever, ulcers are sometimes met with involving the nasal cavities, and more often in glanders and nasal diphtheria. Ulceration has been also observed from gonorrhœal infection of the nasal mucous membrane.

Treatment.—The healing of ulcers is promoted by the application of nitrate of silver, when they are superficial. When they are deeper and persistent, acid nitrate of mercury, or a fine galvano-cautery point carefully applied, is more effectual. The ulcerated surface should be dusted over with iodoform, or covered with an ointment of aristol.

The constitutional treatment will vary with the cause.

(*c*) *Abscess.*—*Acute* abscess of the septum nasi is generally traumatic, but may arise in connexion with infective inflammatory processes, such as erysipelas. It is usually bilateral, and situated in the anterior part of the septum.

The symptoms are those of nasal obstruction, fever, and the usual signs of local inflammation with increased secretion. The external integument is often red, swollen, and tender, and the conjunctiva may also be inflamed. Sometimes vertigo and tinnitus may be observed.

Chronic septal abscess may also be due to injury, or arise from specific causes. It is seen in the anterior region on both sides, and commonly leads to perforation.

Treatment.—Inflammation of the nasal septum, when due to external irritants, usually subsides of itself on the removal of the irritating cause, but such local applications will be called for as alkaline, detergent, and mildly astringent sprays, insufflations of morphine with powdered starch to relieve pain, and evaporating lotions applied on lint over the nose when inflammation is more acute. Together with these local fomentations, general antiphlogistic treatment may sometimes be indicated, but it is not often called for. Abscesses must be opened and drained.

(*d*) *Chronic Thickening.*—This condition of the nasal mucous membrane is usually observed in connexion with hypertrophy, as a result of long-standing chronic catarrh. It is generally confined to the lower and back part of the septum, and is often symmetrical, and associated with similar changes affecting the turbinated bodies.

(*e*) *Deviations and Spurs.*—Perfect symmetry of the nose may be said to be exceptional. The cause of slight deviation of the septum is obscure: possibly extraneous influences involving repeated unilateral pressure, such as sleeping always on one side, or blowing the nose with the same hand

According to Zuckerkandl the septum is always straight before the seventh year. Injuries and chronic inflammatory processes are the usual causes of extreme deflection. The cartilaginous part of the septum is more often displaced, but frequently the osseous portion also; and both may be simultaneously implicated, producing angular or sigmoid flexures. The back part of the septum is more rarely affected.

Spurs, or bony ridges of the septum, occur alone or in connexion with deviation. The ridge may correspond to the line of junction of the ethmoid and vomer, or to that of the vomer and the crest of the upper maxilla. These outgrowths sometimes attain a considerable size.

Symptoms.—Dyspnœa, impaired voice-sound, deafness arising from associated aural derangements, and protracted nasal catarrh are the frequent and serious results of these deviations of the septum nasi. Spurs produce similar symptoms, which are apt to be most prominent when the two conditions co-exist.

Treatment.—The treatment of deviations and spurs is operative. The general indications are noticed under the head of Hypertrophic Rhinitis.

(*f*) *Hæmatoma.*—Injuries to the nose may be associated with extravasation of blood, and, in exceptional cases, fracture leads to a blood-tumour usually situated upon both sides of the septum. Suppuration is apt to occur in nearly all these cases, followed by perforation of the septum. Hæmatoma may be distinguished from polypus by its symmetrical character, special attachment, and smooth bluish-red surface; from enchondroma by its elasticity, and the absence of hardness.

Treatment.—If the tumour is large, markedly obstructive, with signs of fluctuation, it may be aspirated through a fine cannula, and washed out with an antiseptic fluid. If of more solid consistence, it should be freely incised and the clot turned out. But it is better not to resort to these measures in the earlier stage, or until the symptoms call for active treatment. When applied early, a cooling lotion may be all that is necessary.

6. Diseases of the Accessory Nasal Cavities.—The maxillary, ethmoidal, frontal, and sphenoidal sinuses are subject to morbid changes, sometimes arising primarily, but more often secondarily to affections of the nasal fossæ.

(*a*) *Suppuration.*—These spaces, doubtless, frequently participate in nasal catarrh, and they may completely recover when this passes away. Under certain conditions, however, particularly obstruction or occlusion of their apertures, the catarrhal process may become suppurative and lead to chronic discharge of pus from the nose, or to purulent retention and distension of the cavity or cavities involved.

Etiology and Pathology.—An inflammatory effusion is most likely to become purulent in the case of the antrum; less so in the frontal sinuses, which, on the other hand, are usually implicated more extensively than the others in simple catarrh (coryza). Inflammation of the maxillary sinus is more frequently due to caries of the molar teeth, with periosteal inflammation and deep-seated suppuration involving the alveolar region. The watery or purulent discharge—simulating nasal catarrh—is then but the overflow from an accumulation in the antrum. Sometimes, however, inflammatory processes originating in the nasal fossæ extend into the antrum. In the earlier stages these may subside with the treatment of the nasal catarrh. Serious consequences may occasionally follow from pressure of a distended sinus upon neighbouring parts, namely, bulging of the eye or cheek, impaired movement of the eyeball, defect or complete loss of vision, changes in and beneath the muco-periosteal lining membrane, periostitis with formation of bony spicules or plates projecting into the cavity, and the formation of a fistula with constant discharge of pus.

Symptoms.—The symptoms of disease of the nasal sinuses depend mainly upon the particular cavity affected. In disease of the antrum, dull heavy pain is felt mainly in the cheek and teeth. When the ethmoidal or sphenoidal sinuses are affected, it is more deep-seated in the region of the orbit. In the frontal sinuses pain resembles a severe frontal headache.

Facial neuralgia may occur in all cases. It is, however, most frequent in affections of the antrum, least so in connexion with the frontal and ethmoidal sinuses. Purulent discharge from the nose is common to disease of all the cavities, unless the aperture into the nasal meatus is occluded, when the pus may find an exit into the orbit or even into the cranial cavity. The flow is generally unilateral in disease of the antrum, and intermittent, occurring especially when the head is bent down; it is more continuous from the other sinuses. In the case of the sphenoidal and more posterior ethmoidal cells it is apt to find its way into the throat; with the frontal and maxillary sinuses diseased it comes forward through the nostrils. The pus is usually without odour, excepting in antral disease, when it is more or less fœtid. Trans-illumination of the maxillary sinuses from the mouth by electric light—originally proposed by Voltolini as a means of more accurately determining the presence of fluid in the antrum—is a valuable aid to diagnosis.

Protrusion of the eyeball may occur in purulent distension of any of the sinuses, but most commonly in ethmoidal disease; it is more rare with effusion into the antrum. Distension of the frontal sinus may cause bulging of the orbital plate. Impaired vision may be due to pressure upon the optic nerve. The field of vision may be narrowed from antral disease. Sudden and complete loss of sight is an indication of disease of the sphenoidal sinus, and so is ptosis.

(*b*) *Other conditions.*—Apart from simple catarrh and purulent inflammations, the accessory cavities are liable to specific inflammatory processes, such as erysipelas and diphtheria. In the latter, only ecchymosis and œdema are stated to occur, but no false membrane. In erysipelas, head symptoms may supervene with high fever. Mucous and purulent accumulations in the sphenoidal sinuses have been also described in tubercular and cerebro-spinal meningitis. Chronic purulent collections in the same cavities have been accounted a cause of ozæna.

Besides the above-mentioned conditions, neoplasms of various kinds, malignant and non-malignant, develop in the accessory cavities—*e.g.* mucous polypi, cysts, osteomata, fibromata, sarcomata, and epitheliomata. Sometimes they are the seat of thread-worms, maggots, and other parasites. Calcareous degeneration of the lining membrane has been observed in all the sinuses. Mucous polypi are more particularly seen with disease of the ethmoidal cells. Osteomata develop more often in the frontal sinuses.

The symptoms produced by the presence of new-formations in these spaces nearly resemble those caused by purulent accumulations: they are in fact those of distension. Emphysema of the orbit and eyelids has been noticed after blowing the nose, in association with defects in the orbital plate of the ethmoid, as well as from fractures through the ethmoidal cells.

Treatment.—In most cases the treatment of the different forms of rhinitis suffices to reduce acute obstructive swelling, to relieve tension and pain, and control discharge. Other obstructing causes, such as thickening, outgrowth, or polypus, must be removed, or dilatation of the narrowed passages may be effected with a probe. In more aggravated cases, where there is retention of pus in a frontal sinus with urgent symptoms, the cavity must be opened from without by surgical methods. Blocking of the antral orifice may occur from extension of inflammation, from the sinus being plugged with viscid discharge, new-growth, or diffuse thickening in the nose.

An accumulation of pus in the antrum, whatever its source, must be evacuated, and free drainage established. The usual and best way to effect this is by extracting one of the upper teeth, and making an opening into the antrum through the alveolar socket, extracting a diseased tooth if one be found. In some cases it may be better to make the opening in the canine fossa. If the flow of pus is still impeded, the source of obstruction must be sought for and removed. The cavity is then to be washed out with an antiseptic fluid; and sometimes, in order to do this thoroughly, it may be necessary to make a counter-opening in the nasal fossa over the antral orifice. To prevent premature closing of the alveolar opening, a silver cannula should be fitted into it, and kept in place by means of a properly adjusted plate. The subsequent treatment consists in the patient himself daily syringing out the cavity with a warm aqueous solution of carbolic or boric acid. Tincture of iodine diluted with water, or a weak solution of iodated zinc, is better adapted to a later stage.

7. **Syphilis.**—(*a*) *Primary syphilis* may attack the nose by direct inoculation. It is generally seen at or just within the orifice of the nostril. In most cases a nasal chancre is the result of the inoculation of moist secondary lesions, the virus being conveyed generally by the finger, as in nurses attending syphilitic infants. Chancres of the external surface may also occur; originating from wounds such as bites. Chancre is generally single; and appears either as a papule or tubercle with ulcerated summit, or as a more flat erosion. Its specific characters are a circumscribed ulcer with indurated base and borders, accompanied by enlargement of the neighbouring lymphatic glands, headache, lassitude, and sometimes slight rise of temperature. More commonly the lesions met with in syphilitic rhinitis, acquired or congenital, are those associated with general constitutional infection, namely, catarrh of the mucous membrane, specific eruptions, infiltration of the deeper layers with diffuse hyperplasia, circumscribed gummatous growth leading to abscess, disease of the cartilage, periostitis, caries, and necrosis.

(*b*) Mere *congestion*, with swelling of the pituitary membrane and discharge, occurring in the earlier course of acquired syphilis, has nothing to distinguish it from simple nasal catarrh. As a rule, the symptoms are less intense than those of acute coryza. Unless aggravated by extraneous causes, they only tend to irritation and soreness; and neither chronicity nor the character of the discharge offers any reliable aid in diagnosis. This can be established only by the coexistence of more definite general signs of syphilis elsewhere. Intense and persistent nasal obstruction is a very marked feature at the outset of congenital syphilis. It has occasionally to be diagnosed from post-nasal growths.

(*c*) *Mucous patches* of the nose are usually seated about the nostrils, involving the contiguous mucous and cutaneous surfaces. In this region they are often more fissured than papular, with scanty secretion, or covered with thin scales. On the intranasal surface they are more papular in their early stage. They appear either as slightly raised circumscribed erosions, or as superficial ulcers, on the anterior part of the septum or over the inferior turbinated bodies. They are more frequent in infantile syphilis, though they readily escape detection, being hidden by the swelling and discharge.

(*d*) The onset of so-called *tertiary manifestations* is characterised by perforating ulceration of the mucosa, with cellulitis and infiltration of the submucous tissue. Ulcers, either single or, when multiple, coalescing and spreading, with livid swollen borders, undermined edges, and yellowish-grey surface; deep dusky redness, with diffuse and brawny swelling of the septum, bathed in muco-purulent secretion, are the rhinoscopic appearances at this period. Burrowing sinuses—generally seated along the septum—with discharge of fœtid pus, are later evidences of further extension to cartilage and bone, which, ending in necrosis and exfoliation, leads to deformity.

These usually proceed from caries of the vomer or the nasal bones. Disease of the cartilaginous portion may terminate in limited perforation if quickly arrested, and leave little inconvenience or disfiguration. Total destruction of the septal cartilage results in characteristic flattening of the tip of the nose; but caries and necrosis of the vomer are now rarely absent. These may again be limited, or extend in different directions, and so end in grave losses of substance, the bridge of the nose falling in, and perforation of the floor establishing a communication with the mouth.

With superficial inflammation and ulceration only, the earlier symptoms are those of chronic nasal catarrh. Fœtid discharge, deep-seated pain, and intranasal obstruction, together with distressing headache, and, not infrequently, severe attacks of otitis, mark the course of the deeper lesions.

Livid redness and boggy tumefaction of the outer surface, especially seen over the bridge of the nose and extending to the orbital region, indicate retention of pus, which may give rise to intractable fistulæ. At the same time the skin itself often presents ulcerating syphilides.

Deep ulceration of the pharynx and post-nasal space, and in many cases of the larynx, accompanies, almost as a rule, the advanced period of nasal syphilis.

With loss of the velum there is regurgitation of liquids in swallowing, and snuffling speech.

Treatment.—In addition to the established methods of treatment with mercury and iodide of potassium in the respective stages, several special points have to be considered. The superficial lesions of the pituitary membrane require little local treatment. Solid nitrate of silver, a solution of sulphate of copper, and acid nitrate of mercury are the best applications.

In syphilitic coryza of infants mercurial frictions should be used, with the local remedies indicated under the head of Acute Nasal Catarrh.

Later lesions demand more active local measures. In the most threatening cases, however, destructive processes may be averted by large doses of iodide of potassium and mercury. Abscesses must be promptly incised, sinuses laid open, and superficial caries scraped away. This should be followed by insufflations of iodoform. Loose dead bone is to be removed. Cleansing and antiseptic lotions, such as have been enumerated, should be freely used in the form of spray, or vapour of creasote or carbolic acid inhaled through the nose to control fœtid discharge.

The marked tendency to contraction of tissue in syphilis is a serious obstacle in overcoming naso-pharyngeal webs. The writer has found the most inveterate cases in the inherited disease. Operative measures for their permanent removal mostly fail.

8. **Lupus and Tuberculosis.**—Lupus affecting the external aspect of the nose is fully described in the articles Lupus Erythematosus; and Lupus Vulgaris. When lupus spreads to the nasal fossæ the septal cartilage may be perforated or destroyed. Extension to the bony septum is very rare.

Anatomical Characters.—Primary lupus of the pituitary membrane is less common. The tubercles and ulcers form more often on the septum. Greyish-red tumours, the size of a pea or a small nut, break down and form ulcers, with sharply cut or undermined edges, densely infiltrated bases, and granular greyish-white surface. Ulceration alone is the prominent feature in other cases. The inferior turbinated surface, and sometimes the floor of the nasal fossæ, are also affected.

Diagnosis.—Lupus of the nose has to be carefully distinguished from syphilis. This may be done by bearing in mind that lupus develops in early life, and is specially limited to that period; that syphilitic tubercles are, as a rule, larger, more dense and hard, and progress more rapidly to ulceration, the ulcerated surface becoming covered with thick greenish crusts; and that tubercular and pustulo-crustaceous syphilides, respectively, are found on other parts of the body in association with the nasal affection. Beyond this, the history of the case and the effect of antisyphilitic treatment will decide the question in doubtful instances.

Treatment.—To destroy the neoplasm of lupus, the galvano-cautery, scraping, or the application of caustic pastes may be employed. One containing chloride of zinc is very effectual. Inflammation is best allayed by applying sedative lotions before the use of escharotics; mildly astringent and antiseptic washes in the after-treatment promote healing of the cauterised surface.

Lactic acid, menthol, iodoform, and iodol are the best local applications to tubercular ulcerations of the nasal fossæ. General treatment by means of cod-liver oil and tonics is called for in both of these affections.

9. **Rhinoscleroma.**—Ætiology. — This affection is of extremely rare occurrence. It has been observed more especially in Austria and Italy, and is said to be less infrequent in Central America. Its cause is unknown.

Description.—The disease is characterised by nodulated induration of the skin and mucous membrane, commencing over the upper lip and at the orifices of the nostrils in the form of sharply defined, prominent, and hard patches, tender but otherwise painless, with smooth or shining surface, varying in hue from the normal colour of the skin to a dusky redness. The growths are incorporated with the skin, which is deeply infiltrated. They do not become generalised beyond the parts primarily affected; neither is there inflammation with swelling of the surrounding surface. There may be superficial excoriation with scabbing, but never any ulceration or loss of substance, nor interstitial shrinking. This serves to distinguish the affection from lupus, malignant disease, and tubercular syphilides. It resists antisyphilitic treatment. It somewhat resembles keloid, but there is no preceding scarring. Progressing, it invades the nasal septum, and the mucous membrane of the nasal fossæ, and thence may extend to the pharynx and larynx, the gums, and the buccal mucous membrane. The course is chronic; it may extend over fifteen or twenty years.

When fully developed, its characteristic features are ivory-like hardness, with brawny thickening and rigidity of the skin over the nose and upper lip, deformity, thickening of the septum, blocking of the nasal passages, and sometimes urgent dyspnœa from laryngeal stenosis. The affection is strikingly indolent, showing no fatal tendency nor even any general constitutional disturbance. Organisms have been described in the affected parts. *See* Micro-organisms: 13.

The majority of the cases occur between the ages of twenty and forty-five, and no special exciting or predisposing condition has been noted.

Prognosis.—The prognosis, so far as cure is concerned, is most unfavourable.

Treatment.—The treatment of rhinoscleroma can only be palliative.

10. **Diphtheria.** — Diphtheria affecting the nasal passages is more rarely met with as a primary local manifestation than as an extension from the pharynx. Mucoid and muco-purulent discharge from the nose, tinged with blood, often fœtid and mixed with shreds of membrane, together with blocking of the nose, are the local symptoms. *See* Diphtheria.

11. **Glanders.**—*See* Glanders.

12. **Foreign Bodies in the Nose.**—Buttons, pieces of pencil, or other small bodies are sometimes introduced into, and become firmly fixed in, the nasal cavities by children or hysterical women; occasionally, too, they have been ejected into the back part of the nose by vomiting, having been swallowed. The commonest situation for a foreign body in the nose is against the anterior portion of the inferior turbinated body; in the back part of the nose they are usually found in the lower meatus. Their presence generally induces, after a time, an offensive muco-purulent, sometimes sanguineous, discharge. Ulceration, and even perforation, of the septum may result, but necrosis has not been observed.

Rhinoliths. — Calculous concretions are occasionally found in the nares. They originate in a deposit of the saline constituents of the nasal mucus. The concretions are made up chiefly of phosphate and carbonate of calcium, with about 20 per cent. of organic matter, and, as a rule, are probably referable to some alteration in the character of the nasal secretion. The symptoms are those of a foreign body long retained—increasing pressure from progressive accretion of the deposit, ulceration, profuse purulent discharge from the nostrils or into the throat, often offensive, in exceptional cases even burrowing outwards through a fistulous opening on the face. Neuralgia is sometimes also caused by the presence of these substances. In other cases the symptoms may be only those of chronic nasal catarrh with obstruction. The writer once met with a case in a young woman suffering from chronic hypertrophic rhinitis associated with mucous polypi. During removal of the growths a calcareous substance was found wedged in the lower portion of the middle meatus, and deeply imbedded in the polypous mass. This proved upon extraction to be a rhinolith, the nucleus of which was half of a large bead.

13. **Parasites in the Nasal Cavities.**—Parasites occasionally infest the nose, and may produce very serious symptoms. They are specially met with in hot climates; in the temperate zone they are of very rare occurrence.

The most common form seen are *maggots*, derived from the ova of different kinds of flies deposited in the nasal passages or accessory nasal cavities. They are there quickly hatched, and may make their way into all the spaces of this region, destroying the lining membrane, and sometimes causing necrosis of the osseous walls. In extreme cases the larvæ may burrow into the connective tissue of the face and scalp, producing extensive destruction of the tissues.

Earwigs, *leeches*, the *larvæ of beetles*, *round-worms*, and *thread-worms* occasionally invade the nasal passages.

Treatment.—Chloroform has been found the most efficacious means for destroying these parasites.

14. **Tumours.**—(*a*) *Mucous Polypus.*—This is the most common of all intranasal tumours. It is in many instances associated with hypertrophic rhinitis, and appears to result from continued catarrhal irritation.

Anatomical Characters.—Mucous polypi consist of a reticulum of connective tissue, enclosing in interspaces a muco-gelatinous fluid which contains round and fusiform cells. As a rule they are multiple, often bilateral, and in clusters, the tumours varying much in size. They may readily be recognised by their greyish-coloured surface traversed by dilated blood-vessels, their soft and gelatinous consistence, their mobility, and their fluctuating size, due to their hygrometric property.

Mucous polypi are attached by narrow pedicles, more or less dense, and they more commonly spring from the middle turbinated bodies, but have sometimes deeper attachments, such as the superior turbinated bones and upper meatus, the infundibulum, and the borders of the hiatus semilunaris. They usually grow forwards, and occupy the anterior portion of the nasal fossæ. They may also hang into and block the post-nasal space.

Symptoms.—The ordinary symptoms of polypus of the nose are nasal obstruction with dyspnœa, aggravated in damp weather, muffled voice-sound, a sense of 'fulness of the head' and oppression with headache, nasal irritation and sneezing, impairment or total loss of smell, and mouth-breathing, with dryness and irritation of the throat. In certain individuals mucous polypi are an exciting cause of asthmatic attacks.

Treatment.—Removal of the growths is the only effectual treatment. The wire snare is beyond question the best instrument to operate with. A cold wire generally answers better in the case of the large polypi. A galvano-cautery loop is preferable for the removal of smaller growths and redundant tissue. The base of the polypi must be destroyed by the galvano-cautery or chromic acid to prevent recurrence, and it is essential that the last trace of growths should be removed. To effect this, the nasal fossæ must be thoroughly explored, and all operative measures carried out under a bright light through a nasal speculum.

(*b*) *Fibroma of the Post-nasal and Nasal Region.*—*Naso-pharyngeal Polypus.*—Synon.: Nasal Fibroma.—This is a more rare growth, mainly of surgical interest, occurring between fifteen and twenty-five, and more common in males.

It is a hard, fibroid, rounded and lobulated, very vascular tumour, growing from the periosteum covering the basilar process of the occipital bone, at the vault of the pharynx, or from the body of the sphenoid, or in the upper and posterior part of the nasal cavity itself.

Fibromata may become so large as to encroach upon, displace, and destroy the neighbouring structures, expand the osseous framework of the nose, and give rise to that peculiar type of facial distortion known as 'frog-face.' Sometimes they lead to bulging of the palate and deformity of the mouth, or, tending upwards and outwards, cause protrusion of the eyeballs. Invasion of the cranial cavity through the cribriform plate of the ethmoid or of the sphenoidal cells may occur as an extreme result.

The chief symptoms of naso-pharyngeal polypus are nasal obstruction, tenacious mucous or muco-purulent discharge frequently tinged with blood, impairment of the voice, dyspnœa, anosmia, deafness, headache and facial neuralgia, somnolence, difficulty in swallowing, regurgitation of liquids into the nose, and epistaxis. Sarcomatous degeneration is not uncommon. The growth may also have a mixed character from the beginning, and present the type of myxo-fibroma, adeno-fibroma, chondro-fibroma, or osteo-fibroma, chiefly occurring in the nose proper.

Treatment.—This kind of growth, when circumscribed, should be removed with a wire snare, preferably cold to prevent hæmorrhage, which is the immediate danger in extirpating the growth. Electrolysis has in several instances effected a very marked reduction in the tumour.

For more severe cases surgical interference on a larger scale is called for.

(*c*) *Papillomata.*—These wart-like growths are usually met with on the anterior portion of the inferior turbinated bodies, on the septum—at the junction of the cartilaginous and osseous portion, and on the floor of the nose. More rarely, they spring from the mucous membrane lining the deeper portions of the nasal fossæ as well.

The symptoms are obstruction, surface-irritation, discharge, and epistaxis. The treatment consists in evulsion by cutting forceps, or snare; or destruction by the galvano-cautery.

(*d*) *Ecchondromata.*—Cartilaginous outgrowths are not uncommon in the nose, associated with septal deflection. They may be recognised as convex protuberances with broad base, springing from the cartilaginous septum, and producing either obstruction or complete occlusion of the nasal passage. Independently of septal deviations, cartilaginous tumours are rare; they originate in the cartilaginous septum, the outer wall of the nose, or even the vault of the pharynx. They appear as dense, spheroidal tumours, which in extreme cases may attain very large dimensions, and then resemble naso-pharyngeal fibromata in their course and symptoms. When smaller, ecchondromata in the anterior part of the nares cause only obstructive and catarrhal symptoms.

Treatment. — Cartilaginous outgrowths from the septum should either be removed with the galvano-cautery knife or a nasal saw, or they may be snared off when they are more distinctly pedunculated. Deep-seated destructive tumours call for more elaborate operation.

(*e*) *Exostoses.*—Osseous outgrowths, forming bony spurs or bridges obstructing the nares, have already been described.

(*f*) *Osteomata.*—These growths, of varying size and hardness, are more or less spherical, and covered by deep red mucous membrane. They are generally met with between the ages of twenty and twenty-five. They differ from exostoses in that they are not attached to the osseous walls of the nose.

The symptoms that they give rise to often resemble those produced by foreign bodies, or rhinoliths, including neuralgia, headache, soreness and intense itching of the nose, discharge—which may be fœtid from ulceration and necrosis, anosmia, and epistaxis. The treatment involves operation.

(*g*) *Angeiomata.*—These vascular growths, the so-called 'erectile tumours,' are very rare. They are accompanied by catarrh, and particularly by hæmorrhage. They appear as bluish-red or deep purple elevations of the mucous membrane, with irregularly mammillated surface, at times distinctly pulsating. Obliteration of the growth with the galvano-cautery is the best treatment.

(*h*) *Malignant growths: Sarcoma—Carcinoma.*—Malignant disease of the nasal fossæ is rare — carcinoma more rare than sarcoma. The tumour is a single pedunculated growth, with a broad base, dark red or bluish, and less dense than nasal fibroma, but more widespread in the post-nasal region, presenting a rounded and lobulated surface. The ætiology is obscure. The growth has been ascribed to irritation of nasal polypi, but on insufficient evidence.

Sarcoma, as a complication of nasal fibroma, has already been referred to.

Cancer of this region may be a direct extension from the pharynx or antrum; or it may occur as a secondary manifestation, and then present the type of scirrhus or encephaloid.

Epithelioma is more common. Beginning as a wart-like excrescence on the septum or alæ, it grows rapidly, invades the surrounding tissues, and results in deep spreading infiltration and ulceration. The symptoms are those already described as produced by all invading growths of this region, associated with progressive impairment of health and cachexia.

Treatment.—Temporary benefit can be obtained by operation. Palliative measures, to relieve pain and to meet any urgent symptoms that may arise, are, as a rule, the only treatment that can be adopted with advantage. In nasal sarcoma cure is sometimes effected by early removal of the growth.

15. **Post-nasal Adenoid Growths.**—Ætiology.—The great majority of cases are met with in childhood. At times one is called upon to treat the disease in adults, but this is exceptional; and when post-nasal growths are found in any marked degree of development between the ages of twenty and twenty-five, the clinical history will show that the characteristic symptoms of the affection had been evident from a much earlier age. The influence of heredity is often striking. These growths are said to occur especially in subjects of a lymphatic temperament or strumous diathesis. There is, however, no evidence that the vegetations are essentially related to any specific disease. They occur in all classes, under the most varied conditions of living. They may therefore be said to arise solely from a catarrhal process, the tendency to which is inherited, and which induces overgrowth of the adenoid tissue of the post-nasal space; and to constitute an early hypertrophic disease of the naso-pharyngeal tract, which in later life may sometimes result in chronic hypertrophic rhinitis.

The tendency to active growth of lymphoid tissue in childhood appears to be the main predisposing factor in the production of the disease. The exciting causes are all the influences which promote naso-pharyngeal inflammation, including a cold and damp atmosphere, scarlet fever, measles, and whooping-cough. The condition is in a certain proportion of cases associated with cleft palate. In many cases no special cause can be found.

Anatomical Characters. — The growth occurs as an aggregated mass at the vault of the pharynx. With the rhinoscope it is there seen as a circumscribed outgrowth, with a lobulated and fissured surface, situated centrally at the uppermost portion of the naso-pharyngeal cavity. It is analogous in appearance to the faucial tonsils, and is known as the *pharyngeal* or *Luschka's tonsil.* The growths over the lower and lateral portions of the post-nasal surface are more disseminated. When they attain a large size, they project downwards and forwards from the pharyngeal roof, invading and blocking the posterior nares. Extending also laterally, the vegetations encroach upon the Eustachian orifices and obstruct them more or less.

Symptoms.—These vary according to the localisation and extent of the overgrowth in individual cases. The characteristic symptoms are obstinate nasal catarrh, the discharge being watery, mucous, or at times bloody; heavy stertorous breathing; inability to keep the mouth closed; muffled, thick speech, associated with a peculiar 'deadness' of voice; deafness, which, when occurring in early childhood, may at times even result in deaf-mutism; and a vacant facial expression, coupled in aggravated cases with dulness of intellect. Relapsing bronchitis is a not uncommon associate of post-nasal growths, and some cases of asthma in children are either directly due to these or aggravated by their presence. The interference with respiration may prevent development of the thorax, and lead to serious retraction or even deformity of the chest. Post-nasal adenoid growths are a very important source of reflex irritation in certain cases of periodically recurrent and spasmodic coryza, identical in every way with so-called 'hay fever.' In very young infants the obstruction to breathing may be so great as to interfere very seriously with nutrition.

Course.—The active stage of development commences sometimes in very early infancy, and it continues to the age of puberty. After this period the progress of the growths is often arrested; they diminish gradually in size; and in their withered condition they cease to encroach upon the now more roomy post-nasal space.

Diagnosis.—The features of this disease are, as a rule, sufficiently diagnostic. The existence of the growths can be determined by examination with the rhinoscopic mirror or exploration of the post-nasal cavity with the finger. In very young subjects the latter is the readier and more feasible method. The growths are more or less soft. When large, they feel like a mass of earth-worms; when smaller and more diffuse, their surface is granular and velvety. They are very vascular; and they bleed readily, at times very freely, even on introduction of the finger for the purpose of examination.

Treatment.—A cure can only be obtained by extirpation of the growths. The operation must be performed without delay. Evulsion of the growths is best effected by cutting forceps; in other instances they may be scraped away with specially devised ring-shaped knives. The general health requires attention.

William Mac Neill Whistler.

NOSOPHYTA (*νόσος*, a disease; and *φυτόν*, a plant).—A term employed by Gruby to designate a group of cutaneous affections, in which a fungus-formation constitutes an essential part of the disease. *See* Tinea Tonsurans; Tinea Versicolor; and Favus.

NOSTALGIA (*νόστος*, return; and *ἄλγος*, sadness).—Synon.: Fr. *Nostalgie*; Ger. *Heimweh.*—A form of melancholia, sometimes occurring in persons who have left their homes. The symptom from which it derives its name is an intense desire to return home; and this is accompanied by great mental and physical depression, which may end fatally. *See* Melancholia.

NUCLEUS.—*See* Cell.

NUMMULATED SPUTUM (*nummus*, a coin).—A form of sputum which, when spreading out on a surface or floating in water, resembles a coin in shape. *See* Expectoration; and Sputum, Examination of.

NURSES, Training of.—Training is to teach not only what is to be done, but how to do it. The physician or surgeon orders what is to be done. Training has to teach the nurse how to do it to his order; and to teach, not only how to do it, but *why* such and such a thing is done, and not such and such another; as also to teach symptoms, and what symptoms indicate what of disease or change, and the 'reason why' of such symptoms.

Nearly all physicians' orders are conditional. Telling the nurse what to do is not enough and cannot be enough to perfect her — whatever her surroundings. The trained power of attending to one's own impressions made by one's own senses, so that these should *tell* the nurse how the patient is, is the *sine quâ non* of being a nurse at all. The nurse's eye and ear must be trained—smell and touch are her two right hands—and her taste is sometimes as necessary to the nurse as her head. Observation may always be improved by training—will indeed seldom be found without training; for otherwise the nurse does not know what to look for. Merely looking at the sick is not observing. To look is not always to see. It needs a high degree of training to look, so that looking shall tell the nurse aright, so that she may tell the medical officer aright what has happened in his absence—a higher degree in medical than in surgical cases, because the wound may tell its own tale in some respects; but highest of all, of course, in children's cases, because the child cannot tell its own tale; it cannot always answer questions. A conscientious nurse is not necessarily an observing nurse; and life or death may lie with the good observer. Without a trained power of observation, no nurse can be of any use in reporting to the medical attendant. The best one can hope for is that he will be clever enough not to mind her, as is so often the case. Without a trained power of observation, neither can the nurse obey intelligently his directions. It is most important to observe the symptoms of illness; it is, if possible, more important still to observe the symptoms of nursing; of what is the fault not of the illness, but of the nursing. Observation tells *how* the patient is; reflection tells *what* is to be done; training tells *how* it is to be done. Training and experience are, of course, necessary to teach us, too, *how* to observe, *what* to observe; *how* to think, *what* to think. Observation tells us the fact; reflection the meaning of the fact. Reflection needs training as much as observation. Otherwise the untrained nurse, like other people called quacks, easily falls into the confusion of '*on account of*,' because '*after*'—the blunder of the 'three crows.' The nurse is told by the medical attendant, 'If such or such a change occur, or if such or such symptoms appear, you are to do so and so, or to vary my treatment in such or such a manner.' In no case is the physician or surgeon always there. The woman must have trained powers of observation and reflection, or she cannot obey. The patient's life is lost by her blunder, or 'sequelæ' of incurable infirmity make after-life a long disease; and people say, 'The doctor is to blame;' or, worse still, they talk of it as if God were to blame—as if it were God's will. God's will is *not* that we should leave our nurses, in whose hands we must leave issues of life or death, without training to fulfil the responsibilities of such momentous issues.

To obey *is* to understand orders, and to understand orders really is to obey. A nurse does not know how to do what she is told without such 'training' as enables her to understand what she is told; or without such moral and disciplinary 'training' as enables her to give her whole self to obey. A woman cannot be a good and intelligent nurse without being a good and intelligent woman. Therefore, what 'training' signifies in the wide sense, what makes a *good training-school*, what moral and disciplinary 'training' means, and how it is to be attained, are to be clearly understood.

The essentials for a training-school (or, indeed, for a nurse-establishment of any kind) may be shortly given thus:—

(*a*) That nurses should be technically trained in hospitals *organised for the purpose.*

(*b*) That they should live in 'homes' fit to form their moral lives and discipline, to which may be added:—

I. *What makes a good Training-school for Nurses?*

(1) At least a year's practical and technical *training* in hospital wards, under *trained* head-nurses (so-called 'sisters' of London hospitals), who themselves have been *trained* to *train.* A second year if possible as ward-nurse (day and night), with the benefit of further theoretical instruction.

For a district nurse, at least an additional three months' training in nursing by the poor bedside, under a trained and training district superintendent, is essential.

The training of probationers should be as much a part of the duty of the head-nurse ('sister') as directing the under-nurses or seeing to the patients.

To tell the training, you require weekly records, under printed heads corresponding with the 'List of Duties,' kept by the head-nurses, of the progress of each probationer (pupil) in her ward-work, and in the moral qualities necessary in her ward-work; a monthly record by the matron of the results of the weekly records; and a quarterly statement by her as to how each head-nurse has performed her duty to each probationer. The whole to be examined periodically by the governing body.

(2) Clinical lectures from the hospital professors; lectures on subjects connected with nurses' special duties, such as elementary instruction in chemistry, with reference to air, water, food, &c.; physiology, with reference to a knowledge of the leading functions of the body; and general instruction on medical and surgical topics; examinations, written and oral, at least four of each in the year, all adapted to nurses; as also lectures and demonstrations with anatomical, chemical, and other illustrations, adapted especially to nurses—all in the presence and under the care of the matron (Lady Superintendent) and mistress of probationers (Class-mistress and 'Home'-sister); together with instruction from a medical instructor, one of the hospital professors and hospital medical staff, specially selected to teach the nurses.

A good nurses' library of professional books, not for the probationers to skip and dip in at random, but to be made careful use of, under the medical instructor and class-mistress.

(3) Classes for a competent mistress to drill the professorial teaching into the probationers' minds; the mistress of probationers to be above all a 'home'-sister, capable of making the 'home' a real *home*, and of training and disciplining the probationers there in all good—in moral qualities, customs and habits, and manners, without which no woman can be a nurse, and in their duty and feeling to God as well as to their neighbour.

(4) The authority and discipline over all the women of a trained lady-superintendent, who is also matron of the hospital, and who is herself the best nurse in the hospital, the example and leader of her nurses in all that she wishes her nurses to be, in all that training is to make her nurses.

(5) An organisation not only to give this training systematically, and to test it by current tests and examinations, but also to give the probationers, by proper help in the wards, time to do their work as pupils as well as assistant-nurses, and above all to make it a real moral as well as nursing probation—for nursing is a probation as well as a mission.

(6) Accommodation for sleeping, classes, and meals; arrangements for time and teaching and work; surroundings of a moral and religious, and hard-working and sober, yet cheerful tone and atmosphere, such as to make the training-school and hospital a 'home' which no good young woman of any class need fear by entering to lose anything of health of body or mind; with moral and

spiritual helps, and an elevating and motherly influence over all, such as to make the whole a place which will train really good women, who can withstand temptation and do real work, and neither be 'romantic' nor 'menial.' For, make a hospital as good as you will, hospital-nurses require more such helps, and get less, than women either in their own homes or in domestic service.

Every hospital should have and *be* such a school for training nurses for itself and other institutions, including district and private nurses, who must be trained in hospitals, and therefore cannot have a training-school of their own. Professors and medical staff cannot be always, or indeed ever at hospital bedsides, showing nurses what to do. Let them give the pupil-nurses clinical and other lectures. Above all, this is necessary for those who are to be head-nurses, matrons, and lady-superintendents. The success of any training-school depends mainly upon having trained nurses themselves capable of training others—(*a*) in ward-nursing; and (*b*) in cases, so as to be able to understand what physician and surgeon order, and do it.

II. *Course for all Probationers.*

(1) To do duty as assistant-nurse and probationer successively in one or more wards of each of the hospital divisions, one or two or three months in each, male and female surgical, male and female medical, children's, obstetric, ophthalmic, Magdalen; ending her course, if possible, in the medical instructor's wards.

The course should, if possible, *begin* in the female medical wards. No two *fresh* probationers to be in the same ward. One nurse-probationer and one lady-probationer to be together, where possible.

(2) To learn ward-management by being in charge of wards during the head-nurse's dinner-hour, and during nurses' recreation hours; to take, when sufficiently advanced in the year's training, day or night staff duty for staff-nurses on their holidays; to have at least one month's night duty—a fortnight at a time—in the year's training.

(3) To take, when sufficiently advanced, special duty, by day or by night, upon special cases, such as ovariotomy, lithotomy, tracheotomy, typhoid, &c., in the single-bed wards.

(4) To make a set of all the different bandages required.

(5) To learn from the head-nurse to read the 'cards,' or patients' bed-tickets, especially in the medical wards.

(6) To keep a diary of her ward duties.

Besides this diary, each probationer at least once a month to draw up a sketch of her day's work, not merely as a ward-assistant or assistant-nurse, but as a probationer in training, namely, what she has learnt that day from ward-sister and staff-nurse, what she has observed on special cases in the ward, &c.

Warning is given out only *after* the day's work, that it is such and such probationer's day to write it out.

(7) To take careful notes of cases. A case-paper should be regularly kept by every probationer of cases selected by the medical instructor.

The case-paper to have printed headings, such as 'Temperature,' 'Pulse,' 'Respiration,' to be taken morning and evening [in some cases the physician will require the 'temperature' to be taken as often as every hour, or even every quarter of an hour], 'Sleep,' 'Nourishment,' 'Urine,' 'Stools,' to be noted every twenty-four hours—in each case character as well as quantity; 'Treatment,' to be noted daily, in English, and not copied off the 'cards'; and other such heads; preceded by a real medical history of the case—of the causation of the disease; for example, in typhoid fever and other dirt-diseases, produced by foul air and foul water. This is followed by remarks on the termination of the case. These case-papers should be rigorously overhauled by ward-sisters and the class-mistress, as well as by the medical instructor, who should also at his own hospital-beds check the case-taking.

(8) To take careful notes of all lectures, also overlooked by class-mistress and medical instructor.

(9) To read and be shown illustrations of the cases nursed in the wards [the keen professional interest felt by a promising probationer in finding her own cases in a book must be encouraged].

(10) To jot down afterwards, but while still fresh in the memory, any remarks suitable for her own instruction made to the students by the hospital physicians and surgeons in going their rounds, and to write out her jottings in the class-room under the superintendence of the 'home'-sister.

(11) To write out under the superintendence of the 'home'-sister what has been learnt both from ward-sisters and medical instructor as to what is to be done and how to do it in nursing; as to *why* it is done, and why something else is not done; as to symptoms and the 'reason why' of such symptoms.

Without (*a*) time for these things, average nurse-probationers degenerate into conceited ward-drudges. Without (*b*) a system for these things, they potter and cobble out their year about the patients, and make not much progress in real nursing—that is, in obeying the physicians' and surgeons' orders intelligently and perfectly.

III. *Training to Train.*—To enable nurses to train nurses, a special training is required; and for this a longer period than a year, or even two years, in the hospital is necessary. To *train* to *train* needs a system:—

(1) A systematic course of reading, laid down by the medical instructor, who recommends the books for the training-school

library. Hours of study, say two afternoons a week; class-mistress ('home'-sister) to lead one at least of these afternoons.

(2) Regular oral examinations by medical instructor; each training-nurse must acquire powers of expression to train others. He must cultivate these in answering him. Some system of mutual examination.

(3) At least four written examinations in the year on written questions, by the medical instructor. Essays to be written on given subjects in nursing.

(4) Pre-eminently careful notes of lectures, in order to enable nurses in future to drill others in understanding the professional lectures, as they have themselves been drilled.

(5) Pre-eminently careful notes of cases—the touchstone for the future trainer. If she cannot observe and understand her own cases, how can she teach others to observe and understand them? If she never learn the reason of what is done, how can she train others to learn it? 'Reading up' her own cases.

(6) A current constant course of careful learning from head-nurses and medical instructor and physicians or surgeons in wards where she is probationer, to know not only what symptoms are there, and what symptoms are to be expected in such and such an event, but also the *meaning* of such symptoms—the 'reason why.' To know not only when a wound or surgical injury or operation 'looks well' and when it 'looks ill,' but *why* it looks well or ill; and to be able to tell others *why*. To know not only what is to be done, and how it is to be done, but *why that* is done, and not something else.

(7) At least twice in the year's training, but not at the beginning, to have a week or more of going the night-rounds with the night-superintendent of nurses, which is equally good for night-superintendent and for probationer. The future ward 'sister' or matron should have had at least three months as night staff-nurse under an experienced night-nurse, to teach her what the responsibilities of a hospital-ward night-nurse are.

(8) To spend at least a week, but not at the beginning of her year, in the linenry.

(9) The future superintendent, who is to have a training school, should have *at least* a fortnight in the year, about six or nine months on in her training, in the 'home' if possible, taking or assisting at classes, and doing all but the 'home'-sister's secretarial work.

(10) Taking temporary duty of ward-sisters on their holidays, and—the best—of 'home'-sister on her holiday. Of course no fresh probationer, however gifted, would be put on such duty.

(11) Being relieved of the more menial ward-work, such as cleaning lavatory basins, w.c. pans, &c., when she can do it so perfectly of herself without being told, that she can teach others to do it. This will scarcely be, for all kinds of this ward-work, before she is a six months' old probationer.

(12) A second or third year's training for the higher posts. A future matron or lady-superintendent to have had experience as ward-sister, and to have had at least one year as assistant-superintendent and as night-superintendent, in some hospital under a trained lady-superintendent.

(13) The matron must give future matrons or superintendents insight into their duties. There must be an examination and questions given on superintendents' work.

IV. *Current Tests, Current Records of Progress and Examinations.*

(*a*) The candidate should fill up a form of application, answering printed questions. Regulations of training printed on the back.

(*b*) Should enter on a month's trial. She receives the time-table and the list of duties.

If the candidate is accepted after the month as probationer—

(*c*) Each ward head-nurse or sister keeps a record of each probationer, under printed heads corresponding with the list of duties. She fills up the columns with suitable marks once a week. The matron, after examining the ward-sister's reports with ward-sister and 'home'-sister present, and questioning each ward-sister on each probationer, records her own opinion on the sister's reports. The medical instructor should, at appointed times, examine each probationer separately, upon the duties which the ward-sister has 'recorded' her as defective in, in the presence of ward-sister, 'home'-sister, and matron; and also should examine each ward-sister separately upon her records of each probationer in the matron's presence, but not in the probationer's.

The 'home'-sister also furnishes a record of each probationer's conduct at the classes and in the home.

(*d*) A register with two pages for each probationer should be kept monthly by the matron assisted by the 'home'-sister. It corresponds with the ward-sister's book, and has monthly entries for the whole year of training. The accounts in these books must tally at the end of the year, or somebody has been wanting in moral courage.

This register should be supplemented by a further (private) register of the career and character of each probationer who has completed her first year, until she leaves the hospital, and so long afterwards as she keeps in communication with the authorities, and this she should be encouraged to do.

(*e*) While the ward-sisters keep a weekly and the matron a monthly record of the progress of each probationer, she is required to keep a diary of her ward-work, to keep 'case-papers' with the daily changes in case and treatment, and to keep notes of lectures; and the careful examination of these affords important items in the records of results of training, and of the capabilities of each probationer. The medical instructor enters his verdict on professional points in the monthly register.

(*f*) The medical instructor, and each hospital professor who gives lectures to the probationers, examines them orally in the presence of matron and 'home'-sister. He examines their notes of the lectures and awards marks. It is communicated to each probationer how she stands as to marks.

(*g*) Written questions are given by the medical instructor at least four times a year, to be answered in writing, at least by the probationers who are training to train others. Marks are awarded, and the number of marks received communicated to each probationer. Possibly prizes may be given for proficiency.

These are some of the current tests of the results or non-results of training, of progress or no progress. Without some regular system of this kind, there can be no real organisation for training. The heads of the training school *must* 'take stock' and know where each probationer really stands, and what the training is really doing, and must let each probationer know where she stands. The matron must be one whose desire is that the probationers *shall* learn: a rarer thing than is usually supposed. But besides this there is a constant, motherly, intangible supervision and observation to be exercised, for there are qualities which no written tests can touch and no examinations can reach. The probationers must really be the matron's children; the 'home'-sister must really be their elder sister.

A training school without a mother is worse than children without parents. And in disciplinary matters none but a woman can understand a woman.

V. *Staff of Training School.*

(1) The *superintendent* of the training school is the matron of the hospital, and head of all the women in the hospital. She is present when possible at the probationers' lectures and demonstrations and oral examinations. She is responsible for the selection and dismissal of the probationers, and for the due conduct by those in charge under her (home-sister, ward-sisters) of their training. She holds frequent informal meetings of the female heads of the hospital and 'home' for the purpose of exchanging notes and knowledge regarding probationers and nurses.

(2) The trained '*home*'-*sister* (class-mistress; mistress of probationers) resides in the 'home'; is in charge of the 'home' and its servants and of the probationers. She gives two classes a week at least to the senior nurse-probationers and two to the juniors, drilling them in the medical instructor's lectures, &c. &c. She superintends two afternoons at least in the week the study hours of the probationers training to train others—that is, all who are to be in future in charge of nurses, whether as ward-sisters, matrons, or superintendents—and gives direct instruction on one at least of these afternoons. She gives singing and Bible classes. She attends all clinical and other lectures, demonstrations, and examinations. She reports monthly to the matron, and through her from time to time communicates with the ward-sisters on the merits and defects in the probationers' work and characteristics, and as to what action to take respecting them.

Above all, the 'home'-sister must be the mother of the probationers, really caring for each for her own sake, carrying each on her heart before God. She must know how to make it a real 'home,' with constant supply of all wants and constant *sympathy*, which must be taught by example and by precept. It must be a moral and spiritual home, as well as one for the body and for technical and theoretical instruction.

(3) *Ward-sisters* (head-nurses, training-nurses). The ward-sister must train the probationers in all the duties of a nurse. *See* NURSING THE SICK.

The ward-sister (and equally the home-sister) must not want moral courage to let the probationers know any unfavourable report she has made of them in the Sisters' Records. Not to do so would be unfair to the probationers.

The ward-sister, or—instructed by her—the staff-nurse, is to *show* every new probationer how to do her work; not only what things are to be done, but how she is to guard against the *way* they are not to be done, as well as against what is not to be done. She is to instruct the nurses how to instruct probationers. As it is impossible for a 'sister' with a sister's duty in a 'heavy' ward always to have time to show all needful things herself to the probationer, the sister must from time to time question her to see if she has been shown her duties, and how she does them, remembering that it is of use to the probationers to put these things into words; and for this purpose each probationer is to be occasionally taken by the sister on her ward rounds, and examined as to what she has done in each case under her charge—whether she has learnt to do it rightly and knows 'the reason why.'

The ward-sister must also train the probationers in alacrity of intelligent obedience to *her* medical authorities, which must be the probationer's lesson of what obedience ought to be. She must regard the probationers less as hospital servants, than as pupils to be trained for hospital 'sisters' and nurses. The training-nurse must be a bridge for the pupil-nurses. 'He who will be a chief, let him be a bridge.' She must not make them too little of pupils, too much of assistant-nurses—or, rather, they cannot be too much of assistant-nurses, but being too little of pupils makes them too little of real assistants, and (for all their future) of real nurses. The training-nurse must interest the pupil-nurse in her cases. The pupil cannot have a nurse's interest in them without knowing *what they are*—she must feel for their suffering. Cases she is interested in she nurses with twice the efficiency.

The key to the whole situation is the ward-sister, through whom the trained matron influences nurses, probationers, ward-maids, and patients throughout the hospital.

When probationers are put on night duty, the night-superintendent is responsible for their training. Night duty is better taken after the first year's course.

(4) *Medical Instructor.*—The medical instructor, one of the hospital staff who will undertake the duties, gives a course of lectures on medical and surgical topics specially connected with nursing duties; demonstrations with anatomical and other illustrations, specially adapted to nurses; lessons on the elementary knowledge of physiology, anatomy, the situation of the principal arteries, &c.; lessons on bandaging; lessons in hygiene, both of wards and patients, and in diet; lessons on the causation of disease; on what is to be done in emergencies; on how to make beds for various operations and diseases, &c. &c. He is to lay down a systematic course of reading for the probationers who are to train others; to examine them by written questions at least four times in the year; to give them subjects for essays, and to examine these; to award marks. He is to examine all the probationers orally; to examine their notes of lectures, to award marks; to examine their case-papers. He is to give clinical lectures at his own 'beds' (it would be desirable if each probationer could end her course of wards in the medical instructor's wards), and to examine 'case-papers' taken of his own cases; to teach symptoms, and what symptoms indicate, and *why* such or such a treatment; and what shows a case to be 'doing well' and what 'ill'; and to teach the probationers so that they can teach other probationers in their turn. He will encourage in every way the professional interest of the nurse in the cases she is nursing; he will point out these cases in medical and surgical books. At appointed times he will examine each probationer separately with a view to ascertain the duties she is defective in; and each ward-sister separately upon her recorded experience of each probationer. He will fill up the register at the end of each probationer's year of training, with his verdict on her capacities, and on the professional results of her training. The medical instructor should be one of mature age and experience; should be really a father to the pupil-nurses, and one whom the matron can freely consult with. If the hospital have a *permanent* resident medical officer fit for the purpose, he should be the instructor.

(5) *Esprit de corps* should be encouraged. It is a great help to think, 'If I do this I shall be a disgrace to my training-school (or hospital). If I do that I shall be an honour to it.' Let nurses be proud of their *alma mater*. Let them think their own training-school and their own doctors the first in the world. Let there be a friendly rivalry with other hospitals, and never try to fuse all nurses into one mass—one indistinguishable mass—of all training-schools or hospitals.

If, however, there has been little or no discipline in the training-school, then the *esprit de corps* will tend to harm and not to good.

Training, General Consideration of. A year's training is simply teaching the nurse her A B C—teaching her how to go on learning for herself, learning to understand her doctor's orders and to read her own experience, for mere experience may only teach the *post hoc, ergo propter hoc*. A nurse without training is like a man who has never learnt his alphabet, who has learnt experience only from his own blunders. Blunders in executing physician's or surgeon's orders upon the living body are hazardous things, and may kill the patient. Training is to enable the nurse to see what she sees—facts, and to do what she is told; to obey orders, not only by rule of thumb, but by having a rule of thought or observation to guide her. Otherwise she finds out her own mistakes by experience acquired out of death, rather than life, or does not find them out at all.

Medicine, surgery, pathology, and, above all, hygiene, have made immense strides, partly in consequence of improved tools, improved instruments of observation. Nursing, their agent, has to be trained up to them. A good nurse of twenty years ago had not to do the twentieth part of what she is required by her physician or surgeon to do now; and so after the year's training she must be still training under instruction in her first and even second year's hospital service. Indeed, every five or ten years a nurse after leaving the hospital really requires a second training nowadays. Nursing needs its instruments nearly as much as surgery, and yet more than medicine. The physician prescribes for supplying the vital force—but the nurse supplies it. Training is to teach the nurse how God makes health and how He makes disease. Training is to teach a nurse to know her business, that is, to observe exactly, to understand, to know exactly, to do, to tell exactly, in such stupendous issues as life and death, health and disease. Training is to enable the nurse to act for the best in carrying out her orders, not as a machine but as a nurse; not like Cornelius Agrippa's broomstick which went on carrying water, but like an intelligent and responsible being. Training has to make her, not servile, but loyal to medical orders and authorities. True loyalty to orders cannot be without the independent sense or energy of responsibility, which alone secures real trustworthiness. Training makes the difference in a nurse that is made in a student by making him prepare specimens for himself instead of merely looking at prepared specimens. Training is to teach the nurse how to handle the agencies within our control which restore health and life, in strict obedience to the physician's or surgeon's power and knowledge—how to keep the health-mechanism prescribed to her in gear. Training must show her how the effects on life of nursing may be calculated with nice precision—such care or carelessness, such a sick-rate, such a duration of case, such a death-rate.

And *discipline* is the essence of training. People connect discipline with the idea of drill, standing at attention—some with flagellating themselves, some with flagellating boys. A lady who has, perhaps, more experience in training than anyone else, says: 'It is education, instruction, training—all that in fact goes to the full development of our faculties, moral, physical, and spiritual, not only for this life, but looking on this life as the training-ground for the future and higher life. Then discipline embraces order, method, and, as we gain some knowledge of the laws of nature ("God's laws"), we not only see order, method, a place for everything, each its own work, but we find no waste of material or force or space; we find, too, no hurry; and we learn to have patience with our circumstances and ourselves; and so, as we go on learning, we become more disciplined, more content to work where we are placed, more anxious to fill our appointed work than to see the result thereof; and so God, no doubt, gives us the required patience and steadfastness to continue in our "blessed drudgery," which is the discipline He sees best for most of us.'

Florence Nightingale.

NURSING THE SICK.—Nursing proper, that is, nursing the sick and injured, will be here treated of, and not Preventive or Sanitary Nursing, or nursing healthy children.

Nursing is performed usually by women, under scientific heads—physicians and surgeons. Nursing is putting us in the best possible conditions for Nature to restore or to preserve health—to prevent or to cure disease or injury. The physician or surgeon prescribes these conditions—the nurse carries them out. Health is not only to be well, but to be able to use well every power we have to use. Sickness or disease is Nature's way of getting rid of the effects of conditions which have interfered with health. It is Nature's attempt to cure—we have to help her. Partly, perhaps mainly, upon nursing must depend whether Nature succeeds or fails in her attempt to cure by sickness. Nursing is therefore to help the patient to live. *Training* is to teach the nurse to help the patient to live. Nursing is an art, and an art requiring an organised practical and scientific training. For nursing is the skilled servant of medicine, surgery, and hygiene.

Nursing may be divided under four heads: (*a*) *Hospital* nursing. (*b*) *Private* nursing: that is, nursing one sick or injured person at a time, at home; giving the whole time to that one patient, generally of the richer classes. (*c*) *District* nursing: that is, nursing the sick or injured poor at home, taking as many cases as can be well attended to by one nurse. District nursing, or nursing the sick poor at home, is a branch of nursing of the highest importance, and requires the highest qualifications, because the district nurse has not, like the hospital nurse, a medical and surgical staff always at her call, and never hospital appliances to her hand. (*d*) *Midwifery* nursing, including the nursing of the healthy mother and infant after natural childbirth, the feeding, washing, and clothing of infants, and the teaching the mother the management of her own infant and herself, will not be treated of here. It differs from other nursing in this—that the lying-in woman, the patient, is not, or ought not to be, sick, and that the nursing consists in a surgical operation and in hygienic precautions. It is one of the branches of nursing most important for national health. And there is no organised system of monthly nurse-training available for nurses for the poor. Midwives do not appear to learn it, at least as a part of midwifery. Their training is said to be sufficient for it, because it is *not*. [Midwifery and general cases should not be attended by the same nurse. No ordinary precautions will secure the lying-in case from danger arising out of this practice.]

Nursing proper means, besides giving the medicines and stimulants prescribed, or applying the surgical dressings and other remedies ordered—(1) The providing, and the proper use of, fresh air, especially at night—that is, ventilation, and of warmth or coolness. (2) The securing the health of the sick-room or ward, which includes light, cleanliness of floors and walls, of bed, bedding, and utensils. (3) Personal cleanliness of patient and of nurse, quiet, variety, sympathy, and cheerfulness. (4) The administering and sometimes preparation of diet (food and drink). (5) The application of remedies. In other words, all that is wanted to enable Nature to set up her restorative processes, to expel the intruder disturbing her rules of health and life. For it is Nature that cures: not the physician or nurse. (6) Observation of the patient. We shall now discuss these duties in succession.

1. Ventilation. Warmth and Coolness.—(*a*) *Ventilation* is the removal of the air poisoned by the breath and other human emanations, and supplying its place with *fresh* air.

The very first canon of nursing is to keep the air inside as fresh as the air outside, by night as well as by day, without chilling the patient. The best rule of ventilation is still: Poke the fire, open the window, but *at the top*, for fresh air coming in at the ceiling permeates the whole room, without causing draught, and foul air escapes. Air coming in at the floor or at the level of the patient remains there and chills him, and foul air does not escape. Always air from the outside air. Windows are made to open, doors are made to shut. If the nurse ventilate the patient's room or ward through the door—that is, making the room draw the foul air from the rest of the house or building—she ventilates him with foul, not fresh air. But ventilation is impossible without sufficient floor and cubic space, and unless the windows open near the ceiling. Where other patients want air, fever patients, for example, want movement of the air; where other sick want a well-aired room, without draughts, pyæmic patients, for example, want the freest possible supply of air about their beds.

(*b*) *Warmth or coolness.*—This the physician has to prescribe—the nurse has to see to it. In fever, for instance, the physician will require her to examine the patient's feet and legs, at least every hour, to ascertain whether they are chilled, and to keep the extremities warm, even though his temperature be high, whether in summer or winter.

In bronchitis, in ovariotomy, &c., an even, high, moist temperature may be necessary, and a steaming kettle may be required on the fire night and day.

But ordinarily it is not advisable to keep the sick-room always at the same temperature. A cooler air at night is necessary. But whether cool or warm, the air must be *fresh.* Sick children become fretful in foul air at night. And young as well as old night-nurses require training to see that the physician's orders are obeyed as to keeping the air of the ward fresh by night, and not above or below a certain temperature.

The head of the sick should never be higher than the throat of the chimney, which ensures the best air. And the chimney should never be closed with a chimney-board or other contrivance.

2. Health of Sick-Room, or Ward.—This might be called 'nursing the room.' The placing the sick-bed in the best position to secure air without draught, light without glare, quiet and cleanliness—and this often necessitates rearrangement of the furniture of the whole room—is one of the essential arts of nursing. In district nursing of the poor, it must be one of the nurse's first duties to put the room in a state so that the patient *can* recover. So, too, must the hospital and the hospital-ward be built so that the patient shall not 'die of hospital.' To get rid of the conditions which have interfered with health is of course the first nursing step in helping Nature to get rid of the effects of those conditions.

(*a*) *Light.*—Second only to air is light as an essential for growth, health, and recovery from sickness—not only daylight, but sunlight—and indeed *fresh* air *must* be sun-warmed, sun-penetrated air. This should be meant to include colour, pleasant and pretty sights for the patient's eyes to rest on—variety of objects, flowers, pictures. People say the effect is on the mind. So it is; but the enlightened physician tells us it is on the body too. The sun is a sculptor as well as a painter. The Greeks were right as to their Apollo.

(*b*) *Cleanliness.*—Cleanliness and fresh air do not so much give life as they are life itself to the patient. Cleanliness—clean air, clean water, clean surroundings, and a fresh atmosphere everywhere, are the true safeguards against 'infection'—not segregation—or rather segregation by ample floor and cubic space, ample ramparts of fresh atmosphere: not segregation by walls and divisions. You cannot lock-in or lock-out the infectious poison; you cannot wall-out infection. You *can* air it out, diffuse it, and clean it away.

'Infectious Hospitals' and 'Wards,' whether necessary or not, are not a part of hygiene; and the doctrine of 'disease germs,' in the sense in which it may lead to considering 'infection' inevitable, must not be taught as a principle of sanitary nursing. That there is no such thing as 'inevitable' infection, is the first axiom of nursing.

Cleanliness of floors, ceilings, walls, bed, bedding, and utensils, and of sinks; also of lockers, if any—but there should be none.

Floors and walls.—Medical men forbid scrubbing in the sick-room. No sick-room floor ought ever to be washed, except by the doctor's orders and at the hour he orders.

The only clean floor is a floor planed, saturated with 'drying' linseed oil, well rubbed-in, stained (for appearance' sake), not too dark, so as *not* to hide the dirt, and bees-waxed with turpentine and polished. The floor to be wiped with a damp cloth and dried with a floor-brush, or cleaned by a brush with a cloth tied over it. Anything offensive spilt to be washed off at once with soap and water. Hospital-ward floors should be scraped and polished every fortnight by a *frotteur* and dry-rubbed by a man every day. The patients should be provided with slippers. No carpet, of course, in a sick-room, except a piece of washing drugget by the bedside. A dirty carpet literally infects the room.

The only clean wall is one that is oil-painted or of glazed tiles. From this you can wash the animal matters. These are what make a room musty. The worst wall is the papered wall. The next worst is the plastered wall. But the plaster can be made safe by frequent lime-washing and occasional scraping. The paper requires frequent renewing. A glazed paper gets rid of a good deal of the danger. But the ordinary bedroom paper is all that it ought not to be.

Furniture—as little as possible in the sick-room—should all be of polished wood, metal, or marble, kept clean by being wiped with a cloth wrung out of hot water.

Air can be soiled just like water. Air is always soiled where walls and carpets are saturated with animal exhalations. Dust consists greatly of organic matter. There should be no ledges out of reach capable of holding dust. An Arnott's ventilator in the chimney will keep an ordinary paper longer clean, showing the connexion of ventilation and cleanliness. Inattention to these essential matters all but foils the best nurse's best efforts.

How to clean.—Dust is the harbourer and harbinger of disease. Dust in hospitals may contain epithelial scales from the mouth, skin-epiderm, pus-cells. As there appears no limit to the reproduction of epiderm or epithelium, so there is no limit but excessive cleanliness to its deposit in dust in a hospital-ward, 'which,' as a great surgeon has said, 'never rests from fouling itself.'

The only way to *remove* dust is to wipe everything with a damp cloth. And all furniture ought to be so made that it may be wiped with a damp cloth without injury to itself, and so polished or glazed that it may be damped without injury to us. Flapping, by way of dusting, is not cleaning. To 'dust,' as now practised, merely means to distribute dust more equally over a room. To 'tidy' a room, or 'put the room to rights,' means to remove a thing from one place which it has kept clean for itself on to another and a dirtier one.

No one atom of dust ever actually leaves the room under the present system of 'dusting.' The greater part of nursing consists in keeping clean. No ventilation can freshen a sick-room where the most scrupulous cleanliness is not kept.

Bed and bedding; linen, &c.—Feverishness is generally supposed to be a symptom of fever; in nine cases out of ten it is a symptom of bedding. The patient has had reintroduced into his system the diseased emanations from himself, to eliminate which from his system Nature had appointed the disease. These, day after day and week after week, soak into his unaired bedding from below as well as from within, if the chamber-utensils are left, as is too often the case, unemptied and without a lid under the bed. Erysipelas and pyæmia are produced by an uncleansed state of bed and bedding. Black flock is sometimes used for fracture pillows. This gets full of dust, and may be the cause of erysipelas. The feather-bed is dangerous dirt's most favoured nest. Feather-beds should be picked to pieces and the tick washed at least once a year. One of the results of the feather-bed unpicked, say, for twenty years, with perhaps several lyings-in taking place on it, besides ordinary use, may be fatal pyæmia to the mother and sores to the infant. The infant may be kept during the first weeks of its life in a suffocating heap of steaming dirt. Babies are the best test of sanitary conditions. Such foul air dwarfs their bodies and poisons their blood. That patients are 'accustomed to the filth and it does them no harm,' is not only thought but said even in the present year of grace (or disgrace) 1893.

The most dangerous effluvia we know are from the excreta of the sick; these are placed, at least for a time, where they must throw their effluvia into the under-side of the bed, and the space under the bed is never aired; it cannot be with our arrangements—a valance or counterpane down to the floor, or perhaps the quilt so carefully pinned over that no air can pass under the mattress.

An adult in health exhales by the lungs and skin in the twenty-four hours three pints at least of moisture, loaded with matter ready to putrefy; in sickness the quantity is often greatly increased—the quality is always more noxious. This goes chiefly into the bedding because it cannot go anywhere else; and it stays there, because, except perhaps by a weekly or bi-weekly change of sheets, scarcely any other airing is attempted. A nurse will be careful to fidgetiness about airing the clean sheets from clean damp, the clean night-gown from clean damp, the new mattress from clean damp; but airing the dirty sheets from dirty damp, the dirty night-gown (which she is going to put on the patient after washing him) from dirty damp, never so much as occurs to her. And a mattress is supposed to be aired by somebody else sleeping on it and saturating it with his own damp before the patient comes to exhale into it the patient's damp.

The bed is *always* saturated with the patient, and the unfortunate patient who lies in it is always being saturated with the bed.

The ordinary sick-bed of a private patient is generally exactly what it ought to be to bring this poisoning process to perfection: a wooden four-poster with curtains, two or even three mattresses, or even a feather-bed, piled up—perhaps to a height above the throat of the chimney or above the lower chink of the sash-window, which is all that is ever opened; the window not opening or opened at the top; a valance fastened to the frame. Nothing ever thoroughly dries or airs such a bed and bedding.

The best bed and bedding are: An iron bedstead with rheocline springs, or the woven-wire mattress, no valance and no curtains, of course; one thin hair mattress, light Witney blankets, no heavy cotton counterpane, which retains perspiration; no blanket *under* the patient, which acts like a poultice and promotes bed-sores—bed-sores which are, all but always, a symptom not of the disease but of the nursing.

The patient should, if possible, be able to see out of window from the bed.

Two beds, one for the day and one for the night, are desirable for the best nursing of the patient. A true nurse always knows how to make a bed, and always makes it herself. And bed-making has much to do with bed-sores. She hangs up the whole of the bedding to air for a few hours whenever possible. She makes the changes of linen and bed-linen—sheets and draw-sheets—as often as is necessary, which is a great deal oftener than is usually done. In hospitals, she sees to no patient using his neighbour's towel; and to different towels being used for different purposes. In private houses cases of purulent ophthalmia, ending in blindness, have been known to have occurred from the use of a soiled towel by another member of the family. She sees to all dirty linen, and especially bandages, being instantly removed and disinfected. No disinfection will enable dirty linen to be kept with safety a single day in the same building with the sick. It is cruel to allow dirty linen from 'infectious' patients to be taken home by the relatives to be washed in the crowded rooms of the poor. Dirty linen should be removed immediately from the sick-room and sent to the laundry, at least every day. If we are careful to take away and empty bed-pans directly, surely this is still more important with soiled sheets. It must not be supposed that even a good sprinkling of carbolic powder (which, besides, injures the sheets) over the dirty linen lying in a basket, will at all obviate the necessity of instant removal. Steeping in boiling water with an antiseptic solution (carbolic acid 1 in 100) is the only safe method of disinfection. All washing of dirty linen and bandages should be done outside of the sick-room and, if possible, of the house. In a hospital the laundry should be in a separate building.

Bandages with pus on them are always to be burnt at once—to be carried straight to the ward-fire, or to a furnace. The best economy is to burn them; but one must make up the fire so that the burning shall not smell. Bandages used for fractures, &c., are the only bandages that may be washed. Soak these with chlorinated soda, a diluted pint; then boil them all night with soft-soap, soda, and chlorinated soda—a quart bottle for the two. The bandages are then to be rinsed in a tub. The boiler must, of course, only be emptied in a closet-sink.

All disinfectants are more or less a 'mystic rite,' as a great surgeon said. Absolute cleanliness is the true disinfectant; but chlorinated soda, if disinfectants are to be used, is about the best. Always have chlorinated soda for nurses to wash their hands, especially after dressing or handling a suspicious case. 'It may destroy germs at the expense of the cuticle;' but, 'if it takes off the cuticle, it must be bad for the germs,' said the same surgeon. Fire is the right way, if a thing is so bad that it wants a disinfectant. Hair (and all hospital beds should be of *hair*) should be heated to about 350°, teased, and exposed to air. Boil, wash, scour with much soap and water and, say, chlorinated lime; then dry and expose to air all bed-ticks, blankets, coverlids, &c.

Utensils.—All chamber-utensils and bed-pans should be of white glazed earthenware with well-fitting lids. None should ever be left under the bed, but be brought to the room, and, when used, carried immediately to the closet-sink, emptied, and rinsed there. No zinc pail, or pail without a lid, should be carried through a ward or sick-room. The pail should be of glazed earthenware with a lid. But better no pail at all in a sick-room. Without care for these things, the doctor will tell us, 'it is impossible to nurse.' Excreta have often to be put by for medical inspection; the nurse must see to this being done properly and inoffensively, in a closed vessel—never in the patient's room or ward. As for urine, if it has to be measured and tested, there are glass-measures, with covers, fit for the purpose. Bed-pans should have carbolic powder in them lavishly. All bed-pans should have lids. Glass urinals, with wide necks, washed with warm water and soda, are the only really clean ones; zinc and white earthenware, with long necks, are never clean. After being used, they should be put by the bedside, not under, and taken away and emptied at once. Small white chamber-utensils are useful, and district nurses may find old jam-pots the cleanest thing for urinals. Chamber-utensils in a hospital should be ranged on their sides in a sort of hutch open to the outward air through perforated zinc, in the lavatory or other compartment. If in a large hospital-ward chamber-utensils *must* unhappily be allowed under the beds at night, they should all, of course, have lids. Two glazed earthenware (not zinc) pails, with lids, may then be carried round the last thing at night and the first thing in the morning; one pail to empty into, with some carbolic powder in it; one pail to rinse with, with soda or chlorinated soda in it. The chamber-utensils should be then carried off to the hutch in the lavatory. But this is only a *pis aller*; a slop-pail should really never be brought into a sick-room or ward at all. It should be a rule, invariable—rather more important in the private house than elsewhere—that the utensil should be carried directly to the water-closet, emptied there, rinsed there, and not brought back till it is wanted.

There should always be water and a tap in every water-closet for rinsing.

Towels in a hospital should be kept separate for three separate uses, changed for clean ones as often as possible, and marked 'Hands,' 'Bed-pans,' and 'Basins.'

A bottle of chlorinated soda and a bottle of glycerine should always be by, to wash the hands.

A young nurse, dressing an ulcerated leg, has been known to wipe it with the sheet, and alleged that she had seen it done elsewhere! There should always be a special towel for such cases. *Charcoal* may be employed in offensive cases; it may be placed under the bed in pans, or under the limb (if slung) in the bed. Carbolic powder may be placed in the chamber-utensil (clean) if under the bed, or little bags of carbolic powder in the bed. Condy's fluid is sometimes placed in saucers, but thus used is not of much use. Carbolised tow may be used for cancer cases to lie upon, and changed frequently. Wool, with salicylic acid, is sometimes used to cover the dressing of an offensive wound, or salicylic lotion for a warm-water dressing. Slop sinks may be sluiced down with carbolic acid. *Water-closet pans* should be scrubbed with strong nitric acid, if they have been allowed to get at all offensive. Urinals, if allowed to become furred, must be sluiced out with boiling water, and then, if necessary, scraped with a knife all round and inside the grating. Also water-closet slop sinks. These all should be scrubbed with sand and chlorinated soda at least twice a week. In hospitals the head-nurse ought to mop-out and rinse-down the urinals every morning herself with a little bed-pan mop, and let boiling water run through; the same with the water-closet pans. The lavatory basins, when used, should be mopped-out every morning, and scrubbed at least twice a week with sand. There should be two mops—one new one for lavatory basins, appropriated when a little old to the bed-pans, and the old one replaced with new; the new small mop to hang over the lavatory basins, the old one to hang over the slop-sink for bed-pans; an old bottle-brush for the handles of bed-pans, a new bottle-brush, kept in the ward-kitchen, for bottles. Ordinary basins should be washed with tow.

3. **Personal Cleanliness, Precautions against Finger-poisoning, &c.**—One of the most important points nurses have to be taught on beginning surgical ward-work (and, indeed, surgeons also), is how not to poison their fingers. No good nurse will poison her own fingers any more than her patient's.

The following rules should be strictly observed, noting only that many other disinfectants are now in use besides carbolic acid and carbolic oil :—

Pare the finger-nails close; keep them, as well as fingers and hands, scrupulously cleaned; anything which has soiled the fingers is a possible source of contagion to others and to yourself: a hang-nail, or crack, or scratch, or pin-puncture, is as likely to produce a poison-nest to others or to yourself, even more than an open wound or sore. Such poison-nests must be made harmless by first washing with pure water, next by applying styptic colloid, thirdly by putting on some kind of finger-stall. Immediately *before* beginning any dressing, and in every case *after* touching the patient, whether in dressing wounds, rubbing in applications, administering enemata, internal syringing, washing out eyes, ears, nose, mouth—dip the hands into watery solution of carbolic acid, 1 in 80, and then wash hands and nails carefully with carbolic soap. 'Dressing forceps,' or syringe, or whatever is used, to be dipped in solution of carbolic (1 in 80) *before* use as well as *after*. The teeth and joints of the 'dressing forceps' to be brushed clean. Remove soiled dressings with 'dressing forceps,' and not with the fingers; on no account scratch up adhesive plaster or other adhering dressing with the nails. Nurses of the old school will boast that they are not afraid. The fear of dirt is the beginning of good nursing. With all internal cases, keep the nails short, fill the same with carbolic soap, and carefully anoint the fingers you are about to use, especially the first and second fingers in attending on vaginal cases, with carbolic oil (1 in 20). Oil the tube or nozzle, &c., to be used for any internal application, with carbolic oil (1 in 20). Otherwise the appliance used might convey contagious matter from one patient to another. Always use two basins in washing wounds, so as not to dip the fingers in dirty water. Catheters must be cleansed and disinfected, first with a stream of warm water, and then with a stream of watery solution of carbolic acid (1 in 40). Catheters of other material than silver should *not be soaked* in carbolic acid solutions, as the acid injures varnish and gum. Never 'blow down' towards the eye *first* instead of last, for so some lodgment will always be effected at the bottom. Never fail to take your own carbolic soap, with which you will be provided, in your own soap-tin, into the ward each morning and evening in your pocket. But take it out before beginning 'dressings,' as otherwise you put a dirty hand into your pocket. Always dry your cleaned fingers and hands on towels *not* used for any other purpose. After offensive cases, blow the nose and expectorate, and rinse mouth and throat with Condy and water, or with permanganate of potassium—a few grains in water. Cuffs and sleeves and stuff dresses are possible carriers of contagious matter. Always change the apron and over-sleeves which you have worn about the sick before eating or drinking. Report immediately any scratch or hang-nail or sore you may have to the ward-sister; ask immediate advice after breathing in offensive air. Never go on duty in the morning without having taken a meal.

The nurse must be taught the nature of contagion and infection, and the distinctions between deodorants, disinfectants, and antiseptics.

Mischief done by students and dressers might have been saved, and valuable lives spared, even among surgeons, if such precautions had been always scrupulously observed by them.

4. **Food and Drink** (**Diet**). — The physician will tell us that, to give food and stimulants in the way, at the time, of the kind, with the cooking and preparing, that will best enable the poor enfeebled digestion to assimilate it, is one of the great nursing arts. No chemical rules can be given for this as absolute. The patient's stomach is the laboratory, and also the chemist. It is the sole judge of whether the physician's orders are right, and the nurse has to watch and tell him what the patient's stomach says. She must be of course trained and cultivated to understand what it says.

The patient's stomach sometimes craves, and assimilates too, what no rules would have prescribed for it. The nurse must ask the physician whether she may gratify these cravings. Sick-cookery should do half the digestion's work; and proper variety is essential. If a patient is sick after taking food or drink, or feverish, or faint, or torpid, it is often a symptom not of the disease but of the nursing. Indeed, how much of the suffering of illness, as well as of its danger, is the fault not of the illness but of the nursing, is well known to the skilful physician and surgeon.

The nurse, of course, has nothing to do with the prescribing of stimulants any more than of medicines. But life often depends —especially in fevers and severe surgical injuries—upon the nurse knowing how to follow the indications of the changes to be looked for in the patient's state given her by the physician, and to change the times of giving the stimulants accordingly.

The nurse must know how to make gruel, arrowroot puddings, egg-flip, drinks, good beef-tea, and other kinds of sick cookery, so as to please the patients' taste and vary their diet. People say 'fanciful patients' must be 'humoured.' So they must; but it is in order to excite the proper secretions of saliva and gastric juice necessary for digestion. Nothing should ever be cooked in the ward or in the patient's room.

But though 'sweet Jack Falstaff' says 'A nurse is a cook,' the whole of the cooking must not be thrown on the nurse, if she is to nurse; and above all, if she is to eat, she must not be expected to cook for herself. But she will always be required not only to see that the patient's food and drink be as prescribed, but that it be well cooked, and punctually and well served. The physician considers that upon the nurse's power to give weak patients food in the way they like often depends their taking, or at least assimilating, any food at all.

She has also to feed, for example, fever-cases so that they can eat. The mere lifting-up of a patient in bed to give him food may terminate fatally a fever-case. The nourishment or stimulant ordered may have to be put into his mouth perhaps every half-hour — perhaps every five minutes — even during sleep, without rousing the patient—the test of a good nurse. The physician expects the nurse to be able intelligently to make the variations he prescribes in giving these things, especially during the night, according to the state of pulse and other symptoms, which she must know how to observe, in order to follow his conditional directions, upon which hangs the patient's life from hour to hour, often from minute to minute. In convalescence from typhoid fever, one single false indulgence has often induced a relapse and terminated a case fatally.

5. **Application of Remedies.** — The physician or surgeon requires the nurse—

To be able to dress blisters, burns, sores.

To administer stimulants and medicines as ordered, enemas and injections to men and women, and suppositories.

To manage trusses, appliances in uterine complaints; to pass the catheter—at least for women. The district nurse is often now required to pass the speculum for women, also the catheter for men, because there is no one else to do it.

To use the best methods of friction to the body and extremities; to make and apply fomentations, poultices, and minor dressings, wet and dry or greasy; to syringe wounds; to syringe the vagina.

To manage helpless patients—fever, operation, and surgical cases—that is to move, to change them, to keep them personally clean, warm or cool.

The medical attendant will expect the nurse to maintain an exquisite cleanliness of the patient's whole person and skin, and, as in fever—the daughter of dirt—to clean herself the patient's teeth, gums, and tongue, with lemon-juice or white-of-egg beaten to a froth. A nurse is no nurse who cannot wash or sponge a patient's whole body *without exposure or chill to any part.* In typhoid and other fevers, this is often an essential part of the treatment.

To give food and stimulants to helpless patients— fever, operation, and surgical cases; to manage the position of such cases; to prevent or to dress bed-sores.

To make the sick-bed, and especially to make the bed with the patient in it; to change the under-sheet without moving the patient, as in fever and operation cases. The 'best way' includes, in this as in all other things, the doing them at the least expense to the patient's vital powers.

To prepare the bed for fever, for accidents, for ovariotomy, and various kinds of operations; to undress, handle, and put to bed accident cases.

To attend at and prepare for operations—including ovariotomy, lithotomy, hernia; to prepare patients for and manage them after operations and anæsthetics—and all this with the least call upon their small strength.

To be able to do the first thing in case of hæmorrhage, namely, compression by hand or finger, by extemporary tourniquet and plugging.

To bandage all the various parts of the body, arm, leg, and chest (in Paris the *infirmiers* of military hospitals are made to practise all this, till not only it is done perfectly, but in a given number of minutes).

To make bandages of the various kinds used: T-bandages, double-headed, compound, 4- and 6-tailed, many tailed, finger, ovariotomy, triangular, perinæal, starched, and plaster-of-Paris, and other stiff bandages.

To make rollers, to line and pad splints, to make leather and gutta-percha splints, fracture and chaff pillows (black flock fracture-pillows harbour dust), and sand-bags.

The nurse should be able to give subcutaneous injections, to use the galvanic battery, to dry- and wet-cup, and to apply leeches externally and internally.

She is required to be able to apply dry and moist heat; to give inhalations and use the spray-disperser; to apply cold, with the use of siphons and with ice; and antiseptic treatment. Every surgeon and physician has his own 'antiseptic solutions,' his own 'disinfectants,' and every year brings fresh ones. And what is ordered must of course be used by the nurse.

6. **Observation of Patients.**—The physician and surgeon require every nurse to be able to observe correctly, and to report correctly, on the state or character of secretions, expectoration, pulse, skin, appetite; effect of diet, of stimulants, and of medicines; eruptions; the formation of matter; as to intelligence, with regard to delirium, stupor, &c.; as to breathing, whether quick or slow, regular or irregular, difficult, &c.; as to sleep, whether sound, starting, heavy, &c.; and as to the state of wounds. The physician also requires the nurse to be able to 'take' and to record the temperature—sometimes every quarter of an hour in critical cases, the pulse, the respiration; to measure, and sometimes to test the urine for him. She will be required to make these observations—if possible still more accurately—for child-patients, who cannot tell what is the matter with them; to understand the management of sick children and children's wards, which need a yet more exquisite cleanliness. And children show a much more rapid change of symptoms for life or for death generally than adults. Children are the best air-test, the best test of sanitary conditions.

Other Duties.—She must understand the management of convalescents—a whole department of nursing in itself—and the sooner a convalescent, especially a convalescent child, is removed from hospital to a country 'home' the better.

Housekeeping.—She must understand a certain amount of housekeeping or domestic economy—rather an uncommon talent. She must be able to order the proper quantity of bread, milk, butter, &c., and to prevent waste.

She must be competent for the charge of linen—a most important item of nursing, when we consider that on extreme cleanliness of bed and patient's linen—in other words, on linen and nurse, depends the not reintroducing disease into disease.

Generally.—Nursing is, above all, a progressive calling. Year by year nurses have to learn new and improved methods, as medicine and surgery and hygiene improve. Year by year nurses are called upon to do more and better than they have done. It is felt to be impossible to have a public register of nurses that is not a delusion.

Further, year by year, nursing needs to be more and more of a moral calling.

Night-nursing.—The physician or surgeon requires the night-nurse to be as good as the day-nurse, or even better—for the most critical times of fever and severe surgical injury often occur at night, or in the very early morning. But quite the same kind of business capacity is not required in the night-nurse as in the nurse in day charge of wards. Night-nurses, to do their work well, must have at least seven or eight hours in bed where they can sleep undisturbed by day (even horses in the New York 'Horse Hotel,' which work by night, have a separate dormitory to sleep undisturbed by day). They must have hot meals prepared for them when they come off duty in the morning, and before they go on duty at night; besides breakfast at 1 or 2 A.M. They must have one and a half or two hours' exercise. In a hospital they should be obliged to show their pass. It is rather more necessary for a night-nurse to be regular in her habits, if she is to be well and efficient, than for a day-nurse. And there appears no reason why nursing by night, if properly managed, should be more trying than by day. But regularity of habits, of meals, of sleep, of exercise, of personal cleanliness, is the *sine quâ non.* Occasional breaks or transfers to day duty may be necessary; or a night or two in bed every month for a night-superintendent. But a too frequent shifting (*e.g.* every month or every three months) from day to night duty seems hardly advisable, for it takes some time for a nurse to accustom herself to sleep by day. A night-nurse may deteriorate in two ways, if not carefully cared for: (1) She may become 'bumptious,' as if she were the 'sister.' (2) On the other hand, she may become careless and hard from having too much to do to do it properly. The night-nursing in the medical wards of a large hospital is generally much 'heavier' than in the surgical wards, and the matron ought to know from her own experience when the night-nurse absolutely requires additional help, and to provide it. Instant help should also be within call in an emergency, such as a patient becoming suddenly delirious. And the night-superintendent should always be on the watch for emergencies.

Holidays.—All nurses, especially night-nurses, must have holidays, as well as occasional recreation. A month's regular holiday in the year is not too much. Yet more do matrons and superintendents and all women filling nursing offices of great responsibility require an annual holiday, if they are to maintain vigour of body and mind, and not to wear out prematurely.

What a Nurse is to be.—A really good nurse must needs be of the highest class of character. It need hardly be said that she must be—(1) Chaste, in the sense of the Sermon on the Mount; a good nurse should be the Sermon on the Mount in herself. It should naturally seem impossible to the most unchaste to utter even an immodest jest in her presence. Remember this great and dangerous peculiarity of nursing, and especially of hospital nursing, namely, that it is the only case, queens not excepted, where a woman is really in charge of men. And a really good trained ward 'sister' can keep order in a men's ward better than a military ward-master or sergeant. (2) Sober, in spirit as well as in drink, and temperate in all things. (3) Honest, not accepting the most trifling fee or bribe from patients or friends. (4) Truthful—and to be able to tell the truth includes attention and observation, to observe truly—memory, to remember truly—power of expression, to tell truly what one has observed truly—as well as intention to speak the truth, the whole truth, and nothing but the truth. (5) Trustworthy, to carry out directions intelligently and perfectly, unseen as well as seen, 'to the Lord' *as well as* unto men—no mere eye-service. (6) Punctual to a second, and orderly to a hair—having everything ready and in order before she begins her dressings or her work about the patient; nothing forgotten. (7) Quiet, yet quick; quick without hurry; gentle without slowness; discreet without self-importance; no gossip. (8) Cheerful, hopeful; not allowing herself to be discouraged by unfavourable symptoms; not given to depress the patient by anticipations of an unfavourable result. (9) Cleanly to the point of exquisiteness, both for the patient's sake and her own; neat and ready. (10) Thinking of her patient and not of herself; 'tender over his occasions' or wants, cheerful and kindly, patient, ingenious and *feat.* The best definition can be found, as always, in Shakespeare, where he says that to be 'nurse-like' is to be

> 'So kind, so duteous, diligent,
> So tender over his occasions, true,
> So feat.'

A patient wants according to his wants, and not according to any nurse's theory of his wants or 'occasions.' 'Tender over his occasions' she must be; but she must have a rule of thought; and this the physician or surgeon has to give her in his directions; which her training must have fitted her to obey intelligently, using discretion. The nurse must have simplicity and a single eye to the patient's good. She must make no demand upon the patient for reciprocation, for acknowledgment or even perception of her services; since the best service a nurse can give *is* that the patient shall scarcely be aware of any—shall perceive her presence only by perceiving that he has *no* wants. The nurse must always be kind and sympathetic, but never emotional. The patient must find a real, not forced or 'put on,' centre of calmness in his nurse. To call upon a patient by emotion for emotion is the most cruel, because useless, demand upon his strength. It is asking him to bear your troubles and your anxiety as well as his own. Suppressed emotion is as bad—it makes the nurse constrained. It is exposing the patient to both frost and fire. Half the battle of nursing is *to relieve your sick from having to think for themselves at all*—least of all for their own nursing.

FLORENCE NIGHTINGALE.

NUTMEG-LIVER.—A form of disease of the liver, the appearance of which on section somewhat resembles that of the cut surface of a nutmeg. *See* LIVER, NUTMEG.

NUTRITION, Disorders of.—The nutrition of the body, by which we understand the maintenance of its parts in a fit state to perform their functions, depends on three main factors—the supply of suitable food; the assimilation of food; and the prevention or control of waste. When any of these factors are disturbed disorders of nutrition result. If food be inadequate or unsuitable, other things being normal, general atrophy will be the consequence (*see* ATROPHY, GENERAL); and the same result will evidently follow if the organs of assimilation are at fault, or if waste be excessive, even though food be abundant. Hence cancer of the stomach on the one hand, and diabetes mellitus on the other, may be taken as the types of 'wasting diseases.' Increased supply of food, on the other hand, does not improve the nutrition or cause hypertrophy with the same certainty as want produces atrophy, but the increased growth, if any, is chiefly of a single tissue. *See* Hypertrophy; and Obesity.

Similar principles apply, *mutatis mutandis*, to local nutrition or the nutrition of parts of the body; in which the three factors are—the supply of nutritive material by the blood; the power of assimilation possessed by the tissues, depending on the condition of their minute elements; and the amount or rapidity of waste. Hence, local atrophy results from obstruction in the blood-supply to a part; or from the inability of the part to appropriate nourishment, either through faulty innervation or the condition of the tissue-elements. In some cases excessive use, leading to waste, is also a cause of local atrophy. Increased blood-supply alone does not, on the other hand, by itself lead to hypertrophy. *See* Atrophy, Local.

When the disturbance of nutrition, however produced, causes a qualitative rather than a quantitative change in the tissue or organ, this change receives the name of *degeneration*, of which there are several kinds (*see* Degeneration). There are also some instances of disordered nutrition, which are not precisely cases of atrophy or hypertrophy, but are yet dependent on disturbances of some of the factors of nutrition spoken of above. In these cases, supposing that the blood-supply is not interfered with, the assimilative power of the tissues must be in fault, and this will depend upon either innervation or the condition of the tissue-elements. In some of these the nutritive disturbance leads to inflammation.

There are many curious instances of local changes of nutrition in which the blood-supply is quite unimpaired, and the cause has to be sought in some other disturbance, more especially one of the nervous system. Reasoning from certain well-marked cases of disorders of nutrition originating in the nerves, it may be plausibly conjectured that many other changes, and particularly many ordinary diseases, which we usually regard as idiopathic, may similarly be due to disturbance of nervous influence. Again, the nutrition of a part may be affected, not by direct nervous influence, but by reflex innervation, and thus depend upon the condition of some other organ. A very clear instance of a lesion of nutrition depending on the nerves is seen in the disease herpes zoster, and in some other skin-diseases, the distribution of which is obviously regulated by the distribution of certain nerves. In herpes zoster distinct changes have been found in the ganglia—*e.g.* the Casserian ganglion in herpes of the fifth nerve, which must be regarded as the origin of the morbid process. The dependence of nutrition upon the nervous system is also seen in some instances of healing, as in the case of ulcers of the leg, pointed out by the late Mr. Hilton, where rapid healing follows the section of a nerve-branch leading to the ulcerated patch. On the other hand, the loss of vitality dependent on nervous disturbance is seen in the rapid formation of bed-sores on the sacrum in cases of paraplegia, and in perforating ulcer of the foot; the relation of which to affections of the spinal cord and peripheral nerves is clearly made out. The same conclusion must be drawn from the nutritive disturbances, beside the ordinary disturbance of the sensory or motor function of the nerves, which sometimes follow injuries to nerves. Thus injuries of the brachial plexus, not severe enough to cause actual paralysis of motion, may produce a state of swelling and hyperæmia in the fingers—the condition called 'glossy fingers' by Sir James Paget. Similar and more complicated changes have been observed as the consequence of gun-shot-wounds affecting the nerves. These cases, and such as these, have raised the question whether there are 'trophic nerves,' that is, whether, in addition to the fibres passing to the muscles and to the periphery which are concerned in motion and sensation respectively, there are others distributed to the tissue-elements themselves, whose function it is to keep these elements in a proper state of nutrition. It is impossible to discuss this theory here; but we can only say that some of the phenomena which are thought to make necessary the theory of trophic nerves appear to be explicable by assuming the presence in the mixed nerve-trunks of some fibres derived from the sympathetic system. The connexion of the sympathetic nerve-fibres with nutrition, though chiefly displayed through variations in the circulation, is undoubted. In the rare cases which have been observed in the human subject of lesion of the sympathetic nerve in the neck, a permanent change in the nutrition of the affected part is observed when the well-known vascular changes have passed away or become greatly modified. On the other hand, certain affections of the fifth nerve show definite changes of nutrition independent of vascular disturbance, *e.g.* morphœa and facial hemiatrophy. Lastly, it should be pointed out that in certain diseases of the spinal cord, for example, tabes dorsalis, affections of the joints, resembling chronic rheumatism, have been observed, which may be very plausibly, though not yet with certainty, ascribed to nervous derangements. On the strength of these cases it has been supposed that in other forms of rheumatic and rheumatoid disease, the distribution of the morbid changes depends upon the nervous system; but this must be regarded as quite theoretical. Still more uncertain are the theories which have been framed to explain the occurrence of internal diseases, such as inflammation of the lungs, &c., as a direct consequence of nerve-lesions.

When we find disorders of nutrition neither caused by changes in the distribution of the blood, nor connected with any nervous derangements, the fundamental change must be referred to the tissue-elements themselves; it is probable that the number of disorders depending upon such changes in the minute tissue-elements is very large, and the field of 'elemental pathology' may be larger even than that of nerve-pathology or blood-pathology. Such an explanation is particularly reasonable when the changes are symmetrical on the two sides of the body, and when they are connected with advancing age; as, for instance, fatty degeneration of the cornea, turning grey of the hair, and primary degeneration of the walls of arteries. In these cases it seems unnecessary to suppose any implication of the nervous system, and disturbances of the circulation plainly do not account for the facts. It can only be supposed that the tissue-elements, like the organism itself, have their natural term of life, and that this term varies in different individuals, in whom, therefore, these failures of nutrition are merely the expression of the more or less premature old age of certain elements. For instance, the hair of the head has evidently a shorter term of life in men than in women. These changes may be, and often are, the expression of the general condition of the whole body, which is more obvious in some parts than others, simply because the tissue-elements in these parts are older or less vigorous.

Finally, it must be said that certain general changes of nutrition have been shown to be caused by wasting or destruction of blood-glands, *e.g.* the thyroid, which is related to the disease myxœdema. Possibly it may turn out that other blood-glands have similar relations to general nutrition.

TREATMENT.—Having spoken of the chief causes of disorders of nutrition, it remains to consider whether there is any general treatment applicable to such disorders, independent of the special treatment proper to many of them as special diseases.

With regard to the general nutrition of the body, we can only refer to what has been said under the head of ATROPHY, GENERAL, since hypertrophy is not a condition which practically requires treatment, unless exceptionally, as hypertrophy of a special tissue. With regard to local disorders of nutrition, the first and only generally applicable rule must be to remove, if possible, the local cause. If the cause is obscure, or, when discovered, cannot be obviated, the treatment must be guided by circumstances, but will usually be more of a *general* character. As an example of the removal of the cause of disordered nutrition, we have instances in which the phenomena of nerve-lesion above referred to have disappeared entirely on removing a fragment of lead or other irritating substance from the nerve-trunk. A more familiar instance is where the lower part of the leg is in a permanent state of malnutrition from stagnation of blood in varicose veins; œdema, eczema, subcutaneous induration, and ulcers may result. If, by suitable pressure or surgical treatment of the diseased veins, the circulation is rendered normal, all these morbid conditions will be healed. On the other hand, certain local disorders of nutrition can only be treated by improving the nutrition of the whole body. Cachectic children, for instance, may exhibit chronic conjunctivitis, bronchial catarrh, eczema of the flexures, and the peculiar sloughing sores of the fingers which have no distinct name, but are well-known indications of malnutrition. If, in place of, or in addition to, local treatment, we use general treatment, directed to improve the nutrition of the body, all these local disorders may entirely and perhaps simultaneously get well, as they depend only upon the deficient power of resistance possessed by the tissues in general.

J. F. PAYNE.

NYCTALOPIA, or NIGHT-BLINDNESS (νύξ, night; and ὤψ, the eye; the letters 'al' probably represent *alpha privativum*, and express *want of*).—SYNON.: Fr. *Nyctalopie*; Ger. *Nyctalopie*; *Nachtblindheit.*—By the term 'nyctalopia' is meant an abnormal degree of impairment of vision at night, or whenever the light is dim. The degree of impairment ranges in different cases from slight embarrassment to practical blindness. During the day or in a good light the vision may be of normal acuteness, but rapidly fails at dusk.

Like hemeralopia, the term 'nyctalopia' has been used in the opposite senses of *night*-blindness and *day*-blindness (*see* HEMERALOPIA). Most modern writers have used it in the latter signification; but all the ancients, and nearly all the later writers to the end of the seventeenth century, used it in the former. Aristotle, Galen, Oribasius, Aëtius, and Paulus Ægineta among the Greek, and Pliny among the Latin, writers, all employ the term and its cognates as signifying *night*-blindness. An apparent exception occurs in the second book of the pseudo-Hippocratic treatise, entitled *Prorrhetics*, where nyctalopes are said to be those who *see* at night. There are, however, several reasons for believing that the ordinary text is here incorrect. There is at least one good manuscript which gives the reading, 'those who do *not* see at night,' &c.; and it is certain that the nyctalopic affection referred to throughout the Hippocratic writings is night-*blindness*. Moreover, Galen, in his lexicon of Hippocratic terms, defines a nyctalope to be one who is blind at night (ὁ τῆς νυκτὸς ἀλαός). It may be added that the restoration of nyctalopia to its signification of night-blindness, advocated in the first issue of this work, has since been adopted in the Nomenclature of the Royal College of Physicians of London.

Though night-blindness is at all times merely a symptom manifested in several diseases, it is convenient to classify it as *symptomatic* when associated with certain appreciable morbid changes in the fundus oculi; and *idiopathic* or *essential* when unaccompanied by such changes.

Of *symptomatic nyctalopia*, by far the most common concomitant is retinitis pigmentosa. It may occur in connexion with detachment of the retina, with syphilitic and other forms of retinitis and choroiditis, and with some embryological defects or intra-uterine diseases of the retina or of the choroid. In all the affections of this group the beginning of night-blindness is insidious, and the course is chronic, the physical condition being some morbid alteration in the percipient and pigmentary layers of the retina.

Idiopathic nyctalopia is usually more or less abrupt in its onset, and due to torpor of the retina, showing itself by deficient adaptation of the retina to feeble illumination; and is an exaggeration of the physiological blindness which temporarily takes place in passing from bright into feeble light. In many instances it follows prolonged exposure of the eyes to intense glare of any kind. This is especially apt to occur in persons who have been insufficiently or improperly fed, or who are suffering malnutrition from any cause. Formerly it was often met with as an early symptom of scurvy, and it still occurs epidemically among the poor in those countries where strict religious fasts are observed. It is also observed in some cases of anæmia, albuminuria, liver-disease with or without jaundice, pregnancy, malaria, and chronic alcoholism. In many cases of idiopathic nyctalopia there co-exists a peculiar form of xerosis of the bulbar conjunctiva. On the conjunctiva opposite the palpebral fissures are scaly oily-looking patches, which, by gentle frictions of the lids, can be whipped into a fine white foam abounding in minute bacilli. The exact relation between the xerosis and the nyctalopia has not been determined. The xerosis may only be an expression of impaired nutrition of the eyeball.

The *prognosis* of symptomatic night-blindness is generally unfavourable; while that of the idiopathic form is more favourable—at least in so far as the associated constitutional and local states may be amenable to treatment.

TREATMENT.—This must necessarily be determined by the ætiological and associated pathological conditions. Of the symptomatic form the treatment is that of the accompanying retinal or choroidal affection; and of the idiopathic form the treatment will be that of the associated constitutional and local conditions. The eyes should be protected by tinted glasses, shades, or bandages; faults and errors of diet corrected; cleanliness of the lids ensured; and tonics and other regimen and medicaments suited to the special requirements of the particular case must be employed. JOHN TWEEDY.

NYMPHOMANIA (*νύμφη*, the nympha, a portion of the female sexual organs; and *μανία*, madness).—A form of mental derangement in women, characterised by an insatiable desire for sexual intercourse. *See* SEXUAL FUNCTIONS IN THE FEMALE, Disorders of.

NYSTAGMUS (*νυσταγμός*; from *νυστάζω*, I nod).—An involuntary movement of the eyeball, due to clonic spasm of the muscles of the globe. It usually affects both eyes. The movement is generally horizontal, that is, from side to side, and is then called *oscillatory*; but it may be *rotatory*, that is, round the optic axis; or *oblique*, when it is said to be mixed. It may be (*a*) congenital or infantile; (*b*) acquired; or (*c*) symptomatic of cerebral or spinal disease.

O

OBERLAND, The Bernese.—Grindelwald, Gurnigel, Interlaken, Mürren, &c. Cool, bracing, mountain summer climate. *See* CLIMATE, Treatment of Disease by.

OBESITY (*obesus*, corpulent; from *ob*, by reason of, and *edo*, I eat).—SYNON.: Corpulence; *Polysarcia*; Fr. *Obésité*; Ger. *Fettsucht*; *Fettleibigkeit*.

DEFINITION.—This term is applied to a general state of disordered nutrition of the body, characterised by an excessive development of the adipose tissue (more especially in those situations where it is normally most abundant, namely, the subcutaneous, subserous, and intermuscular connective tissue), which leads to various disturbances in the bodily functions.

Ætiology.—(*a*) **Predisposing causes.** The influence of *heredity* in transmitting the liability to obesity is undoubted, and is a matter of common knowledge. But an examination of the families of fat people appears to show that obesity is indifferently transmitted with rheumatism, gout, and other phases of the uric-acid diathesis, oxaluria, diabetes mellitus, and gall-stones; all which perversions of nutrition are in some manner closely correlated and to some extent convertible. The series form a group to which the name *l'arthritisme* has been given by Bouchard, from the marked prevalence of the joint-affections included under the terms 'rheumatism' and 'gout.' *Sex and Age.*—That excessive corpulence is more common among women than among men is also well known. Several circumstances have been suggested to account for this, such as the menstrual functions of women, pregnancy and suckling, from which fatness often dates, their less muscular activity as compared with men, and their frequently diminished oxidative power, due to poverty of red blood-corpuscles. Age appears to have considerable influence in determining this condition. Under a healthy regimen children get fat from birth, notwithstanding that at the same time the albuminoid ingesta must be largely employed in the construction of the rapidly growing tissues; and hence, at this period of life, the fat and amyloid food-stuffs are the chief sources of the adipose deposit. How frequently are seen children, improperly fed on excess of starchy matter, very fat, whilst their general nutrition is much impaired. A fat child is far from necessarily being a healthy one. At puberty there is frequently a diminution in weight, both relatively to the height and absolutely; but the contrary to this sometimes accompanies the establishment of menstruation, especially if the subject be very chlorotic—that is, with an enfeebled oxygen-carrying blood-power. After the age of forty, particularly in women at the climacteric, the influence of age markedly asserts itself. Even the manifestation of the hereditary tendency may be postponed until that period, and for women to become fat at that time is almost the rule. The perversion of nutrition now under consideration is, in some unknown way, curiously but distinctly associated with the degree of development of the sexual functions, and in an inverse direction. This is very noticeable in eunuchs and animals whose generative organs have been removed, and the part played by the cessation of ovulation has been already mentioned. Even during pregnancy, when ovulation is suspended, it is no uncommon occurrence for the subcutaneous fat to be increased in amount. *Occupations.*—Those compelling a sedentary life undoubtedly favour the development of corpulence, especially if there be hereditary predisposition, together with large eating and alcoholic indulgence. *Race.*—Among certain races obesity appears to prevail, as for instance the Hottentots; and whilst amongst some, such as certain castes of Hindoos, the condition has been highly esteemed, amongst others, as the Greeks and Romans, it was regarded as disgraceful. *Climate.*—Although very fat people are met with in all climates, there appears to be a special tendency to their predominance in low-lying, damp countries, whilst, with certain exceptions, they are less often seen in very hot and in mountainous districts. *Nervous influences.*—Since the nervous system so directly influences tissue-changes, it is not to be wondered at that certain nervous states favour obesity as they do diabetes mellitus, another state of malnutrition; it is of frequent occurrence in hysteria and in idiots. Localised increase of subcutaneous fat has been noticed in neuralgic areas and paralysed limbs, and also in cases of atrophic muscular disease—*lipomatosis neurotica.*

(*b*) **Determining causes.**—Excess of *food* is the first of these to be mentioned. Whilst no doubt a large excess of food may lead to corpulency, it must be confessed that it very often does not do so, and extremely thin men are often large eaters. And, on the contrary, many women who become excessively obese have poor appetites. It has been estimated by Bouchard that 40 per cent. of the obese are large eaters, and that 10 per cent. eat less than the normal quantity. Nor does it seem in these different classes of cases that the kind of food makes much difference. Some get fat, eat what they will; others do not, whatever their diet. Nevertheless, starches and sugars are, as a rule, more effective fat-producers than fats. *Drink.*—It is, however, usually the case that very fat people take a large amount of fluid food. How alcohol acts in the production of fat is not very clear. It is asserted that it does so by diminishing oxidation; but this is not the entire explanation, for the extent of obesity is far from being proportionate to the amount taken, and not infrequently an excessive ingestion is not associated with corpulency. There would also seem to be something due to the form in which the alcohol is taken. *Exercise.*—Deficient muscular activity, by diminishing the amount of oxidation of tissue, favours obesity, especially in cases of idleness following on a period of considerable energy, the quantity of food taken remaining the same; and since, as a rule, the stouter the person the less capable is he of exercise, these two conditions react one upon the other, in favour of fat-production. But lack of exercise, like over-feeding, is not invariably followed by corpulence, nor are the two conditions when combined. Bouchard indeed calculates that only 37 per cent. of fat people take too little exercise, and 28 per cent. even exceed the average man in this respect.

Disease.—Exceptional cases of corpulence have followed recovery from severe fevers, and extensive bleedings, even when there had been no predisposition; and a similar result has been met with after prolonged administration of mercurials and arsenic, which is perhaps to be explained by the deteriorating influence that these drugs are said to possess on the red blood-corpuscles.

Pathology.—Assuming that the current views on lipogenesis, or fat-formation, are known to the reader, it is sufficient here to state that from whatever source the fat of the body be derived, whether from the fatty, the amyloid, or albuminoid elements of the food, or from all, as is most probable, the fact of its being stored up as adipose tissue must be regarded chemically as an expression of deficient or delayed oxidation; a process which, if it had been more complete, would have resulted in the conversion of these elements into carbonic acid and water, to which the fat itself is reduced when it is subsequently used up in the economy. It is thus that the corpulence that frequently attends such morbid states as anæmia, chlorosis, hæmorrhage, some pulmonary and cardiac diseases, and alcoholism, is to be explained; since in all these diseases the oxygenising power of the blood is deficient. Briefly, the causes of obesity may be grouped into those which favour the assimilation by, and accumulation in, the tissues of fat, and those which diminish the combustion of the same; conditions which often co-exist.

The fat of the body in an average male adult constitutes about one-twentieth, and in the female rather more, of the total weight. It is not for 3½ months after the commencement of development that the adipose tissue is sufficiently differentiated to be distinguishable; it gradually increases in amount, being considerable at birth and up to puberty, when it often diminishes slightly; during maturity it increases, or the reverse, being very variable in amount; and during old age it decreases. During childhood the adipose tissue is more evenly distributed in the subcutaneous tissue than in later life, when fat tends relatively to diminish on the surface in proportion as it becomes deeper-seated.

In the three situations in which the fat is chiefly deposited—namely, the subcutaneous, subserous, and intermuscular connective tissue—there are certain areas which are preferred by it, as there are others which escape. Whilst the abdomen, buttocks, breasts, and neck are especially prominent, the wrists, ankles, eyelids, scrotum, and penis are free from fat. Beneath serous membranes it is very unequally distributed. Fat is never seen beneath the peritoneal coat of the stomach or intestines, the parietal pericardium, or the visceral pleura; whilst the great omentum, which usually weighs about ½ lb., may reach to 7 or 8 lbs., or, it is said, even 30 lbs., and a thickness of half an inch or more of fat may be included between the layers of the mesentery. A considerable amount is developed beneath the visceral pericardium; and under the synovial membranes fat may be deposited to such an extent as to interfere with the movements of the joints. Adipose tissue is never found within the cranial cavity, but may be present in large quantity in the spinal canal.

The ordinary state of the organs found in very corpulent people is, that the lungs are small; the heart and the liver large, and infiltrated with fat, the former having the right side dilated with hypertrophy of the left ventricle or atrophy of the entire organ, and the latter showing a state of partial cirrhosis or the nutmeg appearance; the gall-bladder containing only a little pale bile or mucus; the stomach large and muscular, but well-developed and with the intestines often dilated; the kidneys small, as also the spleen and lymphatic glands; and the pancreas largely developed. In extreme cases the blood may contain four to five times the normal amount of fat, sufficient to give it an altered appearance to the naked eye.

Like many other conditions of disease, it is impossible to define the exact line at which a morbid obesity may be said to commence. All degrees of corpulence, indicated by such terms as 'stout,' *embonpoint*, &c., occur, to which the notion of disease is wholly inapplicable. Nor, as will be seen, can the disturbance of function be taken in all cases as the measure of a morbid state, since the impairment of function is not always proportionate to the amount of fat.

As instances of extreme corpulency the following may be quoted:—

Daniel Lambert, who at twenty-three years old weighed 32 st., but could walk from Woolwich to London. His subsequent maximum weight reached to 52 st. 11 lbs. Edward Wright, 44 st. Dr. Wardell records the case of a young married woman, who at eighteen was thin and delicate, had no children, and lived well; she died at the age of forty-one; the thickness of the subcutaneous fat on the sternum was 4 inches, and midway between pelvis and umbilicus 8 inches. The heart weighed 36 oz., the liver 118 oz., and there were prolongations of fat from the omentum 1 to 4 inches long, as thick as a candle. More recently a woman of Baltimore, U.S.A., was stated to scale 850 lbs.

As illustrations of precocious obesity, cases are on record of a girl weighing 13 st. at the age of twelve years; of another aged 11 years weighing 29 st.; and of a boy weighing 8 st. 12 lbs. at three years. This boy had three teeth at birth, and twenty-six at thirteen months old. Infants excessively fat at birth usually fail to maintain their relative bulk after weaning.

Thus, in extreme cases, one-half, or three-fourths even, of the body-weight may be fat.

Symptoms.—The general appearance of a corpulent person scarcely needs description. The condition may be associated either with a hyperæmic or full-blooded, or with an anæmic state of body (the hæmoglobin being deficient in amount rather than the corpuscles too few), and it is desirable to recognise this in view of treatment. Owing to the fatty infiltration of the muscular tissues, and the degeneration of the fibres, the muscular energy is diminished, this being especially noticeable in regard to the heart, the action of which is easily disturbed, and palpitation is a frequent symptom, accompanied by dyspnœa, induced by slight exertion. The affection of the voluntary muscles manifests itself in an indisposition to active exercise. The digestive power is often very well maintained, and this notwithstanding the frequent excess both in the quantity and in the quality of food indulged in. Periodical impairments are, however, frequent; and pyrosis, flatulence, and constipation or diarrhœa, with offensive stools containing much fat, are often troublesome. The cardiac sounds are usually feeble and distant, though the reverse obtains when there is a hypertrophied ventricle. The pulse is very variable, full, or small and weak, according to the plethoric or feeble state of the individual; more or less frequent than normal, irregular or dicrotic, dependent on the degree of fatty change in the heart, or, if of high tension, from fibrosis of the arterioles (*see* Heart, Fatty Growth on). The mental activity is uncertain, and many external causes tend to modify it; but the temperament is proverbially 'easy-going,' indolent, and lethargic, especially after meals, although very frequently interrupted by attacks of peevishness and irritability, or by unusual somnolence and quiet. Examples, however, of considerable intellectual attainments are not unknown among the corpulent. The excretions are usually copious. Profuse sweating is induced by slight exertion, and the secretion of the sebaceous glands is abundant and often fœtid. The urine is generally acid, often diminished in quantity, and contains an excess of uric acid, urates, and frequently oxalate of calcium. Partly from chafing, and partly from the excessive cutaneous secretions, intertrigo and other eruptions are apt to occur in the folds of the groin, below the mammæ, and in similar parts. The vessels share in the general malnutrition of the tissues, and atheroma of the arteries is often found, whilst the veins become distended and varicose, forming hæmorrhoids and varicocele. Some œdema of the ankles is also usual, and hæmorrhages from nose or lungs are not uncommon. Depending upon these vascular changes are the congested and bloated appearance of the face, and the liability to headaches, vertigo, and giddiness. Disturbances of sight and hearing are frequently noticed in fat people. Irregularities of menstruation, which may be early in appearance, are frequent. The sexual appetite is frequently deficient in both sexes, and sterility is common in women: in man it has been attributed to the deposition of fat along the course of the spermatic vessels, causing impaired nutrition of the testes, as shown by the scanty and inactive spermatozoa found in the semen. Accumulation of fat around the umbilical ring favours the occurrence of hernia in this situation, a not uncommon event in the corpulent. The enormous weight of the abdomen causes a constant backache from painful overstrain of the dorsal muscles.

The condition of obesity, like other general perversions of nutrition, most distinctly presents other characteristics than the mere signs and symptoms above enumerated. 'Corpulence is not only a disease itself, but the harbinger of others,' as Hippocrates pointed out. There are certain tendencies and liabilities which the state engenders; and intercurrent maladies come to possess special features. Periodically, the fat man ails without perhaps any obvious cause, and such ailments must be regarded as the expression of malnutrition of the tissues produced by the excess of fat. Among the more prominent of these affections is a proneness to catarrh of the respiratory and alimentary mucous membranes, and periodical 'colds' and diarrhœas are frequent. This is in great part due to the fact that the power of self-regulation of temperature, which the body possesses, is diminished by the thick layer of subcutaneous fat, which is a bad conductor of heat, and interferes with compensatory radiation. At the same time the plethoric condition, and the enfeebled circulation due to the weak heart, tend to the same end, namely, a liability to congestion of the ill-supported tissues, such as the mucous membranes, with the results of such congestion in excessive secretion and other derangements of function.

The obese subject is quite as liable to the acute diseases as is the thin man; and these maladies run in him a singularly unfavourable course. The diminished power of heat-radiation increases the pyrexia; and the weak heart favours the establishment of the adynamic state. Such means for lowering the temperature as cold applications have but little effect through the thick fat; and aconite is contra-indicated by the pulse. But since the oxidising process in the corpulent is diminished, the temperature in the febrile state is rarely very high, and at the same time is but ill resisted.

The effective agent in fat formation, namely, deficient oxidation, also favours the formation of uric acid, and hence the fat are often gouty. Saccharine urine (a condition which, whatever view be taken of its pathology, is manifestly an expression of deficient oxidation)—especially that form which is met with in those advanced in life—very frequently occurs in stout people, not only in an intermittent form, but constantly with other symptoms of true diabetes mellitus. In 32 of 140 cases of diabetes mellitus observed by Seegen, obesity preceded the glycosuria.

Progress and Prognosis.—The progress of obesity is essentially chronic, and rarely, if ever, tends to other than increase of this state. Extreme fatness in the very young, as already stated, usually subsides; but the obesity of advanced life never does, unless any exhaustive disease should co-exist, such as cancer or diabetes; and the latter by no means produces then the emaciation that it causes in young people. Obesity should, on the whole, be regarded as a grave matter, since very fat people rarely reach an advanced age; whilst a decrease of fat at middle age in a person hitherto stout should be regarded with suspicion.

In obesity, death by syncope may result from an extremely fatty heart; from apoplexy, caused by rupture of an atheromatous vessel in the brain; or from acute pulmonary congestion, with general œdema from cardiac dilatation; whilst rupture of the heart, angina pectoris, and uræmia are among the dangers to which the obese are liable. Not infrequently some sudden exertion has immediately preceded the fatal end.

Treatment.—It is unnecessary even to enumerate the nostrums that a fanciful empiricism has suggested for the prevention or cure of obesity.

Recognising that accumulation of fat is a perversion of nutrition, which, if once established, and with a strong hereditary predisposition, cannot be cured, it follows that we should endeavour to prevent as far as possible its increase, by avoidance of those factors which pathology tells us are favourable to its development. The guides as to how far a given plan may be proceeded with are, first of all, the age and general condition of the patient, especially as regards the heart's power; and, secondly, the feelings and capability of the patient, as the treatment is pursued. Each case must be treated according to circumstances, bearing in mind that the objects to be aimed at are to diminish the sources of the fat, and to increase the oxygen-carrying power of the blood and oxidising power of the tissues.

The diet must be regulated in quantity and quality. Since a healthy diet should consist of certain proportions of nitrogenous, amyloid, and fatty principles, and since from all these three substances fat may be formed in the body, the question arises, which can be most advantageously diminished. Experience supports our pathological knowledge in advocating a withdrawal as far as possible of fatty and more especially starchy food, whilst at the same time a moderate increase in albuminoid matter is permitted; for with a fair quantity of the other food-stuffs, proteids increase tissue-change. It is on this principle that systems of dietary for the corpulent are founded, the best known of which bears the name of Banting, who for a year (1863) successfully followed out a plan laid down for him by Dr. Harvey, with the result of losing 44 lbs. in weight, and without the recurrence of corpulence when ordinary diet was resumed. There are many other cases recorded. Dr. Cheyne, who weighed 32 st., reduced himself a third in weight, and lived afterwards in good health to the age of seventy-two (Dr. Wadd on *Corpulence*, 1822). Lean meats, sweetbread, fish—except rich kinds, such as salmon and eels—clear soups, poultry, game, eggs, cheese, green vegetables, toast, gluten bread, fresh fruit, and pickles are allowable articles of diet. An average diet for an adult would be 12 oz. lean meat, 6 oz. rusks or gluten bread, 4 oz. green vegetables, 1 oz. butter, and 1½ pint tea. If the normal daily requirements be put at—proteids 130 grammes, fats 86 grammes, and carbohydrates 380 grammes (these ingredients being water-free); then the Harvey-Banting diet may be taken as—proteids 170 grammes, fats 10 grammes, carbohydrates 80 grammes. It is necessary that the *régime* be steadily adhered to for a considerable period, and recurred to from time to time when the weight shows signs of increasing. Several well-known modifications of this diet have been proposed. Ebstein's plan was based on—proteids 100 grammes, fats 85 grammes, carbohydrates 50 grammes, with 1,750 grammes of fluid, being an amount of proteids much below the normal, whilst the fats are of the healthy quantity. The deficiency of proteids tends to prevent this diet being pursued for long without loss of strength, and it would be probably more economical if rather less fat and rather more starch were allowed. Oertel's system is characterised by a marked restriction of fluids, the dry proteids being 170 grammes, fats 44, and carbohydrates 114 grammes. The reader will determine for himself how these proportions of alimentary principles may be distributed among various ordinary articles of diet. The exact influence of an excess of water in tissue-metabolism is uncertain, but there is no doubt that a large number of fat people consume an excessive amount of fluid, of which it may not be forgotten that alcohol forms very frequently a considerable proportion, and on such grounds a restricted intake might be regarded as desirable. But whilst cases of obesity associated with anæmia may be benefited by this treatment, it must be admitted that dehydration is attended with great risk in plethoric persons, especially if the nitrogenous food exceed or even equal the normal quantity, since serious disorders may result from accumulation in the tissues of their products of waste, from lack of fluid to flush them out. Still more is this the case in those extreme methods of dieting which consist of a practically unlimited amount of meat food, with complete abstinence from fats, starches, and sugars; and with such regimen a large allowance of hot water is insisted on. This plan, known as the Salisbury treatment, has been pursued in a modified form by Mr. Towers Smith with considerable success. The fact is that each plan has its merits and can claim successful results, but judgment is requisite in its application to individual cases. All methods compel a very great decrease from the normal of starches, but on each of the other alimentary principles much diversity of practice exists. It cannot, however, be too strongly insisted on that for any considerable increase in nitrogenous food the kidneys must be in a perfectly healthy state, and this should only be permitted in conjunction with a free exhibition of water. Alcohol generally should be avoided, but especially spirits and beer, which must be absolutely forbidden, except on emergency; cider or the light dry wines, both white and red, diluted with water, are less objectionable. Tea and coffee are supposed to interfere with tissue-change, and therefore should be taken sparingly; and milk, from the quantity of fat it contains, is to some extent inadmissible, although a skim-milk diet has been proposed.

Regular exercise, within the limits of the patient's powers, such as riding, walking, rowing, and gymnastics, is of great benefit by directly inducing an increased oxidation of tissue, and improving the quality of the blood, and therefore its oxygen-carrying power. It should form an essential part of every system of treatment, the amount being determined by the state of the patient's heart. Cold bathing, if well borne, is of advantage on similar grounds. Free sweating by Turkish baths is a useful adjunct to dietetic treatment, unless the circulation be enfeebled. Breathing compressed air, with the object of increasing the tissue-oxidation, has been recommended.

It is in carrying out a system rather than in devising one that the difficulty occurs. The regularity and restraint prove irksome to the patient, and are frequently broken. Hence it is that the regimen and spare diet of the various spas, such as Carlsbad, Marienbad, Kissingen, and Ems have great advantages, since at such places, and in such surroundings, the patient more readily and willingly pursues a given plan.

In the treatment of intercurrent diseases, it is essential to remember the enfeebled resisting power of the patient, and the frequent necessity for stimulants.

Among the many drugs that have been used for obesity may be mentioned alkalis, iron, and iodine. Soap was formerly much employed, as much as three ounces being given daily with milk and lime water; and some of the good effects of the various 'waters' are ascribed to their alkaline properties, especially the alkaline aperients of the above-mentioned spas. Iron is an essential in those forms of corpulence associated with anæmia, and most satisfactory results follow its administration, as the health improves and the fat diminishes. Young chlorotic subjects benefit by this treatment, which may be advantageously carried out at some chalybeate spring, such as Tunbridge Wells, Harrogate, or Spa. The iodides, such as those of potassium and iron, given in large doses, undoubtedly effect a reduction in the amount of fat, but not always with a corresponding improvement in health. So long as this does not suffer, and the patient improves, the drug may be persevered in, but it is frequently very badly borne when taken in quantity. The preparations of *fucus vesiculosus*, the basis of certain quack remedies, appear to depend for their value on the iodine contained in them. Permanganate of potassium has been recommended on the same grounds that its use is advocated in lithæmia and in glycosuria, namely, to promote oxidation.

W. H. Allchin.

OBLADIS, in the Tyrol.—Earthy saline waters and climatic health resort.

OBSOLESCENT (*obsolesco*, I grow out of use).—A term applied to miliary tubercle, when, instead of undergoing destructive changes, it becomes dried up, shrunken, and hard, and thus remains inert. *See* Tubercle.

OBSTRUCTION and OCCLUSION.—Obstruction and occlusion of the different tubes and orifices of the body are mainly effected in three different ways: first, by *blocking of a tube* by its contents; secondly, by *alteration in its walls*; thirdly, by *pressure from without*.

1. **Blocking.**—The first mode of obstruction is met with in most of the tubes of the body, and may be produced in various ways. The occluding mass may be composed of the normal contents of the tube; of these contents variously altered; or, lastly, it may be some foreign substance introduced from without. Examples of the first of these modes occur in the intestine, in cases of impacted fæces or intestinal concretions; in the biliary and urinary passages from calculi; in the ducts of glands from the products of catarrh or inspissated mucus; and in the blood-vessels from deposits of fibrin. Obstruction by foreign bodies may of course occur in all tubes in direct communication

with the external surface, but even internal tubes are sometimes obstructed in this manner. As examples of this may be cited the occasional obstruction of the bile-ducts by hydatid cysts, or by the ascaris lumbricoides; of the pulmonary artery by hydatids; of capillaries by masses of bacteria; and of the pulmonary capillaries by air sucked in by a wounded vein.

2. **Parietal Changes.**—Obstruction of tubes from alteration in their walls is the most common cause of the various forms of permanent stricture, and may arise from many different conditions. First, in those tubes whose walls are muscular, it may be the result of spasm. This form of obstruction is usually only of temporary duration, and is probably not of very frequent occurrence. It is supposed to take place in the urethra and the bile-duct, but the most important instances of it are met with in the respiratory and vascular systems. In the former we have examples in spasmodic closure of the glottis, and also in the narrowing of the bronchial tubes in spasmodic asthma; in the latter in the obstruction by spasm of the small arteries of the base of the brain, to which the initial phenomena of the epileptic seizure are ascribed by some. To a similar spasmodic occlusion of the arterioles of the lungs Sir George Johnson ascribes many of the phenomena of cholera. To a more prolonged spasm of the blood-vessels the gangrene of Raynaud's disease, and that produced by ergot, have been attributed.

Obstruction from more permanent alterations in the walls of the tubes may be produced, first, by acute inflammatory swelling and œdema, and by the formation of false membranes; and, secondly, by chronic inflammatory thickenings and cicatricial contractions. These form the non-malignant permanent strictures, as of the urethra, œsophagus, pylorus, and intestines. Thirdly, the growth of some malignant or other tumour in the walls of tubes may lead to the same result. This form of stricture is especially common in the digestive canal, from the pharynx downwards.

3. **External Pressure.**—Lastly, obstruction and occlusion are often the result of pressure from without. This pressure may be exercised by a tumour of some kind, or by enlargement of an organ, as, for example, the obstruction of the trachea produced by an enlarged thyroid body. Or the pressure from without may be produced by the effects of inflammatory processes occurring in the surrounding parts. We have examples of this in occlusion of the intestine by fibrous bands, and in obstruction of the tubuli uriniferi of the kidney by the cirrhotic process. Other examples of pressure from without, causing obstruction, occur in displacements of the intestine in hernia, with which may be classed the various forms of volvulus.

EFFECTS.—The effects of obstruction and occlusion differ, of course, according to the tube or orifice affected. They are in part due to the arrest of function of the tube, and in part are purely mechanical. The most general mechanical effect is dilatation of the tube behind the seat of the obstruction, owing to the accumulation of its contents (*see* DILATATION). When these contents are themselves irritating, or when the disturbing cause also constricts the blood-vessels, ulceration or gangrene and perforation are liable to occur. The other effects are mainly due to the backward pressure of the accumulation. In cases where the tube is the duct of a gland, the ultimate effect is to arrest the secreting function, and cause atrophy of its substance. This is attended by cessation of any further accumulation; and sometimes complete absorption of the previous accumulation takes place, and the dilated duct shrinks and becomes completely atrophied. Examples of this series of changes occur not infrequently in the ureter and kidney. W. CAYLEY.

OCCUPATION, Ætiology of.—*See* DISEASE, Causes of; and PUBLIC HEALTH.

ŒDEMA (*οἰδέω*, I swell).—SYNON.: Fr. *Œdème*; Ger. *Œdem.*—A dropsical effusion in cellular tissue, whether subcutaneous, submucous, subserous, or in the interstices of organs. *See* DROPSY.

ŒSOPHAGUS, Diseases of.—SYNON.: Fr. *Maladies de l'Œsophage*; Ger. *Krankheiten der Speiseröhre.*—The diseases of the œsophagus may be considered in the following order: (1) Œsophagitis; (2) Ulceration; (3) Dilatation; (4) Stricture; and (5) Morbid Growths.

1. **Œsophagitis.**—DEFINITION.—Inflammation of the œsophagus.

ÆTIOLOGY.—Inflammation of the œsophagus, arising in its structures and confined to it, is an affection of rare occurrence; or it may be that it offers so few marked symptoms that but small attention is paid to it, and it never comes before the physician. But by no means uncommon is the extension of inflammation to the œsophagus from neighbouring structures. Thus, a catarrhal inflammation of the throat and fauces may pass down the œsophagus. In children thrush has been seen to extend into the gullet, setting up a certain amount of inflammation; and the same holds good with regard to diphtheria and croup. Where organic disease of this tube exists, a certain amount of inflammation is liable to be set up. But by far the most common causes of acute œsophagitis are the ingestion of irritating or corrosive substances, such as boiling water, alkalis, or acids; and mechanical injury from the introduction of foreign bodies.

SYMPTOMS.—Somewhere in the line of the œsophagus, pain, varying in intensity, of a burning or lancinating character, is complained of, at times so severe as to induce vomiting. This pain is rendered intensely acute by all attempts at swallowing. Even the passage of the saliva is sufficient to set it up, and hence it is that this fluid is seen dribbling from the mouth of the child who is the subject of this disorder. Thirst is a usual accompaniment of œsophagitis; but rather than endure the agony of swallowing fluids, the individual will put from him all fluids, however bland. If the attendant insist upon an effort being made to swallow some sustenance, most usually this is speedily rejected, accompanied with much viscid mucus, flakes of lymph, membranous shreds, and sometimes blood or pus. The amount of fever and constitutional disturbance is in proportion to the intensity of the inflammation.

Prognosis.—If simple, acute œsophagitis usually terminates in resolution, and somewhat speedily. If it be due to the passage of acrid or hot substances, ulceration of the œsophagus may result; or simply a permanent thickening of the coats of the tube, whereby its calibre is reduced, and stricture is the result.

Treatment.—It is best to abstain from all attempts to give nourishment in the ordinary way, and to rely entirely upon nutritive enemata till the acuteness of the affection has passed. Ice may, however, be given to the patient to suck, if it prove agreeable to him. For the relief of the pain warm poultices may be applied externally, or opiate fomentations; cocaine lozenges, $\frac{1}{8}$ gr. in each, may be sucked. Opium may be administered either by enema, or subcutaneously. The state of the bowels must be attended to.

2. **Ulceration.**—Ætiology.—This affection, as we have already seen, may arise as the result of the passage of irritating fluids through the œsophagus. More commonly it is brought about by the swallowing of certain pointed or angular bodies which stick in the gullet, and cannot be dislodged; or which, before their removal, have eroded the mucous membrane and produced ulceration. Simple ulcer and perforating ulcer of the œsophagus have also been described; they are similar to those which are observed in the stomach, but are of rare occurrence.

Symptoms.—These are similar to the phenomena described under œsophagitis, only the pain is more localised, and is more generally referred to a circumscribed spot between the scapulæ in the back, at the top of the sternum, or in the præcordia. The same difficulty in swallowing is experienced, and, on account of the slowness of the ulcerated surface to heal, is much more protracted, so that the patient emaciates rapidly, and death from starvation has even been known to occur. Hæmorrhage occurring in the act of vomiting or expectoration is highly suggestive of ulcer. In the perforating variety a communication may be established between the œsophagus and one of the bronchi—more likely the left, the pleura, or the pericardium. Auscultation may reveal a change of tone in the sound of the swallow, it being more dead in quality than in health. The bolus swallowed seems also as if it were diminished in bulk, but much elongated, so that it takes longer to pass the ulcerated spot than it does at any other portion of the tube.

Prognosis.—This must be founded on the nature of the ulcer, but it is always serious.

Treatment.—Not much reliance is to be placed upon medicinal treatment. The patient's strength must be sustained by the liberal use of generous diet if he can swallow, or by nutrient enemata. It may be possible to pass into the stomach a small-sized œsophageal tube (catheter No. 15) and thereby introduce plenty of nourishment. Stimulants will also most likely be called for. Ice may be freely allowed. Local application of nitrate of silver, tannic acid, carbonate of bismuth, borax, cocaine, and other agents, by means of bougies, has been advised.

3. **Dilatation.**—Dilatation may affect the œsophagus in its entire length, but more commonly involves merely a portion of the tube, as is frequently observed in cases of stricture of the œsophagus, which in almost every case precedes this condition. In addition to this, sacs are met with in the walls of the canal, which communicate with it. These diverticula are usually formed by the distension of all the coats of the œsophagus, but sometimes by the mucous membrane alone becoming dilated, and pushed between the other coats. The *causes* which give rise to this condition, in addition to stricture, are the lodgment of some foreign body in the walls of the œsophagus (this is one of the most frequent origins of the diverticula), and paralysis of the walls induced by chronic inflammation.

Symptoms.—These are not marked. If the dilatation be idiopathic, and involve the whole length of the tube, nothing very abnormal will be present to lead to the discovery of this condition. If it be secondary, dependent upon stricture, then, in addition to the symptoms described under that head, it will be observed that the food, after it has been swallowed, is much longer retained than formerly. There is also experienced a sensation of fulness, which may sometimes be perceptible to vision, at the point above the stricture, and this is accompanied by regurgitation of the food into the mouth, initiating in this way a habit of chronic rumination; or there is experienced a desire to relieve the sensation by vomiting, which sooner or later occurs, spontaneously or induced by the patient himself, and affords great and immediate comfort. In the case of diverticula, when of some size, the symptoms are very similar to those above described. In addition, it may be noticed that a very bad odour is given off from the mouth of the patient, due to the retention and decomposition of the food in these pouches. According to their site, tumours, varying in size as the individual has more or less lately been partaking of food, may be observed. These may sometimes interfere with respiration, deglutition, or circulation. Auscultation in the case of simple dilatation indicates that no obstruction to the passage of the bolus exists, and there is no prolongation of the time it takes to pass into the stomach. But an alteration in the vigour of the peristaltic action is observed. There is a deficiency or entire loss of the contraction of the muscles, and the gradual transmission of the bolus onwards is no longer heard, but it appears to run or drop at once into the stomach. It is generally believed that men are more subject to this affection than women; and it is met with in the decline of life.

Treatment.—Treatment is of no avail for simple dilatation of the œsophagus, except to remove the cause, if possible, and to treat symptoms. In reference to the treatment of diverticula, *see* Memoir by Mr. Butlin, *Royal Med.-Chir. Trans.* vol. lxxvi. 1893.

4. Stricture.—This affection may be the result of either of the two first-named disorders; or of a changed condition of the walls of the œsophagus, brought about by the existence of a new-growth, such as cancer, or syphilis. Further, contraction of the œsophagus may be due to the presence of a tumour or other growth pressing upon, and so narrowing its calibre. Or, finally, it may be simply functional, giving rise to temporary obstruction, known as *spasm (œsophagismus)* and functional *paralysis* of the œsophagus.

Symptoms.—*Organic* stricture of the œsophagus may have existed for some time before the gravity of the complaint is realised, because the symptoms develop themselves only gradually. The most noticeable is the difficulty in swallowing. At first this may be merely occasional, and only perceived when an effort is made to pass a tolerably large bolus down the gullet; but gradually the difficulty increases, and it is now not only confined to the attempt to swallow solids, however finely masticated, but semi-solids give rise to a sensation as if the food never passed a certain point, this point being usually referred to the manubrium sterni, where the stricture is situated. If the patient, by dint of resolution and perseverance, overcome the difficulty to such an extent as to swallow some food, the first morsel passed being always the greatest trial, it may be retained for a time, but is ultimately rejected. This desire to get rid of the food swallowed increases to such an extent, that all aliment is regurgitated, rather than vomited. The rejected matter consists of the food, little altered, mixed with mucus, or sometimes with a little blood and pus. The reaction is always alkaline. Finally the dysphagia becomes so marked that even the attempt to swallow liquids is given up as hopeless. Coincident with the advance of this dysphagia does the emaciation progress; the abdomen falls in; and the patient dies from starvation. The passage of a bougie will definitely settle any doubt as to the existence of an organic stricture, besides affording information as to its site, extent, and form; but the operation must not be performed without due consideration, as it has happened that an unrecognised aneurysm has been accidentally ruptured by the passage of an instrument. Auscultation will also aid in the diagnosis. It will reveal the same slowing of the passage of the bolus already referred to, and the same elongation of it. In addition, if the stricture be very narrow, then the food will be heard to pass through it with difficulty and with a creaking sound; while if it be narrower still, particularly if the food be fluid, 'it eddies as it were in a funnel, with a prolonged resonant gurgle,' as described by Dr. Allbutt.

Spasmodic stricture of the œsophagus (which is merely a temporary clonic contraction of the muscular coat) differs from the organic form in the suddenness with which the dysphagia comes on; its paroxysmal nature; its not infrequently being but one of the many symptoms of hysteria; its occurrence in young anæmic females, or hypochrondriacal men; and though dyspepsia may be complained of, and even prove an exciting cause, still emaciation does not exist. The point where the impediment to the passage of the food is experienced is usually at the upper part of the œsophagus or pharynx. Occasionally pain is complained of on attempting to swallow, and food taken is sometimes ejected. But the spasm soon yields, and food finds it way into the stomach. The difficulty in swallowing is much increased by the attempt being witnessed by sympathising friends, and a stern command to cease from such frivolous efforts often succeeds, to a surprising degree, in overcoming the dysphagia. On introducing a bougie, it will of course be stopped if the spasm exists at the moment; but gentle, careful, continuous pressure will ultimately cause the spasm to give way, and thus its true nature will be revealed.

Prognosis.—The prognosis in cases of real organic stricture cannot be otherwise than always grave. If it be due to cancerous growth, then it must necessarily be most unfavourable. Spasmodic stricture is very hopeful.

Treatment.—The treatment appertains more to the domain of surgery than of medicine. In the case of organic stricture, the frequent passage of bougies of varying size often proves valuable, except in the case of cancer, when it should never be attempted. Diet must be attended to, the state of the stomach looked to, and dyspeptic indications combated. If food cannot be swallowed, a small catheter may be introduced through the stricture, and the patient fed by the stomach-pump; or nutrient enemata may be administered. For the spasmodic variety, the general system must be treated, tonics prescribed, and the usual anti-hysterical remedies ordered.

5. **Morbid Growths.**—By far the most common form of growth in the œsophagus is cancer. Occasionally fibroid tumours are seen, either as such, or as polypi, situated about the level of the cricoid cartilage. When carcinomatous, the growth may be any of the usual varieties of cancer, but most commonly it is the pavement-cell epithelioma which invades this organ. It will occasionally be found to affect the upper third, much more commonly the lower third, and very rarely the middle of the gullet. It commences in the submucous tissue, speedily involving the other coats of the tube. From this it may extend to other organs, and perforation of the trachea, bronchi, aorta, or pericardium may take place.

Symptoms.—Confining the attention to cancer of the œsophagus, this disease may well be suspected if, in an individual above middle age, gradually increasing dysphagia be complained of; if symptoms of stricture be pronounced; if pain be experienced, especially of a lancinating character, about the spine and shoulder-blades; if nausea and retching be observed, together with irritating cough, and occasional hiccough; if the patient continue to emaciate, and present the dirty greenish-yellow complexion common in cancerous cachexia, together with enlargement of lymphatic glands; and most certainly shall we be confirmed in our diagnosis if, on examination of the vomited matters, cancer-cells or nests of epithelial cells be seen.

Prognosis.—The prognosis is of the worst description. The patient gradually becomes exhausted, and dies of inanition.

Treatment.—Treatment can be merely palliative. It consists in relieving the pain by anodynes; and endeavouring to sustain the patient's strength as long as possible, most successfully by the use of peptonised nutrient enemata. To prolong life, the aid of the surgeon may be called in, either to dilate the stricture by catheters, or to perform gastrostomy. Œsophagotomy will probably be out of the question.

Claud Muirhead.

ŒSTRUS (οἶστρος, a gadfly).—Synon.: Fr. *Œstre*; Ger. *Bremse*.—A genus of dipterous insects, called gadflies, the larvæ of which, vulgarly known as maggots or bots, live parasitically in man and animals. The ordinary human bot, *Œstrus hominis*, is of rare occurrence in England, but is not infrequently met with in warm countries, especially in South America. The larva of the gadfly of the ox, *Œstrus bovis*, also occasionally attacks man.

True maggots and other bot-like larvæ are occasionally encountered in medical practice. The late Dr. Livingstone, when in Africa, was attacked in the leg by a small bot-like larva, which Dr. Kirk removed by incision. The specimen is now preserved in the museum of the Royal College of Surgeons of England.

OEYNHAUSEN, or REHME, in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

OFEN, in Hungary.—Sulphated waters. *See* Mineral Waters.

OÏDIUM ALBICANS.—Synon.: *Saccharomyces mycoderma*; *Mycoderma vini* (Grawitz).—A vegetable parasite, associated with thrush. *See* Mouth, Diseases of.

OINOMANIA (οἶνος, wine; and μανία, madness).—A synonym for dipsomania. *See* Dipsomania.

OLD AGE, Signs of.—*See* Senility.

OLFACTORY NERVE, Morbid Conditions of.—The principal morbid conditions that occur in connexion with the nerve of smell are the following: (1) Hyperæsthesia; (2) Subjective Sensations of Smell; (3) Perversion of the Sense of Smell; and (4) Olfactory Anæsthesia.

1. **Olfactory Hyperæsthesia.**—Synon.: Hyperosmia.

Definition.—Increased sensitiveness of the olfactory nerve.

Ætiology and Symptoms.—This condition is seen in the increased nervous sensibility which results from chronic debilitating illness. It occurs also in hysteria, in which remarkable, almost animal, acuteness of the sense is sometimes present, so that not only objects but persons have been discriminated by this means. In insanity the same condition is sometimes met with. It is usually associated with, and has to be distinguished from, an altered appreciation of odours, shown in the abnormal enjoyment of or disgust at the odours which are recognised with natural or preternatural acuteness.

Treatment.—The condition rarely calls for special treatment.

2. **Subjective Sensations of Smell.**—Subjective sensations of smell occur from central disease, or from irritation of the nerve of smell. In the insane, olfactory hallucinations occur, though less commonly than those of the visual or auditory sense. Schlager met with them in five cases out of six hundred. In epilepsy subjective sensations of smell occur as occasional prodromata

of fits, and the disease in these cases probably involves the olfactory centre in the anterior part of the temporo-sphenoidal lobe. It was so in a case of tumour recorded by Sander. Irritation of the nerve, from meningeal disease or injury, also, in rare cases, causes olfactory hyperæsthesia. Persistent disagreeable smells are occasionally complained of after influenza. Sir Richard Quain has recorded an interesting case of perityphlitis, in which an apparently subjective sensation of a foul odour was persistently complained of by the patient, until evacuation of the contents of the abscess, when the supposed smell completely disappeared.

3. Perversion of the Sense of Smell. Synon.: Parosmia.—This is a rare condition which occasionally results from irritation of the nerve or central organ. In a case recorded by Legg, some time after an injury to the head all substances 'tasted' of gas or paraffine, and there was marked diminution in the acuteness of the sense of smell.

4. Olfactory Anæsthesia. — Synon.: Anosmia.

Definition.—Loss or diminution of the sense of smell.

Ætiology. — The causes may be local changes in the organ of smell; disease of the nerve; or disease of the centre.

(*a*) Among *local* causes may be mentioned the following: (1) Acute and chronic catarrh of the olfactory mucous membrane, the latter causing thickening—a condition sometimes produced by excessive snuff-taking. A large proportion of the cases follow severe and prolonged catarrh, and are due purely to the local effect on the tissues through which the olfactory nerve-endings are stimulated. (2) Dryness of the mucous membrane, as in cases of destruction of the external nose (Notta), or in paralysis of the fifth nerve. (3) Occlusion of the passage by polypus, preventing the access of air to the olfactory region. (4) Impaired access of air consequent on facial paralysis. The loss of the power of dilating and keeping expanded the nostril prevents a due quantity of air being drawn through the nasal passage; and, moreover, the loss of power of compressing the nostril in 'sniffing' prevents the air being directed into the olfactory region. (5) In rare cases loss of pigment in the nose, consequent on general loss of pigment, has appeared the cause of loss of smell.

(*b*) *Damage to the olfactory nerve* may result from injury or disease. It is not an uncommon result of blows or falls upon the head, and it is probable that in these cases the delicate olfactory nerves are lacerated as they pass through the bone, or may even be torn from the bulb (*see* Nose, Diseases of). The bulb, or tract, may also suffer in adjacent disease, as tumour, abscess, caries of the bone, and meningeal changes, especially syphilitic. Spontaneous atrophy of the olfactory bulbs occasionally occurs in old age, and has been met with in younger persons, and (rarely) in tabes dorsalis. Excessive stimulation of the nerve by a very powerful odour has been followed by anosmia.

(*c*) In *cerebral disease* the sense of smell is sometimes lost. It may be impaired in so-called functional disease, as in hysteria, and in degenerative disease, as paralytic dementia. It is occasionally lost in organic disease involving the roots of the olfactory nerve. Unilateral anosmia has been met with in cases of aphasia (Hughlings Jackson), an association which is explained by the passage of the external root of the olfactory nerve past the island of Reil to the anterior part of the temporo-sphenoidal lobe. Together with the other special senses, loss of smell has been observed on the side opposite to a lesion near the posterior extremity of the internal capsule in the opposite hemisphere.

It is to be remembered that the olfactory nerves are sometimes congenitally absent.

Symptoms.—The evidence of anosmia is the loss of the perception of odours and flavours—the former term being applied to the sensation when its cause enters by the anterior nares, the latter when it enters by the posterior nares and the sensation is blended with that of taste. It is generally imagined that flavours are tasted, and hence those who are suffering only from anosmia are said to have lost smell and taste. The loss of the olfactory sensation may be partial or complete, according to the extent of involvement of the nerves. In some cases, especially of traumatic origin, the ability to perceive one or two odours may be unimpaired, no others being recognised. It may be lost on both sides, when due to degenerative changes; or on one side only, from local changes or injury or brain-disease. When due to organic brain-disease, it is generally lost on the side of the cerebral lesion. Unilateral loss, in hysterical hemianæsthesia, occurs on the side opposite to the hemisphere which is in a state of partial inhibition; and a similar loss, with that of the other special senses, has been met with in rare cases of organic disease.

Diagnosis.—The diagnosis presents little difficulty. In examination, care must be taken to employ only substances—as aromatic oils, &c.—which affect the olfactory nerve, and not acrid substances, as ammonia and acetic acid, which stimulate also the fifth nerve.

Prognosis.—The prognosis in anosmia is favourable when it is due to a local cause which has existed but a short time, or in which its cause (such as obstruction from a polypus) can be removed. Prolonged changes in the mucous membrane of the nose seldom pass away sufficiently to permit restoration of smell; and whenever there is reason to suspect injury or disease of the olfactory nerve or centre, recovery is very improbable. Hence traumatic loss of smell, which has continued for some months, will certainly persist.

Treatment.—Anosmia, as a symptom, rarely calls for treatment, which should be directed to its cause. Sometimes local stimulation is of service; and occasionally counter-irritation, by blisters to the neck, has appeared to assist recovery. In hysterical cases faradisation of the nasal mucous membrane has been recommended; but the olfactory nerve itself is not accessible to electrical stimulation. The chief therapeutical measures are those for the treatment of the nasal mucous membrane. *See* Nose, Diseases of.
W. R. Gowers.

OLIGÆMIA (ὀλίγος, small; and αἷμα, blood).—Deficiency of the total amount of blood in the body. *See* Blood, Morbid Conditions of.

OMAGRA (ὦμος, the shoulder; and ἄγρα, a seizure).—Synon.: Fr. *Omagre*; Ger. *Schultergicht.*—A name for gout in the shoulder. *See* Gout.

OMENTUM, Diseases of.—*See* Peritoneum, Diseases of.

ONANISM (Onan).—A synonym for masturbation. *See* Masturbation.

ONYCHIA (ὄνυξ, the nail).—An inflammatory affection of the matrix of the nail. *See* Nails, Diseases of.

ONYCHOGRYPHOSIS (ὄνυξ, the nail; and γρυπός, curved).—This term is applied to curvature of the nails; and, more particularly, to the oblique elevation of the nails from their matrix by the accumulation beneath them of crude cell-substance, which forms a kind of wedge, and crumbles away upon desiccation. *See* Nails, Diseases of.

ONYCHOMYCOSIS (ὄνυξ, the nail; and μύκης, a fungus).—Parasitic disease of the nails. *See* Tinea Tricophytina; Favus; and Nails, Diseases of.

OPHTHALMIA (ὀφθαλμός, the eye).—Synon.: Fr. *Ophthalmie*; Ger. *Ophthalmia.* A general term which might be used to express any morbid condition of the eye, but which is restricted by custom to the forms of inflammation which originate in the superficial structures of the organ, such as the varieties of conjunctivitis, or the phlyctenulæ which sometimes appear upon the cornea and may give rise to shallow ulcers. Thus we have mention by authors of *infantile*, *catarrhal*, *contagious*, *purulent*, and *strumous* or *phlyctenular*, ophthalmia. *See* Eye, and its Appendages, Diseases of.

OPHTHALMITIS (ὀφθαλμός, the eye). Synon.: Panophthalmitis; Fr. *Ophthalmite*; Ger. *Augenentzündung.*—A term which has been used to express inflammation affecting the whole of the structures of the eyeball, superficial as well as deep. Such a condition is most frequently seen after operations upon the eye, and was described by the late Dr. Jacob as *eyeballitis*! *See* Eye, and its Appendages, Diseases of.

OPHTHALMOSCOPE (ὀφθαλμός, the eye; and σκοπέω, I examine).—Synon.: Fr. *Ophthalmoscope*; Ger. *Augenspiegel.*

The ophthalmoscope is an instrument for lighting up the interior of the eye, in such a manner as to render the contained structures clearly visible.

Description.—The first ophthalmoscope was invented about 1847, by the late Mr. Charles Babbage, who laid it aside because an ophthalmic surgeon to whom he showed it, and who failed to perceive its probable utility, afforded him no encouragement. In 1851 another form of the instrument was invented by Helmholtz; but, in 1852, Babbage's original form was re-invented by Ruete, and this, with a few unimportant modifications, has ever since held its ground in practice. It consists, essentially, of a slightly concave mirror, with a small central perforation; or, if the mirror be of silvered glass, with the silvering removed from a small circle in the centre. A mirror the size of a shilling is large enough for most practical purposes, and a central aperture of not more than 2 or 3 millimètres in diameter is better than a larger one. The mirror may be attached to a handle of any proportions preferred by the owner, or may be left without one; but it must be accompanied by certain auxiliary convex and concave lenses, the uses of which will be presently explained. The focal length of the mirror is usually about 8 inches.

Method of Use.—In order to learn the use of the ophthalmoscope, the beginner will do well to avail himself of a contrivance called Perrin's artificial eye, or of one of the more elaborate forms of it designed by Landolt and by Frost. The instrument essentially consists of a small hollow sphere of metal, to represent the eye, closed in front by a lens, which can be changed at pleasure, and behind by a door for the insertion of pictures of various healthy and diseased conditions of the retina. When an artificial eye is not available, the learner should take the patient into an obscurely lighted room, and should stand or sit facing him, with the two heads upon the same level. A gas or oil flame—preferably, from its greater steadiness and superior illumination, that of an argand burner—is then placed upon the same level as the eye which is to be examined, on the same side of the head, and a little behind it, so that no direct light shall fall upon the cornea. The observer, commencing with his face exactly opposite that of the patient, and about eighteen inches distant from it, places the back of the ophthalmoscope mirror against his eye, using preferably that which is opposite to the eye to be examined, the right eye for the patient's left, and *vice versâ*. The patient is directed to look as if at a distant object, over the shoulder of the observer which is most remote from the eye under inspection, thus looking over the observer's left shoulder when the right eye is being examined. In this position, the observed eye is turned a little towards the nose; and the optic nerve-entrance, which is somewhat on the nasal side of the posterior pole, is brought opposite to the pupil. Looking through the mirror-aperture, the observer directs the light of the flame, reflected from the polished surface, in such a manner that it falls into the pupil of the observed eye; and this light, returning from the eye, reaches him through the perforation. It exhibits the cavity of the eye illuminated, but, as a rule, shows no objects, but only the pupil as a reddish or yellowish circle. In order to see the contained structures, two methods are employed, the *indirect* and the *direct*; the former of which gives the better general view of the fundus, the latter the greater facilities for studying the condition of single points on the nerve or on the retinal surface. It is therefore necessary to be conversant with both, and to use one or both as circumstances may require.

Indirect Method.—In using the indirect method, the observer takes a biconvex lens, of about two inches focal length, and holds it with his free hand in the track of the returning light, and at about two inches from the eye of the patient. The rays of light, thus rendered convergent, become united into an aerial inverted image of the fundus of the eye, which image, and not the fundus itself, will be the object of vision to the observer. The position of the image is in the focal plane of the lens, on the side next the spectator; and, in order to see it clearly, nothing is necessary but to have the observing eye in the track of the returning rays, and at the right distance from the image; which, it must be remembered, with a two-inch lens, will be four inches or more nearer to the observer than the eye of the patient. The whole art of using the ophthalmoscope for the indirect method may be said to consist in moving the eye to and fro upon the line of sight until the right distance is attained, without moving it laterally so as to get out of the track of the rays, and without losing the illumination. As soon as a vessel, or any other defined object, is seen, the observer knows that his distance is correct, and he then causes the patient to change the direction of his eye until every part of its fundus has come successively into view. The image, it must be remembered, is inverted in every particular; its nasal side representing the temporal side of the retina, and its upper portion the lower portion of the retina. In first attempts to use the ophthalmoscope it is desirable to have the pupil of the observed eye dilated by atropine or duboisine, but, after dexterity has been attained, the dilatation may in most cases be omitted. The details of the retinal image are sometimes more or less obscured by an image or images of the lamp-flame; of which there may be two, one formed by the anterior and one by the posterior surface of the lens. These images are only sources of embarrassment when the lens is held vertically, and may be displaced and put out of sight by giving it a small degree of obliquity. A bright image of the mirror itself upon the retina, showing the central perforation as a dark spot, is sometimes troublesome to beginners; and it is said that this image has even been mistaken for that of the optic nerve. The blackness and sharp definition of the perforation should render such a mistake impossible; and the image may readily be displaced by a slight alteration of the angle at which the mirror is held.

In order to magnify the inverted image, and to increase its brightness by bringing the mirror nearer to the eye of the patient, a convex lens may be placed behind the mirror for the observer to look through. Something of this kind is always necessary for observers who have reached the period of life at which spectacles are required for reading; and it is advantageous to all persons. The writer's practice is to use a lens of about seven inches focal length in this manner; and there is thus obtained an image which for many purposes is as good as that afforded by the direct method. With such a lens, the eye of the observer can be only seven inches from the image, and, as this will be formed four inches in front of the eye of the patient, it follows that the two faces will be only eleven inches apart. At this comparatively small distance, the illumination of the fundus of the observed eye, which is afforded by a good mirror, is exceedingly satisfactory.

Direct Method.—In the direct method, the observer does not apply any intervening glass between the mirror and the eye of the patient, but comes as close to the latter as possible, and looks, not at an aerial optical image, but at the actual fundus itself, magnified by its own crystalline lens. It is only when the eyes of both observer and patient are of normal refraction, or emmetropic, that this can be done without the aid of a lens, which when required is most conveniently placed behind the mirror. The lens employed for this purpose must be such as to correct the sum of the error of refraction of both the eyes; and must therefore be concave when this error is on the side of myopia, convex when it is on the side of hypermetropia. An observer who is short-sighted will begin his investigation with a concave lens behind his mirror, which corrects his own short sight; and he will add to or diminish the power of this lens to meet any degree of ametropia which the observed eye may present in addition to, or in diminution of, his own. In order to facilitate the required changes, all necessary lenses are now usually mounted upon a revolving disc placed behind the mirror, and so arranged that each one of them can be brought in turn before the aperture. In one of the best of the modern forms of instrument, that of Dr. Loring of New York, the mirror itself is made to turn upon pivots in a vertical line independently of the disc of lenses, so that the correcting lens receives no obliquity from the position of the mirror. This contrivance is valuable in some cases, especially when a correcting lens of high power is required, because such a lens, if held obliquely, is liable to produce some distortion of the objects seen through it. In using the revolving disc, a normal-sighted observer commences with no lens behind the aperture; and, if he then obtains clear definition, he knows that the eye into which he is looking is normal-sighted also, or at most is only in a slight degree hypermetropic. If, on the contrary, he does not obtain a clear image, he knows that the eye into which he is looking, unless the transparency of its media be impaired, is not normal-sighted, but that it is either myopic, or hypermetropic in a somewhat high degree. Keeping the fundus in view, he causes the disc to revolve until a lens comes over the aperture which renders the picture distinct; and he has then only to see the number and kind of the lens in order to know the degree as well as the nature of the defect of refraction. In many cases it is even possible to prescribe spectacles, as the result of such an examination, with a very fair degree of correctness and success. But the chief use of the direct method, especially in the applications of the ophthalmoscope as an instrument of diagnosis in general medicine, is to scrutinise, as already stated, some portion of the fundus of the eye which has been shown, by the indirect method, to require more minute examination than that method will itself permit the observer to accomplish.

Ophthalmoscopic Appearances.—In order to interpret ophthalmoscopic appearances, and to distinguish physiological variations from pathological changes, it is before all things necessary to bear in mind the anatomy of the structures which are, or may be, rendered visible, and the relations which they bear to each other. The fundus of the eye is composed of several layers, the more anterior of which commonly conceal the posterior; and conceal them in such a manner that, when the former are rendered more transparent by malformation or disease, the latter are brought into view.

1. *Sclerotic.*—Commencing with the posterior layer, it consists of the inner surface of the sclerotic, a smooth and shining white surface, which is ordinarily entirely concealed by the pigmentation of the choroid and of the posterior or epithelial layer of the retina. The sclerotic is naturally visible, as a general white background to a vascular network, in cases of albinism, in which the natural pigment of the eye is congenitally absent, or in some very fair persons, who are not albinos, but whose eyes are very sparingly pigmented. It is rendered visible in patches, as a result of malformation or disease, in cases in which it is exposed by a fissure through the choroid, such as generally accompanies *coloboma iridis*; in cases in which the choroid has suffered atrophy as a result of antecedent hæmorrhage or inflammation; and in the immediate neighbourhood of the optic discs, in the so-called crescents of choroidal atrophy which are so often associated with high degrees of myopia. The whiteness of an exposed sclerotic may be distinguished from that of an opaque white deposit in the choroid or in the retina, by many small physical characters, such as the relation of the borders of the whiteness to the neighbouring tissues and vessels, which will show the one to be the result of the removal, the other of the addition, of material. The most conspicuous white deposits are those associated with albuminuria or diabetes mellitus, with syphilitic retinitis, and with the first stages of retinal glioma. In all these the deposits manifestly cover and conceal vessels, which may be seen to emerge from beneath them; while in complete atrophy of portions of the choroid, it is not uncommon to see a few remains of dwindled vessels, and other shreds of choroidal tissue, rendered unusually conspicuous by their white background, and manifestly situated in a plane anterior to it.

2. *Choroid.*—The next layer from behind forwards is the choroid, which is essentially a vascular network, containing more or less pigment in the intervals between the vessels. In very fair eyes, as already mentioned, the choroid may allow the general whiteness of the sclerotic to shine through; but, in the great majority of cases, it conceals the latter entirely. In like manner, the actual structure of the choroid is itself usually concealed by the pigment in the epithelial layer of the retina; and the choroid generally only plays the part of a red background, varying up to dark chocolate colour in very dark eyes, and exhibiting neither structure nor vessels. When the retinal epithelium is scantily pigmented, as occurs in light eyes, the larger choroidal vessels may be seen through the retina; and they are readily distinguished from those proper to this structure by their different arrangement; the vessels of the retina being arborescent, whilst those of the choroid are either nearly parallel to one another, or arranged in more or less diamond-shaped reticulations. When both sets are visible together, moreover, the vessels of the

retina will be clearly seen to be in a plane anterior to that of the vessels of the choroid, and a variety of minute differences of colour and aspect will suffice to show that the two sets form parts of different circulatory systems.

3. *Retina.*—The retina itself is formed of several layers, the deepest of which contains the perceptive elements, or the rods and cones of the so-called Jacob's membrane. In front of the perceptive elements there are ganglionic and granular layers, subservient to the functions or to the nutrition of the rods and cones; and, in front of these again, a layer of connective tissue, containing and supporting the conducting fibres, which are ultimately massed together in the trunk of the optic nerve, and which convey impressions from the retina to the brain. The fibre layer and its connective tissue are necessarily thickest in the immediate neighbourhood of the optic nerve, and they thin off towards the peripheral parts of the retina; whilst all but the perceptive elements are wholly wanting over a small circle or depression at the posterior axis of the eyeball, a little to the outer side of the nerve, and known as the 'yellow spot,' with its *fovea centralis.* The central artery of the retina enters the eye in the trunk of the optic nerve, and the central vein emerges in the same manner, the circulation between the two being almost a closed one, save for a few very small and insignificant anastomoses of the terminal vessels, some at the nerve-entrance itself, others in the ciliary region. The retinal blood-vessels are chiefly lodged in the connective tissue of the fibre layer, and only small twigs dip down into the deeper retinal tissues. The arteries and arterioles divide, and the veinlets and veins unite, in an arborescent fashion; and the two sets of vessels are readily distinguished apart by the larger calibre and deeper colour of those which carry venous blood. At the nerve-entrance, both sets bend at a right angle, or nearly so, in order to pass from the axis of the nerve-trunk into the plane of the retina, or *vice versâ.*

Between the rods and cones of Jacob's membrane, and the anterior or capillary layer of the choroid, there is a sheet of pavement-epithelium, the cells of which contain a larger or smaller quantity of pigment. This epithelial layer was at one time regarded as part of the choroid, but more recent histologists refer it to the retina. When full of pigment, it forms an opaque screen, by which the choroid is concealed from view, and against which the delicate retinal structures, especially near the nerve, may become apparent as a thin, almost pellucid film, in which blood-vessels ramify. In the eyes of fair people, with only scanty pigmentation, the epithelium neither completely conceals the choroid, nor does it throw up the retina with anything like the same distinctness, so that the retinal blood-vessels are clearly seen, but not the structure which supports them. When the pavement-epithelium has been removed, either by disease or by senile changes, the choroidal tissues become conspicuous.

4. *Optic Nerve.*—The general aspect of the optic nerve varies greatly, within limits defined by differences in the degree of its capillary vascularity, by the effects of contrast arising from the degree of pigmentation of the surrounding parts, and by the mechanical arrangement of the structures of which it is composed. The aperture in the sclerotic, by which the nerve enters the eye, is closed by a cribriform plate of condensed connective tissue, the *lamina cribrosa*; and the fibres normally leave their sheaths on the outer side of this lamina, only the axis-cylinders passing through its perforations. The combined axis-cylinders constitute a mass the whiteness of which is subdued rather than glistening, and which derives a certain amount of reddish, roseate, or pink colour from the capillary vessels by which it is permeated. The axis-cylinders, like the vessels, bend round as they pass from their original direction into that of the retinal surface; and, in the majority of instances, they leave a central depression in the nerve-disc as they separate, a depression at the bottom of which the glistening whiteness of the lamina cribrosa is visible, and which has been called the *porus opticus.* In other instances, this central depression does not exist, but the axis-cylinders are gathered chiefly towards one side of the nerve-entrance, and the lamina is visible laterally instead of centrally. The size of the *porus opticus* is very variable, insomuch that sometimes, when it constitutes quite a large central depression, it is described as congenital or physiological excavation of the nerve. This congenital excavation is always readily distinguishable from the excavation produced by the pressure consequent upon excess of internal tension; because the former never, and the latter always, extends to the extreme margin of the nerve. In other words, the congenital excavation, however large and remarkable, is always surrounded by a ring of nerve-tissue; while the morbid excavation always extends to the margin of the opening in the sclerotic. The position of the blood-vessels in the nerve-entrance is also another variable factor, since they are sometimes nearly central, and at others are seen to pass into or out of the nerve-tissue close to its margin. In a few cases, moreover, the axis-cylinders at some portion or portions of the circumference carry their sheaths for a short distance into the retina; and the nerve is then surrounded by white glistening processes, with brush-like terminations. Sometimes, again, the margin of the opening in the choroid is richly pigmented, and the nerve is surrounded with a ring, or bordered by a crescent, of chocolate or black colour.

5. *Fundus as a Whole.*—The general appearance of the healthy fundus oculi may be summed up somewhat in the following way: The background seen in the inverted image ranges in colour from an almost chocolate tint in very dark people or in the dark races, to a closely woven reticulation of vessels carrying red blood, and affording indications of the white sclerotic lying behind them. In light eyes, the retina itself is invisible; but in dark eyes its thickest portion appears as a delicate film, which has been compared to moistened tissue-paper, over the portion of the field which immediately surrounds the optic nerve. Except in very light eyes, the vessels of the choroid are not individually visible, being concealed by the pigmentation of the pavement-epithelium; and, when visible, they are distinguishable by their parallel direction, and by the absence of branches. The vessels of the retina are always clearly visible, and may be traced along their numerous arborescent ramifications to twigs of extreme fineness. The arteries are smaller and brighter than the veins, and often present the appearance of a white line running along the axis of the vessel, almost as if it were a translucent red tube, carrying a white fluid. The veins, larger and darker than the arteries, seldom display the white line. The vessels pass off the optic disc on all sides, but make bold curves which carry them clear of the region of the yellow spot. In the close vicinity of the disc, the vessels are sometimes attended by fine white threads, pursuing the same general course with them, and which are apparently coarser portions of the connective tissue by which they are sustained. The optic disc, or termination of the optic nerve itself, the most conspicuous object in the ophthalmoscopic image, stands out boldly against its surroundings, and presents a general colour-effect which depends partly upon the richness of its capillary blood-supply, and partly upon the greater or less degree of pigmentation of the tissues around it. Over part of its surface, generally in or near the centre, but sometimes laterally, it displays the whiter colour of the lamina cribrosa, and the mottling of its perforations for the passage of the nerve-fibres. It is often bordered, either entirely or partially, by a line of dark pigment situated at the margin of the choroidal opening; and it often exhibits also a fine white line at its margin, which is the edge of the opening in the sclerotic, seen through the semi-transparent nerve-tissue. The vessels pass over its margin without deviation or change of plane. The apparent size and shape of the disc depend much upon the refraction of the eye. As seen in the inverted image, it appears comparatively small in a myopic eye, and large in a hypermetropic; while, in cases of astigmatism, it is distorted into the appearance of an oval. In the same way, the refraction modifies the apparent actual, but not the relative calibre of the vessels. In the myopic eye the vessels appear of small diameter, and in the hypermetropic they appear of large diameter; so that no conclusions about their actual size can be drawn until the state of refraction has been taken into account. The fact that the veins are relatively larger or smaller than usual, when compared with the arteries, is, of course, not influenced by refraction, except that, in a hypermetropic eye, such a difference would be more conspicuous than in a myopic, by reason of the more magnified image produced by the optical conditions of the media.

6. *Circulation.*—In a general way, the blood-currents in the vessels of the retina are continuous and uninterrupted; but any hindrance to the entrance of blood may be attended by pulsation, first in the veins and subsequently in the arteries. Such hindrance may arise from disordered action of the heart, as in cases of insufficiency of the aortic valves; from disease of the coats of the arteries; or from increased resistance on the part of the fluids already occupying the cavity of the eyeball. The venous pulse depends upon an arrest of the outflow through the veins by the pressure of the entering arterial current; which, at the acme of the pulse-wave, has force enough to push back the venous current when there is not room enough for both. Hence, in the venous pulse, the vessels empty themselves in a direction from the centre of the disc towards its periphery, and refill in the opposite direction. The ordinary cause of venous pulse is increased tension or fulness within the eyeball, so that it is among the early symptoms of glaucoma; but it is also to be seen in a small proportion of cases in which no excess of tension is to be discovered either by touch or by symptoms, and in which the eyes appear to be healthy. In the arterial pulse, the resistance to the entrance of blood, or rather the disturbance of the balance between the propulsive and the resisting forces, must be considerable; and the course of events is that the arterial current can only make its way into the eye at the acme of the pulse-wave, during which the arteries fill from the centre of the disc to its periphery, to collapse again as soon as the impulse of the systole diminishes. In such a condition, the impediment to the entrance of arterial blood is sufficient to imperil the nutrition of the nerve-tissue; and the writer has seen at least one case of partial nerve-atrophy, attended with arterial pulsation, for which no other cause than excessive arterial tension could be assigned. Arterial pulse is probably always present in advanced stages of glaucoma; but by the time it is produced, the fundus is usually obscured or

rendered invisible by other changes. Apart from glaucoma, its most frequent cause is aortic regurgitation; and in this form the eye does not suffer, except together with other parts of the organism.

7. *Optic Neuritis and Atrophy.*—The morbid appearances seen with the ophthalmoscope, and interesting to the physician, are chiefly those which point to the existence of some diathesis, or to the presence of disease in other organs. Swelling of the intra-ocular extremity of the optic nerve, with obliteration of its margins and obstruction to its vessels, occurs in many forms of intracranial disease, especially in connexion with intracranial tumour, and is often followed by atrophy and blindness when life is sufficiently prolonged. The most interesting characteristic of these cases is that, since the swelling affects only the connective-tissue layer, which is absent over the region of the yellow spot, there is commonly no diminution of the acuteness of central vision until the atrophic changes have commenced; by which time, in many instances, the primary swelling has passed away. Hence, for many years, there existed great uncertainty about the cause of the atrophy, and this uncertainty was only removed when physicians began to examine the fundus oculi in all cerebral cases, without regard to the state of sight. Prior to that time, the intra-ocular changes were apt to remain undiscovered in their primary stage, and until commencing impairment of vision produced resort to an ophthalmologist, followed by an ophthalmoscopic examination in due course; and then the atrophy was often attributed to many fanciful causes, among which the smoking of tobacco held a prominent place. It is not necessary to assume that tobacco is never injurious to the optic nerves, in order to be quite sure that the majority of the instances of atrophy once attributed to its influence were, in reality, due to a totally different cause. The changes associated with intracranial diseases will be found described in a special article. *See* OPHTHALMOSCOPE IN MEDICINE.

8. '*Albuminuric Retinitis.*'—Very frequently in albuminuria, and occasionally in diabetes mellitus, the fundus of the eye becomes studded over with spots or patches of a glistening white colour, which are probably due to fatty degeneration of the connective tissue of the retina, and which are often associated with scattered hæmorrhages. The blood, in these instances, is usually effused into the fibre-layer, and, following the course of the fibres, becomes spread out into somewhat striated spots, with brush-like terminations. Every case in which either the white patches or the hæmorrhages, or both, are detected by the ophthalmoscope, whether with or without impairment of sight, calls for a careful examination of the urine, and renders it proper to follow mainly the indications of treatment which such an examination may afford.

9. *Hæmorrhages.*—Without the white patches, hæmorrhages may occur in the retina under various conditions. Sometimes they are distinctly arterial, in which case they are generally small in absolute amount, and may often be traced to some manifest point of rupture in the vessel from which they have occurred. These hæmorrhages seldom produce extreme impairment of vision, although they are usually discovered on account of some degree of impairment; and their chief importance is derived from the warning they may give of a state of brittleness of the arteries, and of a consequent liability to similar bleedings elsewhere, as in the brain. They call for all the precautions which such a state would suggest, as for the consumption of a diminished quantity of fluid, and for the avoidance of constipation and of all violent bodily efforts.

Hæmorrhages which are distinctly venous occur not infrequently in connexion with the disturbances of circulation which are incidental to the cessation of the menstrual function, or to the irregularities by which cessation is preceded. The blood may proceed from comparatively large veins, in which case it often forms a layer immediately beneath the *membrana limitans* of the retina, causing great temporary impairment of sight, or even total blindness; and yet, in many cases, being quickly absorbed without permanent injury. In other instances it may proceed from smaller and deep-lying veinlets, in which case the effusion will usually be situated in the fibre-layer, and will be moulded, so to speak, by the fibres, into what have been described as 'flame-shaped' hæmorrhages. These are generally multiple, and usually cause an impairment of function, which is decided although not total, and is often permanent. The flame-shaped hæmorrhages are said by Mr. Hutchinson to occur preferably in persons of gouty diathesis, and he holds the same doctrine with regard to a less common form, of which some remarkable examples have been observed by himself, and by Mr. Eales of Birmingham. In these cases, the subjects were young males, of constipated habit, and in many instances of gouty family history. The bleedings were large in amount, so as to penetrate into the vitreous body and to cause for a time total loss of sight, and were frequently recurrent. To what extent they were due to deficient plasticity of the blood, to abnormal friability of the vessels, to variations in vaso-motor tension, or to the withdrawal of external support from the vessels by diminished tension within the eyeball itself, is at present a matter of conjecture. It is obvious that the treatment of such cases, and of retinal hæmorrhages generally, must resolve itself into that of the constitutional conditions with which they are associated

The only special indications, as regards the eye, will be the enforcement of functional rest, and the maintenance of an elevated position of the head during sleep. In cases connected with the cessation of the menstrual function, the absorption of the effused blood often appears to be promoted by the careful administration of iodide of potassium, which should usually be combined with ammonio-citrate of iron, or with some other suitable tonic, and care should always be taken to maintain a moderately relaxed condition of the bowels. Even apart from the injurious effects likely to be produced by straining, constipation appears to predispose to hæmorrhage.

10. *Embolism of the Central Artery.*—Sudden loss of vision is sometimes occasioned by the plugging of the central retinal artery by an embolus. This is especially to be suspected in cases of known valvular disease of the heart, and the condition is readily recognisable with the ophthalmoscope. The retinal veins are usually somewhat dilated, but their contained blood is broken up into irregular portions, in which an uncertain or wavering movement may sometimes be detected. The arteries are either obliterated, or so dwindled as to be scarcely visible. The connective tissue of the retina rapidly becomes cloudy and opaque, so that the general surface of the fundus is milky or opalescent; but in the region of the yellow spot, where there is little or no connective tissue, this opacity cannot be produced, and the red colour of the choroid shines through, producing the effect of a cherry-red spot on a white ground. After a few weeks the retina regains its transparency, but the optic nerve passes into a state of absolute atrophy.

R. Brudenell Carter.

OPHTHALMOSCOPE IN MEDICINE.—In a large number of diseases which come under the care of the physician—diseases of the nervous system, kidneys, blood, and other structures—intra-ocular changes occur, and may be observed with the ophthalmoscope. Hence this instrument is highly useful in practical medicine. By its aid we can observe, magnified about twenty diameters, the termination of an artery, of a vein, and of a nerve; a peculiar vascular structure (the choroid); and a peculiar nervous structure (the retina). Nowhere else are nerve and vessels exposed to direct observation. Many changes affecting these tissues throughout the body may be first and best detected here, and in some diseases these intra-ocular structures are affected in a special manner.

The chief changes in the fundus oculi which are of importance to the physician are the following: (*a*) In the *retinal vessels*: Variations in size, and in the condition of their walls; the existence of aneurysms; the tint of the blood; the occurrence of visible pulsation in arteries or veins, of hæmorrhages, or of vascular obstruction. (*b*) In the *optic nerve* or *papilla*: Congestion, neuritis or papillitis; atrophy, simple, consecutive (after neuritis), secondary (to disease of the trunk of the nerve), or choroiditic. (*c*) In the *retina*: Various inflammatory or degenerative changes or growths. (*d*) In the *choroid*: Inflammatory exudations, with their resulting disturbance of the choroidal pigment; atrophy; growths. For a description of these various changes the reader is referred to the special articles. In this place it is only possible to point out the changes which present themselves in the more important diseases which come under the physician's care.

I. Diseases affecting the Nervous System.—**1. Brain.**—Two forms of ocular changes are met with: (1) 'associated,' the consequence of the cause of the cerebral disease; (2) 'consecutive,' the direct result of the cerebral disease. *Anæmia* and *hyperæmia* of the brain are not, as a rule, revealed by any corresponding change in the retinal circulation, this being regulated in a special manner by the intra-ocular tension. Such changes, when affecting the whole head and considerable in degree, are, however, shared by the retinal vessels. Moreover, acute cerebral hyperæmia may, after a time, lead to congestion of the optic papilla. *Acute general cerebritis* is usually accompanied by meningitis, and to the latter the ophthalmoscopic changes are probably in part due. There is a very rare form of *chronic general cerebritis*, of which the symptoms are somewhat like those of tumour, but the only changes to be found after death are microscopic. In this condition well-marked neuritis (papillitis) may be present. Local cerebritis, which does not lead to the formation of pus, usually causes no ophthalmoscopic changes.

In *cerebral hæmorrhage* consecutive changes are extremely rare, and are almost confined to cases of meningeal hæmorrhage, from which slight neuritis may result. Of associated changes, aneurysms are rare, but have been noted; retinal hæmorrhages are not infrequent. They are most significant in blood-states, although most common in renal disease associated with albuminuric retinitis. In the latter they indicate vascular disease, but not necessarily that a cerebral lesion is hæmorrhagic, since they are often associated with softening of the brain.

In *softening from embolism*, retinal embolism may be, in rare cases, associated. In ulcerative endocarditis hæmorrhages may be seen in the retina—small extravasations with white centres. Consecutive changes are, as a rule, absent; occasionally slight optic neuritis is developed, apparently as a consequence of the irritant character of the softening produced by a plug from a malignant endocarditis.

In *softening from arterial thrombosis*, when this is due to atheroma of the vessels, associated changes (hæmorrhages, or renal retinitis) may be found in the retina, but there are usually no consecutive changes. The latter are also absent in thrombosis from syphilitic disease of arteries; but associated changes—the various ophthalmoscopic manifestations of syphilis—are common, and are often of the highest diagnostic importance.

In *abscess of the brain*, optic neuritis occurs in a considerable number of cases, although not in all. It has no known relation to the position of the abscess, but is perhaps most frequent in the cases in which the abscess results from an injury.

Tumours of the brain.—Associated changes are very rare, and are confined to the cases in which a similar growth (glioma or tubercle) exists within the eye. Consecutive changes are more common than in any other cerebral affection. Optic neuritis occurs in about four-fifths of the cases. On what its occurrence or absence depends we do not know. Neither position, size, nor nature of growth seems to influence it in any considerable degree. It does not depend on increase of intracranial pressure. In some cases it is at least aided by the occurrence of meningitis. In many cases a slight descending inflammation may be traced from the optic tracts down the nerves to the eyes, and this, at the papilla, seems to be excited in a more intense degree, probably aided by the passage of irritant material down the sheath of the nerve to the lymph-spaces of the papilla. The sheath is commonly found distended after death. A tumour may exist for a long time without neuritis, or the neuritis may be present as soon as the symptoms of tumour manifest themselves. Often the neuritis and the tumour correspond in their course, each being acute or chronic. Both may even be almost stationary for years. An acute neuritis, occurring during the course of a tumour which appeared chronic, usually indicates an increase in the growth, and is of bad prognostic significance. The degree of neuritis varies; it is least in the tumours of most chronic course, and greatest in the rapid growths. It is often accompanied by hæmorrhages. Commonly bilateral, it is in rare cases unilateral, and is then usually in the eye opposite to the seat of the tumour. It may exist in considerable degree without impairing sight. Perception of colour may be affected before acuity of vision. If the tumour be arrested by treatment, as in syphilitic and tubercular growths, the neuritis will subside; it also often lessens when the intracranial pressure (which drives the fluid into the sheath of the nerve) is lessened by trephining the skull, and, still more completely, after removal of the tumour, when this can be effected. Too often, however, before this result is obtained, sight has been damaged beyond recovery. Secondary atrophy of the optic nerves sometimes results from tumours in the neighbourhood of the chiasma, although far less commonly than 'consecutive atrophy.'

Intracranial aneurysms are rarely accompanied by intra-ocular changes. Now and then, an aneurysm of the internal carotid has caused atrophy by pressure, and even optic neuritis, single or double.

Internal hydrocephalus is usually accompanied by no other ophthalmoscopic changes than slight fulness of the veins. Occasionally simple atrophy occurs, commonly from the pressure of the distended third ventricle on the optic commissure.

Meninges.—Growths in the meninges lead to optic neuritis, just as do tumours in the cerebral substance. The effect of meningitis varies according to its form and seat. Simple meningitis of the convexity is rarely attended by ocular changes. It is very different with basal tubercular meningitis. Occasionally, though rarely, tubercles of the choroid may be seen. In a considerable number of cases there is distinct neuritis; it is well-marked in at least half. Usually too late to be of diagnostic importance, it is now and then sufficiently early to decide the nature of the case. A similar change is common in both syphilitic and traumatic meningitis, but is rare in the epidemic cerebro-spinal form, except in cases of unusual duration.

Diseases of the cranial bones.—Caries of the sphenoid bone may cause descending neuritis; caries elsewhere usually only affects the eye by causing meningitis or abscess. Thickening of the cranial bones may be attended by well-marked, sometimes intense, neuritis, with hæmorrhages. This is apparently produced by the resulting constriction of the nerve and sheath at the optic foramen. Inflammatory mischief or growths in the orbit frequently cause neuritis or atrophy, the optic nerve-trunk being damaged directly. In these cases the affection is unilateral, at least for a long time, and is often accompanied by prominence of the eyeball, and tenderness when it is pushed back.

Injuries to the head may affect the eye in various ways: (1) The retina may suffer in consequence of the immediate concussion. (2) Optic neuritis may come on after a few days, commonly as the result of a traumatic meningitis. (3) Direct injury to the optic nerves may cause loss of sight and simple atrophy. (4) Optic neuritis may come on some weeks after the injury, and is usually due to inflammatory processes in the damaged brain.

2. **Spinal Cord.**—*Acute myelitis* and *spinal meningitis* are very rarely attended by eye-changes. In one or two cases coincident optic neuritis has been observed. The connexion between the two is obscure. *Sclerosis of the posterior columns* (locomotor ataxy) is accompanied by atrophy of the

optic nerves in a considerable number of cases, although not perhaps in more than 15 per cent. When it does occur it is frequently an early rather than a late symptom. It is always the simple form of atrophy, often grey, with unnarrowed vessels. Sight usually suffers gravely; the field of vision is much restricted; and perception of colours may be lost. The atrophy is not the result of any extension upwards of the disease in the posterior columns. It may occur when this has scarcely commenced, and even years before the earliest symptoms. It is apparently an associated degeneration. In *lateral sclerosis* changes in the fundus oculi are, as a rule, absent. In *disseminated sclerosis*, optic nerve-atrophy may occur, just as in posterior sclerosis, but less frequently. Damage to sight, without ophthalmoscopic changes, occasionally results from the sclerosis invading the optic commissure or nerves. In caries of the spine, changes in the optic disc are practically unknown. In very rare cases of injury to the spine, neuritis and subsequent atrophy have been observed, but these results are so uncommon that their precise significance is doubtful.

3. **Functional Diseases.**—In *exophthalmic goître* the only ophthalmoscopic change is increased size of the retinal arteries, which may pulsate visibly. In *chorea*, embolism of the central artery of the retina has been once or twice observed; and optic neuritis, slight in degree, is not rare. It is usually met with in hypermetropic eyes, but, nevertheless, subsides when the chorea is over. With *neuralgia* of the fifth, optic nerve-atrophy has been observed; the nature of the association is doubtful. In *idiopathic epilepsy* the appearance of the fundus is, as a rule, perfectly normal. Even during an attack it is probable that the only change is distension of the veins in the stage of cyanosis. But during the status epilepticus, when attacks recur with great severity for several days, a condition of slight neuritis may be produced, subsiding after the attacks are over. In cases of *convulsions* from organic brain-disease, it must be remembered, optic neuritis or its effects are often met with. The frequency with which morbid appearances are to be seen in the eye in *insanity* has been variously stated, and by some writers unquestionably exaggerated. They are most frequent in general paralysis of the insane. Optic nerve-atrophy is the usual change, and is sometimes an early event, just as in locomotor ataxy. In very rare cases slight neuritis has been seen. In mania, melancholia, and dementia it is probable that there are no related morbid appearances in the eye.

II. Diseases affecting the Urinary System.—1. **Bright's Disease.**—Sight may be impaired in this complaint by uræmic poisoning, or by retinal changes. The latter may occur, even in considerable degree, without any affection of vision. The arteries may occasionally be conspicuously narrow (contracted), and in rare cases may present sclerosis of the outer coat, or minute aneurysms. Aneurysmal dilatations of the capillaries may often be found *post mortem*, in association with other degenerations, and probably lead to the occurrence of a very common change in the retina—hæmorrhages. These are usually striated, situated in the nerve-fibre layer; sometimes they are irregular in shape, and situated in the deeper layers. They may detach the retina from the choroid, or burst through into the vitreous. Sometimes they exist alone; more commonly they are conjoined with other changes, to which the term 'albuminuric retinitis' is given. This latter change may occur in all forms of renal disease, but is by far the most common in the granular kidney. It is a late symptom, never appearing until the general system is suffering. The disease of the retina presents certain elements which are variously combined in different cases. (1) Diffuse slight opacity and swelling of the retina, due to the infiltration of its substance by an albuminous coagulable liquid (œdema). (2) White spots and patches of various size and distribution: some large and soft-edged; others minute, and of pearly whiteness. They are due to fatty degeneration of the retinal elements, or to granular degeneration of albuminous exudations. The small white spots often radiate around the macula lutea. (3) Hæmorrhages. (4) Inflammation of the optic papilla—'neuritis.' (5) The subsidence of the inflammatory changes may be attended with the signs of atrophy of the optic nerve and retina. According to the predominant character, four types of retinal affection may be distinguished: a degenerative, hæmorrhagic, inflammatory, and neuritic form. In the first the white spots predominate, and there are usually extravasations, but there is little diffuse opacity. In the second the hæmorrhages are so abundant as to be the chief feature. In the third there is much diffuse opacity and swelling of the retina. In the fourth the optic neuritis is in excess of the other changes, and the appearance may easily be ascribed to cerebral disease—the more so that it is often conjoined with headache, and other evidence of cerebral disorder. The conspicuous combination of white spots and hæmorrhages usually enables the retinal affection of albuminuria to be recognised without difficulty. It may be confounded with the degeneration left by a previous wide neuro-retinitis, but in such cases the signs of atrophy will be conspicuous. The course of the affection in Bright's disease is often progressive, but arrest and even recovery may be obtained by the treatment of the renal disease. When extensive, sight is usually impaired, but is rarely completely lost.

2. **Diabetes Mellitus.** — In diabetes mellitus, in rare cases, retinal changes have been observed exactly similar to those of the degenerative form of the albuminuric affection, and this when there was no albumen in the urine. Miliary aneurysms have been found *post mortem*. A distinction from the renal form is the frequency with which there are opacities in the vitreous, due probably to slight extravasations of blood.

III. Diseases of the Heart. —The peculiar conditions of the intra-ocular circulation prevent any dynamical changes in the circulation. Venous distension, if considerable, may be visible in the eye, especially in cyanosis. When arterial pulsation is strong, it may be seen in the retinal arteries, as in exophthalmic goître and in aortic regurgitation. In these cases also the arterial pulsation may (probably in the sclerotic ring) be communicated to the vein, and this also may pulsate. Embolism of the central artery of the retina may occur, and, like embolism elsewhere, is most common in mitral constriction. In ulcerative endocarditis, accompanied with multiple embolism, retinal hæmorrhages occur, for the most part round, with a pale or white centre. They are almost pathognomonic.

IV. Diseases of the Blood. — Acute *anæmia* from hæmorrhage may be followed by loss of sight, slight or considerable, transient or permanent. The accident most commonly follows hæmatemesis, uterine hæmorrhage, or venesection. In some cases no ophthalmoscopic changes have been found; in others there has been neuroretinitis. The mechanism of the affection is obscure. Simple chronic anæmia is accompanied by marked pallor of the veins, sometimes of the choroid and disc, but the latter is always within the physiological variations in tint. Occasionally in chlorosis optic neuritis is met with, developing quickly to a high degree of intensity, such as is met with in cerebral tumour. It disappears rapidly under iron, but too often ignorance of the cause has led to the loss of so much time, while iodide of potassium, &c., have been given, that sight is hopelessly damaged. In *pernicious anæmia* the choroid is notably pale, the arteries small, the veins very broad (atonic) and pale. Hæmorrhages are frequent, especially around the optic disc, and they are often associated with white patches. Some extravasations are rounded, with a white or pale centre. Occasionally there is marked neuritis. In *leucocythæmia* the pallor and the width of the veins are very striking. Extravasations are almost invariable at some period. White spots are frequent; some degenerative, others due to aggregations of leucocytes; some are surrounded by a halo of extravasation. There may also be considerable general swelling of the retina, throwing the distended veins into conspicuous antero-posterior curves. In *purpura* and *scurvy* retinal hæmorrhages also occur. In the intense forms of purpura, indeed, they are probably constant, and may be large. They have sometimes been seen in the choroid.

In rare cases of *menstrual* disorders, and still rarer instances of *intestinal* disturbance (chronic diarrhœa), optic neuritis has been observed. Suppression of the menses has been followed by retinal hæmorrhages. The connexion between the several events is obscure.

V. Chronic General Diseases.—In chronic general diseases ophthalmoscopic changes are met with occasionally. In *tuberculosis*, tubercles may form in the choroid, and be recognisable as small, round, yellowish-white spots, free from pigment. They have more frequently been found in this situation after death than during life, perhaps because not looked for with sufficient perseverance, since they may form rapidly. They are sometimes of great diagnostic importance, especially in cases of general tuberculosis causing obscure and ill-defined symptoms. In *syphilis* ocular changes are, as is well-known, common, but they come chiefly under the care of the surgeon. Traces of past iritis, or of choroiditis—areas of choroidal atrophy with irregular accumulation of pigment—frequently afford the physician important evidence of the previous existence of syphilis, acquired or inherited. In the latter the choroidal changes are of especial importance, and may be confined to small round white spots with pigment in the centre, or there may be evidence of more extensive choroiditis or merely of choroiditic atrophy, a yellowish disc, with the edge a little blurred, and very small retinal vessels. *Gout* has been supposed tc cause retinal hæmorrhage (Hutchinson), and to it is probably due the widespread 'hæmorrhagic retinitis' that is the consequence of thrombosis in the central vein of the retina. Intra-ocular neuritis is seldom due to this cause, except in slight degree, as the result of a more intense inflammation behind the globe. This may occur in the subjects of acquired gout, or in young persons the subjects of the inherited disease, and may be on one side or on both, simultaneously or in succession.

In *lead-poisoning*, besides the amblyopia which may come on without ophthalmoscopic changes, atrophy of the disc is occasionally met with, preceded, in some cases, by a stage of congestion—a red disc, with softened edges, without swelling. A considerable degree of neuritis, double, with swelling and hæmorrhages, occurs occasionally, especially in connexion with cerebral symptoms, but without any coarse lesion of the brain. In *chronic alcoholism*, optic-nerve atrophy has been described, and also a condition of congestion. The amblyopia which accompanies the atrophy is said by Förster to be characterised by loss of central vision for colour. The same fact is well established with regard to *tobacco* amaurosis, in which similar congestion and atrophy may occur.

VI. Acute General Diseases.—In acute general diseases, changes in the fundus are for the most part rare. After *typhus*, *typhoid*, and *scarlet fevers*, optic neuritis has been occasionally observed, apart from any renal or cerebral complication. The renal sequelæ of scarlet fever may of course lead to the special retinal changes. *Malarial fevers*, *ague*, &c., are frequently attended with retinal hæmorrhages (Poncet, S. Mackenzie). Sometimes the extravasations have paler centres. Optic neuritis and atrophy have also been observed. *Erysipelas of the face* has been accompanied by loss of sight, and followed by atrophy, probably by the extension of the inflammation to the orbit, and to the trunk of the optic nerve. *Pyæmia* and *septicæmia* have long been known to be occasionally accompanied by metastatic panophthalmitis, and recent observation has shown that slighter alterations in the fundus oculi frequently accompany the severer forms of these affections. Of these the most important are retinal hæmorrhages, round or irregular, sometimes large, and often with pale centres, as in ulcerative endocarditis. Although it is probable that they are in some cases due to septic embolism, they may occur without endocarditis, and may be due, in some cases, to chemical changes in the blood, produced by the organised virus of the septicæmia. They are almost invariable in puerperal septicæmia (Litten). They are of very grave significance, but not necessarily a fatal omen. In other cases a peculiar form of retinitis has been observed, with white spots about the papilla and macula lutea (Roth).

Most of the appearances mentioned above will be found figured in the writer's *Manual and Atlas of Medical Ophthalmoscopy.*

W. R. Gowers.

OPISTHOTONOS (ὄπισθεν, backwards; and τόνος, a stretching).—A tetanic spasm, in which the body is arched backwards, so that it rests on the head and heels. *See* Tetanus.

OPIUM, Poisoning by.—In consequence of the extent to which opium and its preparations, including morphine, are used for the relief of pain, and the readiness with which the drugs are procurable, poisoning by these agents is of frequent occurrence; and there is no doubt that great numbers of infants perish every year in this country through the improper use of quack remedies containing opium.

So far as toxicology is concerned, the effects of opium may be referred exclusively to morphine; since the effects of the other active constituents of the drug are overshadowed by those of its chief alkaloid. *See also* Morphinism.

Anatomical Characters.—The *post-mortem* appearances after opium-poisoning may be almost *nil*. As a rule the brain is congested, the *puncta cruenta* being especially marked; and the lungs and right side of the heart may exhibit an engorgement, as if from a modified asphyxia; but this condition is by no means invariable.

Symptoms.—The first effect of the administration of a toxic dose of opium—a state of *bienfaisance* or exaltation—commonly observed also after the administration of a medicinal dose, may be either very short or entirely wanting; and this is usually the case when morphine is injected hypodermically. A second stage, in which the symptoms closely resemble those of congestion of the brain, soon sets in. The face is either suffused or cyanosed; the pupils strongly contracted; the skin dry and warm; the breathing slow, deep, and becoming stertorous. The patient is apparently unconscious, but may be aroused by shaking, or shouting in the ear; and when he is aroused, the respirations become more rapid, and the skin may regain its normal colour. The symptoms of this second stage may gradually ameliorate under appropriate treatment; or a third stage—that of prostration—supervenes. The coma is now profound, and it may be impossible to arouse the patient. The pupils are contracted to the size of pin-points; or towards the termination of life may be widely dilated. Respiration is now very slow, shallow, with gradually increasing intervals, during which there are no signs of breathing, and the patient lies in a death-like calm. The face is at once pallid and cyanosed; the skin is bathed in perspiration, at first warm, and then cold and clammy. The pulse increases in rapidity, with progressively increasing feebleness. The patient may even now recover, signs of life returning very gradually; or death may occur from failure of respiration, the other functions of life becoming also gradually extinguished.

Unusual symptoms in opium-poisoning are trismus and convulsions. In children toxic doses may produce very rapid effects, the second stage of the intoxication being wanting, and severe collapse and complete unconsciousness rapidly supervening.

Diagnosis.—The certain diagnosis of opium-poisoning is often a matter of great difficulty, as the symptoms may differ in no material respect from those exhibited in congestion of the brain, however produced, apoplexy, and uræmia. The case may also be confounded with profound alcoholic intoxication. It may also be difficult or impossible to diagnose from poisoning by chloral hydrate —a matter of less importance, since the treatment of the two cases would be similar. The differential diagnosis of opium-poisoning rests upon the equally and minutely contracted state of the pupils, a condition which is all but universal in the second stage of opium-poisoning; our ability to arouse the patient temporarily, the rousing being followed by more or less complete disappearance of the cyanosis of the countenance, and by increased rapidity of respiration; and the profuse warm or clammy cold perspiration. An examination of the urine, which may have to be drawn off by the catheter, for albumen should always be made; but it must be borne in mind that uræmia and opium-poisoning may be co-existent.

Prognosis.—This is at all times doubtful. There is great liability to relapse, even when the patient appears to be doing well.

Treatment.—First, evacuate the stomach by means of the stomach-pump, or, failing this, by the use of emetics. These, however, act with difficulty in cases of opium-poisoning; and there is a special danger in the use of depressing emetics, as, for example, tartar emetic, on account of the possible retention by the stomach of a fatal dose of the emetic. Warm mustard and water, and carbonate of ammonium, are the best emetics to administer. Secondly, the patient must be prevented lapsing into a state of somnolence, by walking him about; alternate warm and cold applications to the chest; flicking the feet with a damp towel; shouting into the ear; and the application of the faradic current. These means will have the additional advantage of maintaining the flagging respiration, and restoring normal breathing. In the last resort artificial respiration must be freely employed. The absorption of the alkaloids of opium may be delayed by the free administration of solutions containing tannin, so as to render the alkaloids insoluble; and among the best media containing tannin are strong infusions of tea and coffee. The caffeine which these infusions contain, itself also exerts a powerful remedial influence in this form of intoxication. Atropine, as a respiratory stimulant, appears also to be most serviceable as a direct antidote to morphine. It is best given by subcutaneous injection, in doses of $\frac{1}{40}$ to $\frac{1}{20}$ grain. Alcoholic stimulants should be freely given.

Thomas Stevenson.

OPIUM-EATING.—*See* Morphinism.

OPPRESSION.—A term applied to a sense of weight or pressure in any part of the body, but more frequently used in connexion with the chest and epigastrium. The expression is sometimes also employed in reference to a general feeling of the system being overloaded or overweighted, which is felt at the commencement of certain acute diseases, as well as in other conditions.

OPTIC NERVE and TRACT, Diseases of.—The optic nerve may be damaged by various intra-ocular processes; but these, and also its primary atrophy, have been already described (*see* Eye, and its Appendages, Diseases of; Ophthalmoscope; and Ophthalmoscope in Medicine). In this article only those affections which are situated behind and independent of the eye will be described.

Passing from the orbit into the intracranial cavity by the optic foramina, into which they closely fit, the optic nerves are connected at the chiasma, where an approximate semi-decussation takes place. From the chiasma each optic tract, containing fibres from the same-named halves of both retinæ, passes backwards, between the crus cerebri and the inner edge of the temporo-sphenoidal lobe, to the posterior portion of the optic thalamus, where it becomes connected with this and the external geniculate body. Fibres pass also to the corpora quadrigemina, especially the anterior; and from the thalamus to the convolutions of the occipital lobe.

Ætiology.—In the orbit the nerve may be damaged by inflammation, which is sometimes apparently due to gout, and sometimes invades the nerve from the orbit (as in orbital cellulitis from facial erysipelas), or is produced by exposure to cold. Inflammation outside the nerve rarely invades its substance on account of the thickness of the sheath which invests it, but the fibres are damaged by the pressure of the inflammatory products. It may also be compressed by an aneurysm of the ophthalmic artery or by orbital tumours; or may be itself the seat of morbid growths or of hæmorrhage. At the optic foramen the nerve may be compressed by new-growths or by a narrowing of the foramen, such as occurs in thickening of the cranial bones, an occasional consequence of syphilis, acquired and congenital. Within the skull, the nerve in front of the chiasma may be damaged by the extension of inflammation from the meninges. The optic commissure is occasionally compressed by or involved in growths, and may be compressed by great distension of the third ventricle. Interstitial inflammation probably sometimes occurs. The nerves in front of the chiasma, and the chiasma itself, are liable to be damaged by the pressure of aneurysms of adjacent arteries. The optic tracts may be involved in hæmorrhage into, or softening of, the crura cerebri; but the most frequent cause of their damage is a tumour arising at the base of the brain, or in the adjacent part of the temporo-sphenoidal lobe. The central continuation of the optic nerves, constituting the visual path—the optic thalamus, the white substance from it to the occipital lobe, and occipital cortex, may be damaged by tumour, softening, or hæmorrhage, with impairment of sight as the result. The corpora quadrigemina are rarely affected so as to cause visual symptoms, except by growths, which produce this effect by pressure on the adjacent visual path to the cortex.

SYMPTOMS.—Damage to the optic nerve, between the optic commissure and the eye, causes an affection of sight in that eye only. There may be either a concentric or sectorial defect in the field, or complete blindness; the reflex action of the pupil is impaired. When the nerve is slowly compressed, the loss of sight is followed by slow atrophy of the intra-ocular extremity. When it is invaded by inflammation, this usually descends to the eye, and is visible as intra-ocular neuritis, often slight; it may ascend to the commissure, and the sight of the other eye then suffers. Inflammation at the back of the orbit usually also involves the motor nerves, and so may cause paralysis of all the ocular muscles. These recover, however, much more readily than does the optic nerve. When the nerve is compressed by narrowing of the optic foramen, the loss of sight is usually accompanied by intra-ocular atrophy or slight neuritis. This is also present in most cases in which inflammation extends from the meninges to the intracranial part of the optic nerves, or the optic chiasma, but seldom in extension to the optic tract. Damage to the chiasma usually affects the sight of both eyes. In most cases the decussating fibres suffer chiefly or alone, and consequently there is loss of function of the inner half of each retina, and loss of the outer half of each field of vision—*temporal hemianopia.* Damage to the outer part of the commissure on each side affects the fibres which do not decussate, and so causes loss of function of the outer half of each retina, and so loss of the inner half of each field—*nasal hemianopia.* This is very rare, but has been seen from calcification of the carotid artery on each side (Knapp). Partial nasal hemianopia is also sometimes met with in tabes. In irregular damage to the chiasma the loss of vision may be irregularly distributed in the two eyes.

The optic tract receives fibres from the half of each retina on the same side, and its damage thus causes loss of sight in the opposite half of each field of vision—*lateral* or *homonymous hemianopia.* The loss is often more extensive in the eye on the side opposite to the lesion than in that on the same side. Since the motor tract, in the adjacent crus cerebri and hemisphere, has decussated at the medulla, if it is also involved in the lesion, there is hemiplegia on the same side as the loss in the field of vision. The patient is unable to see to the side on which he cannot move the limbs. Thus the writer has recorded a case in which a patient had, first, right hemianopia, and afterwards right hemiplegia. Both were due to a small tumour of the inner part of the temporo-sphenoidal lobe, which had first invaded the optic tract and then the crus.

Lateral hemianopia results, occasionally, from disease of the posterior extremity of the optic thalamus, and frequently from a lesion involving the fibres that pass thence, adjacent to the posterior extremity of the internal capsule, and through the white substance of the occipital lobe, to the cortex at the extremity of the hemisphere, and chiefly to the cuneus, disease of which always entails this symptom. Partial disease of the cuneus causes a partial loss of the half field; the upper quadrant is lost if the upper half of the cuneus is diseased, the lower quadrant of the field if it is the lower half of the cuneus. It is uncertain whether damage to the cortex on the outer surface of the occipital lobe causes hemianopia, or whether, with this lesion, the symptom has been due to the disease penetrating the white substance to the fibres from the cuneus. These fibres, the 'optic radiation of Gratiolet,' may be reached by extensive disease of the middle part of the cortex, and then hemianopia may be associated with hemiplegia, and even with aphasia. When the cause of hemianopia is disease of the chiasma or tract, the pupil does not contract when light is thrown on the blind half of the retina (Wilbrand, Wernicke, &c.), because the fibres for the reflex centre are involved. When the disease is in the thalamus or occipital lobe there is no loss of action; this affords a means of distinction, but much care is needed to get clear results.

Double hemianopia involves complete loss of sight, and is the probable cause of such loss, when of sudden onset. Half loss of the colour-fields, with no loss for white light, has been observed, and perhaps depends on a hemiopic colour-centre on the outer aspect of the occipital lobe.

In hysteria, with loss of the other special senses on one side, there is a peculiar affection of vision, which is sometimes met with as a result of organic disease—'crossed amblyopia.' There is dimness of sight of the eye opposite to an organic lesion, and great contraction of the field, with loss of colour-vision; on the side of the lesion there is a much slighter but similar change. In the cases in which the lesion has been ascertained, it has always involved the angular gyrus in the postero-inferior angle of the parietal lobe, in front of a line drawn across the brain from the parieto-occipital fissure. It would seem that here there is a centre related to both half vision centres, in which they are recombined, but to which the opposite field is chiefly related. A partial lesion in this centre can be compensated by the other hemisphere, but the effect of a partial lesion in the half-vision centre is permanent, as much so as one in the optic path leading to it.

Any one of the diseases to which the brain is subject has the same effect if in a corresponding situation; but, as a rule, softening from arterial obstruction, due to syphilitic disease or atheroma, or a new-growth, is a more frequent cause of damage to the optic path in tract or hemisphere than is cerebral hæmorrhage.

Diagnosis.—The chief points which are our guides in determining the position of post-ocular disease, causing loss of sight, have been already stated. If the affection of sight is confined to one eye, it is probably—and if associated with unilateral optic neuritis it is almost certainly—due to disease of the nerve in front of the chiasma. In this case the reaction of the pupil to light is impaired. On the other hand, if the unilateral affection of sight is associated with hemiplegia, and especially with hemianæsthesia, on the same side, it is probable that the disease is in the hemisphere, and the failure of sight is produced in some manner at present unknown. In this case the pupil acts well to light. Lateral hemianopia indicates disease of the tract, the posterior part of the thalamus, or the white substance between the thalamus and the occipital convolutions, or of these convolutions themselves. In which of these positions it is, must be determined by the indications of the localisation of disease of the brain (*see* Convolutions of the Brain and Cortex Cerebri, Lesions of). Nasal hemianopia or temporal hemianopia indicates disease of the optic chiasma.

Prognosis.—This must be influenced by the position of the lesion, and especially by its nature. When there is simple pressure on the optic nerve, sufficient to abolish sight, the prognosis is very unfavourable. Damage due to the extension of inflammation often lessens considerably. In disease of the optic commissure or optic tracts the prognosis is also grave, because the morbid processes, from which these parts suffer, rarely recede. Whether it is likely to become stationary must be inferred from its probable nature. On the other hand, in disease of the hemisphere, considerable improvement often takes place, just as it does in other symptoms; but when the hemianopia has become stationary it persists, with little change, to the end of life. Often, however, this symptom is thought to have disappeared when it still persists in a diminished degree.

Treatment.—The treatment is essentially that of the disease to which the symptom is due, and need not be further discussed in this place.

W. R. Gowers.

OPTIC THALAMUS, Lesions of. *See* Thalamus Opticus, Lesions of.

ORANGE FREE STATE. — *See* Africa, South.

ORBIT, Diseases of.—Synon.: Fr. *Maladies de l'Orbite*; Ger. *Krankheiten der Augenhöhle.*—The diseases of the orbit are not numerous, and are almost exclusively surgical in their character. The bony walls of the cavity are liable to be fractured by direct injury, which generally implicates other portions of the skull; the contained tissues are liable to phlegmonous or suppurative inflammation; and the cavity may be the seat of tumours of various kinds, arising either from the walls or from some portion of the contents.

1. **Hæmorrhage.** — Hæmorrhages into the orbit, excepting as results of injury or from the rupture of aneurysmal tumours, are extremely rare; and the few cases which have been recorded have nearly all occurred in persons of generally hæmorrhagic tendency, as one local manifestation among others of a constitutional malady.

2. **Emphysema.** — Emphysema of the orbit is not unknown, and the writer has seen a young man who, in blowing his nose violently, must have ruptured some of the ethmoidal cells, for he distended his left orbit with air, and, in his own words, blew his eye nearly out of his head. The distension soon subsided, and no permanent injury was done.

3. **Inflammation.**—Inflammation of the tissues within the orbit is not a common affection, but it is liable to occur as a complication of fevers and other debilitating diseases, and especially as a complication of erysipelas of the head and face. It is marked by brawny swelling of the eyelids, with some protrusion of the eyeball and some limitation of its movements, the symptoms appearing too suddenly and increasing too quickly to be attributable to the growth of a tumour. The injection of the conjunctiva is generally less marked than that of the lids, and sight is scarcely or not at all impaired so long as the swelling is only moderate in amount. When the injected conjunctiva of the eyeball becomes œdematous, and more especially when the œdema is limited to one sector of the globe, or is much more pronounced over one sector than elsewhere, it is, in the opinion of the writer, an almost pathognomonic sign of suppuration; and the localisation of the œdema will serve as a guide to the position in which pus may be looked for. Other symptoms of suppuration, such as rigors, must of course be taken into account.

Treatment.—As soon as pus is believed to exist, it should be evacuated, since its retention among the orbital tissues may be productive of serious injury, not only to the eye, but also to the ocular muscles and to the nerves which traverse the orbital cavity. The evacuation is usually best effected by introducing a narrow straight knife through the skin, near the margin of the orbit in the selected position, and by thrusting it carefully onward as far as may be prudent, giving the blade an occasional turn upon its axis, to allow of the escape of pus as soon as it is reached. The direction of the point should be governed by complete knowledge of the anatomy of the parts; and it is better to withdraw the blade too soon than to incur any risk of wounding important structures. When it is withdrawn, if no pus follow, the puncture may be carefully deepened or extended laterally by a probe; but it is not necessary to be very strenuous in such endeavours, because if the wound through the skin and fascia be kept from healing by the introduction of a strip of lint, or of a bit of drainage-tube, the pus will soon find its way into the channel of escape thus provided for it. The cavity of the abscess should be syringed out from time to time, according to the amount of discharge, with some suitable astringent or antiseptic lotion; and care must be taken that a free opening is maintained as long as pus continues to be secreted.

4. **Caries.**—In strumous children, caries of some part of the margin of the orbit is not uncommon; and, after the diseased bone has come away, we frequently see much deformity of the lids produced by adhesions between the skin and the deeper tissues, or by the contraction of cicatrices. Many of such cases require plastic operations; but each one, before any operation is undertaken, must be carefully studied in order to discover the most promising method of procedure. In a lad with inherited syphilis, the writer has seen very extensive necrosis of the orbital margin, subsequent to the partial removal, and partial absorption, of a large gummatous tumour in the cavity.

5. **Tumours.**—Tumours of the orbit may be cysts (hydatid, dermoid, or sebaceous); lipomata; gummata; sarcomata, originating in connective tissue, and presenting the characters of myxoma, or of the sarcomatous growths distinguished respectively by round and by spindle-shaped cells; or they may be gliomata, springing from the connective tissue of the optic nerve. In other instances they may commence as an apparent hypertrophy of the lachrymal gland; or they may be cartilaginous, or osseous. All alike produce protrusion of the eyeball, and limitation of its movements, together with an amount of disturbance of vision, which depends upon the degree of pressure or of stretching to which the optic nerve is subjected, or upon the degree in which the intra-ocular circulation is impeded. Many of the forms are liable to recurrence, and may thus ultimately destroy life.

TREATMENT. — All tumours of the orbit alike require removal, if possible, without sacrifice of the eyeball.

R. BRUDENELL CARTER.

ORCHITIS (ὄρχις, a testicle).—Inflammation of the testis. *See* TESTES, Diseases of.

OREZZA, in Corsica.—Iron waters. *See* MINERAL WATERS.

ORGANIC DISEASE. — This expression indicates a disease in which there is a structural change in the part affected, as distinguished from a merely functional disorder, in which there is no evidence of such change. *See* DISEASE.

ORGANS, Displacement or Malposition of.—The special malpositions of the chief individual organs are considered in the articles which are devoted respectively to these organs, and it is only intended here to discuss the subject from a general point of view. A distinction is sometimes made between *malposition* and *displacement*, the former including all changes of position, from whatever cause; the latter implying that the organ has by some force been displaced from its normal situation after it has occupied it; and the term *dislocation* has also been used in the same sense. For all practical purposes they may be considered together.

ÆTIOLOGY AND PATHOLOGY.—The circumstances under which an organ comes to occupy an abnormal position may be thus summarised: 1. The condition may be *congenital*, the organ never having been in its proper place. In this way all or part of the organs occupying the chest and abdomen may be transposed to the wrong side of the body (*see* MALFORMATIONS). In this connexion may also be mentioned the fact that an organ, which some time or other after birth changes its place in the ordinary course of development, may fail to do so, and thus remain in a wrong situation. This may be illustrated by the testis, which occasionally is retained in the cavity of the abdomen or the inguinal canal, instead of descending into the scrotum. 2. A violent strain or effort is liable to cause displacement of an organ, especially if repeated several times. This has been made to account for some cases of movable kidney; and hernia may certainly arise in this way. 3. Malposition may depend upon imperfection in the attachments or supports of an organ. This may be congenital, the attachments being unusually long or loose; or they may become repeatedly stretched from different causes, and thus rendered inefficient. The kidney, again, affords an illustration of this cause of displacement; and also the intestines, certain portions of which may come to occupy an abnormal position owing to the unusual length of their peritoneal attachment. 4. Another cause of displacement of organs is to be referred to abnormal conditions connected with orifices or canals, which either remain patent or too large, when they ought to have closed or contracted ; or which have been artificially formed, as the result of injury or other causes. Thus, a large inguinal canal and orifice, or non-closure of the peritoneal prolongation, may account for inguinal hernia ; or a new opening may be produced in some part of the muscular or tendinous structures of the abdominal wall, leading to some form of ventral hernia ; or an opening may remain, or be formed after birth, in the diaphragm, and hence an organ be displaced from the abdomen into the thorax, or *vice versâ.* 5. Pressure is an important cause of displacement of organs. This may come from without, as from wearing tight stays or a belt ; but is of most importance in connexion with morbid conditions within the body. Accumulations of a liquid, gaseous, or solid nature, whether the last-mentioned be due to enlarged organs or separate tumours, are frequent causes of malposition of organs, either temporary or permanent. This is well illustrated by the effects of pneumothorax, pleuritic effusion, or an intra-thoracic growth upon the lungs and heart, or even upon certain abdominal organs ; and the same thing occurs from similar conditions within the abdominal cavity. 6. Traction is another force which causes displacement of organs. The action of the lung free to expand in cases of unilateral pleuritic effusion has been supposed to aid in the lateral displacement of the heart, by exercising a kind of elastic traction upon it ; but this cause is best exemplified by the effects of the contraction of diseased organs upon neighbouring organs, to which they have become adherent. For instance, the heart is frequently altered in its position as the result of a contracted cavity at the apex of the lung, in cases of phthisis. The contraction of adhesions themselves may assist in originating more or less malposition, and they frequently cause the altered situation of an organ to be permanent, by fixing it in its new position. 7. Disease in an organ itself may originate its own displacement. It commonly happens that such disease enlarges or contracts an organ, and thus causes it to pass beyond or to be drawn within its normal limits ; but, further, an organ may become so heavy as the result of disease, that by its own weight it displaces itself in the direction of gravitation. 8. In the case of certain muscular hollow organs, such as the intestines, excessive or irregular action of the muscular coat may lead to malposition. In this way hernia may be originated, or internal strangulation of the intestine, or intussusception of one part of the bowel into another. In this connexion the influence of straining at stool in causing protrusion of the lower part of the rectum may be alluded to. 9. The displacements of the uterus constitute a special group, the causes of which are much discussed. Probably prolonged standing is one element in the causation of some of these displacements in certain cases.

Varieties. The principal varieties of malposition of organs have been casually indicated in the preceding remarks, but it may be useful to arrange them more systematically. 1. An organ may occupy a wrong cavity altogether ; for example, the stomach or liver may lie in the chest, or partly in both chest and abdomen. 2. There may be a transposition of one or more of the viscera to the wrong side of the body. 3. An organ remains in its proper cavity, but is more or less removed from its normal position. This may merely be a temporary change, the organ returning to its place when the cause of the displacement is got rid of ; or it is a permanent condition, the organ being fixed in its new site. 4. Instead of being normally fixed, an organ may be more or less freely movable, so that its situation can be altered by change of posture, manipulation, or in other ways. 5. A portion of an organ may protrude out of its cavity, so as to lie under the skin or amongst the muscles, as in external hernia ; or it may even come altogether out of the body, as happens when organs are protruded in consequence of injury, with an external wound. A portion of the brain may thus protrude through an opening in the skull after injury, constituting the so-called *hernia cerebri.* The displacements named *procidentia* and *prolapsus* may also be mentioned here. 6. In the case of the intestine, one part may alter in its relations to other parts, as happens in the case of invagination. Coils of the bowel also occasionally find their way into curious positions, owing to the presence of bands of adhesion, openings in the mesentery, and other abnormal conditions which predispose to their displacement (*see* Intestinal Obstruction). 7. The uterus presents special malpositions, both as a whole, and in relation to its different parts, which need not be discussed here. *See* Womb, Diseases of.

Effects and Symptoms.—There may be no manifest results whatever of the displacement of an organ, or at least such as can be regarded of much or any consequence. On the other hand, this condition may, if brought about suddenly or acutely, be attended with immediate symptoms of a grave nature. For instance, in the case of the intestine, obstruction to the transit of its contents is often produced, and other serious results ensue, familiar enough in cases of hernia ; while rapid displacement of the heart may lead to grave embarrassment of its action, and prevent the passage of blood into the arteries, by altering the relation of their orifices to the cardiac cavities. In chronic cases also displacement of an organ frequently gives rise to phenomena of greater or less importance. Thus, its own functions are not uncommonly disturbed, and may be seriously interfered with, as happened in a case observed by the writer, where the stomach passed through the diaphragm into the thorax. The displaced organ may also produce physical effects, such as irritation or pressure, and thus give rise to pain or other subjective sensations, or to symptoms obviously connected with other structures and organs. Physical examination often reveals malposition of an organ, and this is one of the conditions which should always be borne in mind when examining the more important viscera. In some instances it assumes the characters of a tumour, as in the case of movable kidney; and this may prey so much upon the mind of the patient as to lead to considerable general disturbance, although the condition may really not be of much moment. It must be remembered that an organ may be diseased at the same time that it is displaced, and then the symptoms are likely to be more marked.

Treatment.—When an organ is suddenly or acutely displaced, and the displacement is attended with serious symptoms, the first aim in treatment should be to endeavour to restore it to its normal position as soon as possible. This may be illustrated by the treatment of hernia and other forms of intestinal displacement, or of protruded organs, as the result of injury; and by the removal of pleuritic effusion, by operative methods, when it gravely impedes the cardiac action in consequence of displacing the heart. In chronic cases the same principle should be kept in view in the first instance. For this purpose any causes of displacement should be removed, and it may be necessary to employ mechanical means, or even to adopt operative procedures, to prevent a recurrence of the malposition. This may also be exemplified by the treatment of hernia, and of displacement of the uterus. In many cases, however, the restoration of an organ to its normal position is impracticable. Under these circumstances no particular treatment may be required; or perhaps any ill-effects resulting from the malposition may be obviated by the application of a bandage or other means of mechanical support, as in the case of movable kidney. Medicinal agents may be of service in combating symptoms, and in improving the general condition, if required. When a malposition is of no consequence, the patient's mind should be made quite easy on the point, especially if any notion is entertained of the existence of a tumour.

Frederick T. Roberts.

ORTHOPNŒA (*ὀρθός*, erect; and *πνέω*, I breathe).—A form of difficult breathing, in which the patient is unable to lie down, and is compelled to assume the sitting or erect posture. *See* Respiration, Disorders of.

ORTHOTONOS (*ὀρθός*, straight; and *τόνος*, a stretching).—A form of tetanic spasm, in which the body is rigidly extended. *See* Tetanus.

OSMIDROSIS (*ὀσμή*, odour; and *ἱδρώς*, sweat).—A condition of the perspiration in which it yields an unusually strong or fœtid odour. *See* Sudoriparous Glands, Disorders of.

OSSEOUS DEGENERATION.—A kind of degeneration, in which the affected textures assume the characters of bone. *See* Degeneration.

OSSEOUS SYSTEM, Diseases of. *See* Bone, Diseases of.

OSTEITIS (*ὀστέον*, a bone).—A synonym for inflammation of bone, which may be of various kinds. *See* Bone, Diseases of.

OSTEOCOPIC PAINS (*ὀστέον*, a bone; and *κόπος*, fatigue).—Aching pains in bones. *See* Syphilis.

OSTEOID CANCER.—This term has been vaguely employed, as implying a cancer including bony structure, or with reference to malignant disease involving a bone. *See* Bone, Diseases of; Cancer; and Tumours.

OSTEO-MALACIA (*ὀστέον*, a bone; and *μαλακός*, soft).—A synonym for mollities ossium. *See* Mollities Ossium.

OSTEO-MYELITIS (*ὀστέον*, a bone; and *μυελός*, the marrow).—A name for inflammation of the medulla of bone. *See* Bone, Diseases of.

OSTEO-SARCOMA (*ὀστέον*, a bone; and *σάρξ*, flesh).—A sarcomatous growth in connexion with bone. Also a sarcoma with tendency to ossification. *See* Bone, Diseases of; and Tumours.

OTALGIA (*οὖς, ὠτός*, the ear; and *ἄλγος*, pain).—Pain in the ear: earache. *See* Ear, Diseases of.

OTITIS (*οὖς*, the ear).—Inflammation of the ear. *See* Ear, Diseases of.

OTORRHŒA (*οὖς*, the ear; and *ῥέω*, I flow).—Discharge from the ear, usually purulent. *See* Ear, Diseases of.

OVARIES, Diseases of.—Synon.: Fr. *Maladies des Ovaires*; Ger. *Krankheiten der Eierstöcke*; *Krankheiten der Ovarien.*

In the article Abdomen, Diseases of, mention is made under one of the groups of diseases of the female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries. Under the heads Menstruation, Disorders of, and Hysteria, much information may be found upon subjects which might be included among the diseases of the ovaries. But there remains something regarding the pathology, diagnosis, and treatment of ovarian diseases interesting to the physician, without entering upon the more surgical question of such cysts and tumours of the ovaries as call for tapping or ovariotomy.

In proceeding to estimate the frequency and importance of the diseases of the ovaries, we have to consider the wonderful series of periodical processes which go on in women every month for some thirty-five years; sometimes without any interruption by pregnancy, sometimes interrupted by many pregnancies, either carried on to the full period, or interrupted at different stages, followed by lactation for periods variously prolonged, perhaps suddenly stopped by the death of the child or by another pregnancy, attended by losses of blood of less or greater quantity, and ceasing usually from forty to fifty years of age, after more or less irregularity. We have to remember that at each menstrual period one or other ovary becomes swollen; that one or more of its ovisacs enlarges, opens, and permits the escape of the ovum it contained; that the fimbrial end of the Fallopian tube grasps the ovary, receives the ovum, and allows of its passage into the uterine cavity; that the uterus itself receives an increased supply of blood; and that its mucous membrane undergoes a series of exfoliative changes. We must consider, further, how these periodical processes are associated with much that is of supreme importance in the state of the nervous centres, and in the mental condition of woman; that the normal process, instead of recurring at regular intervals, and ceasing in a few days, may be abnormally prolonged, and may recur at most uncertain periods; and that evolution and involution may be both affected by pregnancy and lactation. When we bear in mind all these highly complex conditions, processes, and relations, the wonder is not that ovarian diseases should be frequent, but that so many women pass through life without suffering from them. If an ovary become swollen and tender, its blood-vessels over-distended, and extravasation or apoplexy of the proper ovarian tissue take place; or if blood, escaping into the peritoneal cavity, become encapsuled, or if it form a hæmatocele in the loose cellular tissue between the layers of one or both of the broad ligaments, we can only wonder that such an accident does not happen more frequently, and be prepared to recognise the effects of repeated slight extravasations. These are uneasiness in the abdomen, increasing to pain, more or less severe, want of sleep, and raised temperature, preceding discharge of blood from the uterus. Then follow swelling and tenderness in one or both groins, bearing down like labour-pains, recurring at intervals, with discharge of fluid or clotted blood or of membranous shreds; extension of pain to the loins, and irregular flow of urine—all symptoms so often observed as to be almost neglected. And if a vaginal examination is made, especially when combined with examination by the rectum, not only may one or both ovaries be felt larger and lower down than they ought to be, behind and on either side of the uterus; but they may be extremely tender on pressure, and there may be more or less evidence of peri-uterine extravasation. After repeated attacks of this nature, permanent hardening and enlargement of ovaries and uterus, and their impaired mobility, due to organisation of blood-clot or of plastic lymph, are among the most frequent pathological changes which the practitioner is called upon to treat.

The diseases of the ovaries, which will be specially alluded to in this article, are as follows: (1) Abnormalities; (2) Displacements; (3) Disturbances of Circulation; (4) Acute Inflammation; (5) Chronic Inflammation; and (6) Tumours, including Cysts.

1. **Abnormalities.**—Absence of the ovaries, or their imperfect development, may occasionally be inferred; and the presence of a third or accessory ovary, now and then observed in the dissecting-room and on the operating-table, may probably account for the recurrence of regular menstruation in spite of serious disease of both ovaries, or after the removal of both by ovariotomy.

2. **Displacements.**—Congenital or acquired displacements are also observed, as hernia into the inguinal canal, or prolapse into Douglas's pouch. *See* OVARIES, Herniæ of.

3. **Disturbances of Circulation.**—Hyperæmia, when not excessive, may be considered as an essential part of normal menstruation. A very little excess may lead to the formation of a large clot in an unbroken ovisac, or extravasation into the stroma of the ovary, constituting apoplexy; or between the layers of the broad ligament, or into the peritoneal cavity, thus forming peri-uterine or pelvic hæmatocele. In some cases apoplexy of the ovisacs is clearly traceable to torsion of the ovary upon its nutrient blood-vessels.

4. **Acute Inflammation.**—Acute oophoritis and peri-oophoritis are probably of much more frequent occurrence than acute orchitis in the male. The testicles are far more liable to mechanical injuries, but are probably not more liable to extension of the poison of gonorrhœa, or its sympathetic effects; and they are free from the periodical hyperæmia which may be regarded as the first step in the process of ovarian inflammation. This periodical hyperæmia, influenced by accidental sudden suppression of discharge of blood from the uterus, is the usual history of an acute attack of oophoritis.

SYMPTOMS.—The symptoms of acute inflammation of an ovary are pain over the pubes, tenderness on pressure in one iliac region, irritation of the bladder, tenderness of the vagina, and pain on moving the cervix uteri, and on passing the finger behind and on one side of the cervix towards the sacro-iliac synchondrosis. In patients with lax tissues, by combined abdominal, rectal, and vaginal examination, the swollen ovary may very often be felt. If one ovary can be felt and moved, the patient at once complains of greatly aggravated pain.

Treatment.—The treatment should consist in absolute rest on the back, with the hips raised and thighs flexed; or on the side not affected, if dry-cupping glasses can be applied over the sacrum. Mustard poultices, or turpentine and chloroform liniment, may also be applied over the sacrum and on the iliac region. The bowels should be well cleared out, and small doses of blue pill and Dover's powder given frequently, with a sufficient quantity of bromide of potassium. Leeching the cervix uteri has been recommended; but the local disturbance caused by this method usually does more harm than the loss of blood can make up for. Sometimes the pain is so very severe that it may be necessary to give chloroform or some other anæsthetic, and repeat it more than once before relief is obtained.

5. **Chronic Inflammation.** — Chronic oophoritis, distinguished by those paroxysmal attacks of pain recurring at the menstrual periods commonly known as ovarian dysmenorrhœa, is a much more common condition than the acute form of the disease. And there can be little doubt that both amenorrhœa and menorrhagia may be often due to changes in the ovaries, which are the result of repeated attacks of subacute inflammation. Some turgescence of the mucous membrane of the uterus and Fallopian tubes is a condition attendant upon ovulation; and is physiologically or pathologically in close relation with the normal or abnormal process in the ovary. So far as anatomical examination teaches us, it is rare to find much change in the ovaries alone, without proof of what is called peri-oophoritis; adhesions between the surface of the ovary and the fimbriæ of the Fallopian tube or the tube itself; adhesions due to pelvic peritonitis; hardening and enlargement of the ovary itself; hard clots in some of the ovisacs; or, on the other hand, a shrivelling, contraction, or atrophy of the gland.

Treatment.—Whether the chronic form of the disease has succeeded an acute attack—non-puerperal or puerperal, or one or more attacks of gonorrhœa, or repeated abortions, or has merely increased in intensity or duration after repeated recurrence, the treatment must still be the same: namely, avoidance of known causes, rest, attention to the general health, counter-irritation, and the use of sedatives, especially conium, belladonna, and the bromides. In cases of distinct falling downwards of one or both ovaries, an elastic ring pessary, worn in the vagina for a few weeks, is sometimes of signal service. Hard pessaries are not well borne. When all other means fail, the operation of extirpating both ovaries must be seriously considered in consultation. We require more facts, accurately observed and faithfully recorded, especially as to the mortality, and to the results obtained by the operation when it does not prove fatal, and the state of the patient's health of body and mind for some years afterwards, before the true value of the operation can be estimated. But enough evidence has been already collected to prove that, after ordinary measures have failed, and morbid physical and mental conditions are clearly dependent on abnormal menstruation, and possibly upon morbid conditions of the ovaries, the physician would be fully justified in advising the patient or her friends to call for the aid of surgery. Unfortunately there has been of late years a deplorable tendency among a few specialists to mutilate women without any just cause. Women have been rendered sterile without explanation of any such result of the operation proposed to them. Many who have refused to submit to such treatment have recovered without it, have married, and borne children. Recoveries after an unnecessary operation have been recorded untruly as cures of the diseased condition, and many failures have been left unrecorded. It is not unnecessary to repeat protests against neglect of the true principles of professional honour, and against the recent abuse of an operation which may only occasionally be justifiable and valuable.

6. **Tumours.**—Of all the diseases of the ovaries, far more common than any malformation or displacement, even more commonly the cause of such suffering as to lead a patient to seek for medical advice than either the acute or chronic forms of ovarian inflammation, or than the ovaralgia or nervous hysterical form of ovarian irritation associated with dysmenorrhœa, and with various forms of eccentricity, and possibly of hypochondriasis, melancholia, or maniacal excitement—common though these conditions may be—cysts of one or both ovaries are the most frequent of all the diseases of these organs. So far as regards their pathological anatomy, for all practical purposes of diagnosis and treatment, they may be divided into *simple* or *unilocular*, and *compound* or *multilocular*—the former a dilated dropsical ovisac, the latter a proliferating cystoma or a dermoid cyst. A still more practical, if less scientific, division might be made into (1) *cysts*, and (2) *tumours* of the ovaries, including in the former division such simple or multiple cysts as from the preponderance

of fluid and small amount of cyst-wall, may properly be considered as ovarian dropsy—*hydrops ovarii*, or *hydrops folliculorum Graafii*; and in the latter such solid or semi-solid tumours as, under a general class of proliferating cystomata, include pseudo-colloid tumours, myxo-cystoma, cystoid adenoma, sarcoma, fibroma, papilloma, carcinoma, and (as a separate class) dermoid cysts. The histogenesis and the microscopic character of these varied forms of disease must be studied by the aid of special treatises or monographs. Here their clinical history is of chief importance.

Symptoms and Diagnosis.—Clinically the main points for consideration in cases of fluctuating abdominal tumours are whether the fluid is contained within a cyst, or whether it is in the peritoneal cavity, either free or limited by visceral adhesions. In solid tumours their seat and nature must be investigated. *See* Ascites.

In the diagnosis between fluid in an abdominal cyst and in the peritoneal cavity, important points are that the limit of fluctuation as recognised by palpation, and the limit of dulness as ascertained on percussion, exactly correspond when the fluid is encysted. The wave of fluid cannot be made to pass beyond the line of dulness on percussion. But, when the fluid is free, the resonant intestines are floating in or on it, and fluctuation may be detected where percussion gave a resonant or tympanitic note. The wave of fluid is not stopped by any cyst-wall.

Chemical and microscopical examination.—If tapping have been resorted to, in order to give temporary relief to urgent symptoms, or to complete a doubtful diagnosis, chemical and microscopical examination of the fluid affords valuable information. The albumen in the serum secreted by the peritoneum is ordinary albumen, which is coagulated by heat, and will not redissolve in double its volume of strong boiling acetic acid. The albumen secreted by the epithelial layer of an ovarian cyst is that secreted rather by mucous than by serous membranes, known as metalbumin and paralbumin, which (like true albumen) is coagulated by heat, but (unlike true albumen) is redissolved, or converted into a translucent gelatiniform liquid, after having been boiled in double its volume of strong acetic acid. Then on examining the deposit which subsides after ovarian fluid has been at rest for some hours, there may be found in the field of the microscope the nuclei of the epithelial cells which line the interior of the cyst. The scales are thrown off, the cell-walls break down, and the nuclei remain. These are the so-called 'ovarian granule-cells' of Nunn, Bennett, and Drysdale, and are characteristic of innocent growth. In addition to these, there are found in malignant growths characteristic groups of cells of different sizes, described about the same time by Foulis and Thornton as large pear-shaped round, or oval cells, containing a granular material, with one or several large clear nuclei, with nucleoli and a number of transparent globules or vacuoles. The great variety in size and shape of the cells composing the groups is the characteristic feature. When these large groups are found in fluid removed from a cyst, it is extremely probable that a malignant growth projects into the cavity of the cyst. When the groups are found in peritoneal fluid, there is either some malignant growth, or an ovarian cyst of a malignant character has burst into the peritoneal cavity. Some of the cells have planted themselves upon the surface of the peritoneum, where they have grown and multiplied. Some observers believe that when such groups of cells are found in fluid removed from a cyst or from the peritoneal cavity, the evidence of the malignant nature of the disease is so strong that no other than palliative treatment is justifiable. But microscopic knowledge has certainly not yet reached such perfection as to justify a surgeon in refusing to attempt to save life by removing a tumour, if it can be removed, even if it be characterised by the formation of such groups of cells as have been described. Several such ovarian tumours have been removed after they had burst, and after several tappings of the peritoneal cavity, with the happy result of recovery from the operation and subsequent good health. After the removal of a proliferating cystoma recurrence of the disease has been observed, but there is good ground for believing that recurrence is exceptional.

Semi-solid tumours.—Semi-solid ovarian tumours are more common than simple cysts. Instead of a smooth uniform surface, irregularities may be felt, due to cysts, or groups of cysts, of different shapes and sizes, or to thickening of portions of the wall of the main cyst. The wave of fluctuation is interrupted by septa in different directions; and hard nodules, or bone-like projections, may perhaps be detected. Occasionally a deep sulcus between two portions of a semi-solid tumour, with resonant intestine in the sulcus, may lead to doubt whether both ovaries are not affected.

Solid tumours.—Ovarian tumours which are entirely solid, not fluctuating in any portion of them, are very rare, but still are occasionally met with, both as innocent fibroma and as true cancer.

Adhesions.—Any ovarian tumour—cystic, solid, or semi-solid—may be free from adhesion to the abdominal wall or to the omentum or viscera, or may be adherent anywhere within the abdominal or pelvic cavities. But as the result of ovariotomy is very little affected by the presence or absence of adhesions, a very minute diagnosis of the nature and extent of adhesions is not of much practical importance. Still, if there are firm adhesions low down in the pelvis, fixing the uterus, rectum, and bladder together, or fusing them, as it were, into one mass with the ovarian growths, ovariotomy should not be performed, or only to relieve threatening danger, and after a very guarded prognosis.

Inflammation, hæmorrhage, and *gangrene.* Any ovarian cyst, simple or compound, may be the seat of inflammation either on its surface, when the symptoms do not differ from those of peritonitis, or in the cyst-wall or lining membrane, when (without any peritonitis) there may be pain and considerable fever, sometimes followed by rigors and suppuration. Hæmorrhage into one or more of the cyst-cavities may lead to all the symptoms and effects of internal hæmorrhage. Or the whole or portions of the tumour may become gangrenous, from a twisting of the pedicle obstructing the circulation of blood in the vessels of the tumour. In some cases twisting of the pedicle may be followed by a complete separation of the tumour from its ordinary supply of blood. In this condition the tumour is nourished by vessels in the omentum, abdominal wall, or some other structure adherent to the peritoneal coat of the tumour, if the woman's death is not speedily caused by gangrene of the growth.

Other abdominal tumours.—The abdominal tumours most frequently mistaken for ovarian tumours are fibroid or fibro-cystic tumours of the uterus, and tumours or cysts of the spleen, liver, or kidney. Pregnancy, either normal or extra-uterine, may also be mistaken for an ovarian tumour, or may be present at the same time. It is not rare to find a woman with an ovarian or a uterine tumour to be also pregnant; so that the ordinary signs of pregnancy must be borne in mind in examining any woman who has an abdominal tumour. And the frequency of fæcal accumulations, or of tympanitic distension of the intestines, with thick or rigid abdominal walls and a fat omentum, must also be remembered and excluded, as well as fatty or fibro-fatty tumours which may form in the omentum, or consist of hypertrophied appendices epiploicæ, and fibro-plastic growths, from any part of the peritoneum or sub-peritoneal cellular tissue. Peritoneal hydatids, or hydatid cysts of the liver, spleen, or omentum, retro-peritoneal abscesses, pelvic cellulitis followed by abscess, distended bladder, pelvic hæmatocele, enlarged mesenteric or lumbar glands, aortic aneurysm, and enchondroma, are all conditions which must be borne in mind in cases where the ordinary signs of an ovarian cyst or tumour are not sufficiently characteristic to exclude doubt.

But the most frequent source of error is cancer of the peritoneum, not necessarily involving the ovaries, although these organs may not be free from the disease. In some cases the uterus, and both ovaries, and the peritoneum everywhere become covered or infiltrated with cancerous deposits or growths, and in nearly all cases there is considerable accumulation of fluid in the peritoneal cavity. If the coats of the small intestines are involved, the very characteristic signs are manifest of movable tumours, which are both hard and resonant, and which on being pressed or kneaded gurgle under the fingers. In any case of abdominal tumour, with or without peritoneal fluid, where the loss of flesh and strength is rapid, although the tumour may not be large, where there is much pain, and the patient is subject to vomiting or diarrhœa, the diagnosis of intra-abdominal cancer generally proves too true.

Prognosis and Treatment.—1. *Medical.* It must be confessed that the medical treatment of ovarian cysts and tumours in a curative sense is quite hopeless. In cases of supposed simple cysts, where powerful purgatives and diuretics have been followed by disappearance of the fluid, the true explanation has been either a mistake in diagnosis, or an accidental rupture of a thin cyst. In the compound cysts, or the more solid tumours, iodides, bromides, mercurials, and every other remedy that has been tried, have proved useless at the best, and have often injured the general health of the patient without affecting the morbid growth. Beyond attending to the general health of the patient, and palliating any urgent symptom, the chief aim of the physician should be to do no harm, to encourage a cheerful state of mind in his patient by the assurance that the disease is curable, and whilst he postpones surgical treatment so long as it is not clearly necessary, he should not allow a patient to wait so long that, after unnecessary and prolonged suffering, she should fall into a condition unfavourable for the result of an operation.

2. *Surgical.*—If, after exposure to cold, or as the result of a blow or fall, a patient with an ovarian tumour presents the signs and symptoms of inflammatory changes in the tumour or in the peritoneum, rest, fomentations or poultices, and opiates are indicated. If very severe symptoms point to hæmorrhage or cyst-rupture, immediate ovariotomy may afford the only hope of saving life.

In considering the very important question how long a patient should be left to ordinary hygienic or medical treatment without any assistance from surgery, it may be said: 'So long as the patient does not suffer much pain, is not annoyed by her size and appearance, has no great difficulty in locomotion, does not suffer from injurious pressure on the organs of the chest, abdomen, or pelvis, and so long as the heart and lungs, digestive organs, kidneys, bladder, and rectum perform their functions tolerably well, surgical treatment is seldom called for. It is only a projected marriage, or a necessary voyage, or some such family circumstance, that may justify or render expedient earlier resort to surgical aid. Under ordinary circumstances the surgeon would not interfere until an ovarian tumour either distressingly deforms a patient, or seriously impedes her locomotion, or prevents the free action of heart or lungs, or obstructs the circulation through the large veins of the abdomen, or, by deranging the digestive organs, leads to emaciation and weakness, or by its pressure causes pain, loss of rest, or mechanical obstruction to bladder or rectum.' These are the rules laid down in 1872 by the writer of this article. Subsequent experience of the ill effects of delay, and of the diminished and diminishing mortality of ovariotomy, leads to the conclusion that these rules rather err on the side of over-caution and too long delay; and that the welfare of most patients is better promoted by advising an earlier adoption of surgical treatment, and probably the removal of an ovarian tumour as soon as its nature and connexions can be clearly ascertained, and it is beginning in any way physically or mentally to do harm.

In cases of single cysts the question of palliative treatment by tapping, or the radical cure by ovariotomy, must be seriously considered. And when a cyst is really single, the removal of the fluid not only gives great relief for a considerable period, but in some cases fluid does not collect again for several years, sometimes never. Even when a cyst is not absolutely single, but contains one cavity so large that smaller cavities are practically insignificant, tapping may give sufficient relief to warrant its recommendation in cases where patients desire to postpone any more hazardous operation. But in all cases it should be done with the strictest antiseptic precautions against the entrance into the emptied cyst-cavity of atmospheric air possibly containing some germ or material which may set up putrefactive or infective changes within the body.

Tapping by the abdominal wall, vagina, or rectum, alone or followed by pressure, by drainage, by injection of iodine, by incision, or by the formation of a permanent communication between the cyst-cavity and the peritoneal cavity, in these days can only be regarded as substitutes in cases where ovariotomy is rejected by the patient, or where the surgeon finds that the ovarian tumour cannot be removed. In a very large majority of cases the only hope of cure is in ovariotomy.

Question of Ovariotomy.—When it has to be considered in consultation whether a patient should be advised to submit to ovariotomy or not, the chief points for discussion are: 1. How long is she likely to live if left alone, or relieved by palliative treatment only—hygienic and medical—or by tapping? 2. What is the risk of ovariotomy at the average rate of mortality, and how far is the risk in the one patient who is the subject of consultation likely to be above or below the general average?

In reply to the first question, it is believed that after an ovarian tumour has attained such a size as to inconvenience a patient she rarely lives four years—even if relieved by occasional tapping—and that, with due allowance for a few exceptional cases of many years' duration, two years would be the full average expectation of life. Thus, even at the best, two years of invalid life is what is lost, even if ovariotomy be done and is unsuccessful.

The average risk of ovariotomy in a large number of cases, including the most and the least favourable, has been diminishing for many years past; and the diminution since about 1875 has been much greater than before the adoption of antiseptic precautions during the operation. Before 1860 so many unsuccessful cases were concealed, and the numbers who died, of the cases reported, were so great, that the calculated mortality of about 50 per cent., or half the patients operated on, is probably far too small, and it would be more correctly estimated at 70 to 80 per cent. Since 1860 it has been gradually diminishing from 35 to 15 per cent.; and since 1878, when antiseptics came into general use here and in Germany, it has fallen below 10 per cent., whilst well-founded hopes are entertained of a still smaller mortality. It may be said in 1893 that ovariotomy is by far the most successful of any of the 'capital' operations of surgery. In cases which before operation are looked upon by an experienced operator as favourable, the expectation of success as at least 95 in 100 will probably be justified by the result.

Whether any one patient is likely to have more or less than the probability of ten to one in her favour must depend upon her general health. For the rule holds good, that, while the easy removal of small free tumours from women with a feeble heart, or unsound lungs, kidneys, or liver, or shattered nervous system, may hasten death—so may very large adherent tumours be removed with extreme difficulty from sound, healthy women, and complete recovery may follow, without fever or any unpleasant symptoms; and, most satisfactory of all, perfect health may afterwards be enjoyed for many years, the operation leading to no appreciable modification in subsequent pregnancies or parturition. The removal of one ovary does not appear to affect the number of pregnancies, nor the sex of the children, nor the occurrence of twin pregnancy; and it is quite exceptional to observe that the removal of both ovaries leads to obesity, or to any other mental or bodily peculiarity.

T. SPENCER WELLS.

OVARIES, Herniæ of the.—Displacements of the ovaries, apart from those occasioned by ovarian disease, were generally ignored until comparatively recently, and still receive less consideration than their pathological importance demands; being amongst the most frequent causes of many of the special troubles which come before us in gynæcological practice. In the majority of cases these displacements occur downwards into Douglas's space, and in such instances the left ovary is the one usually displaced. The next most frequent forms of ovarian herniæ are those occurring in the inguinal regions, either above Poupart's ligament, or, as is more commonly the case, following the canal of Nuck downwards and forwards and presenting in the labia. In the first named, or directly downward displacement, the ovary, on vaginal examination, may be discovered in the recto-vaginal fossa as a small ovoid, firm, elastic, and highly sensitive tumour, bulging into the post-cervical *cul de sac.*

Ætiology.—Although in some instances congenital, ovarian herniæ more usually occur in patients whose abdominal parietes have been relaxed and viscera compressed by repeated gestation, or want of due support after parturition. They may also be induced by causes similar to those of other herniæ, such as the violent muscular efforts of the second stage of labour, lifting a heavy child, or straining at stool. In displacement downwards into Douglas's space, the cause of the protrusion is, however, generally gynæcological rather than obstetric, the result of the *vis à tergo* of abdominal or uterine tumours, or of the tension on the appendages occasioned by displacements of the uterus.

Symptoms and Diagnosis.—Ovarian displacements, when inguinal, may be mistaken for enlarged glands, or as an enterocele or epiplocele; when labial, for other tumours in that situation; when downwards, for pelvic abscess or hæmatocele, retroversion or retroflexion, or for a fibroid growth from the posterior uterine wall. The sudden occurrence of a small ovoid tumour, possessing the physical characteristics just referred to and located in one or other of these situations, accompanied by constitutional and nervous disturbance, with a peculiar dull sickening pain, aggravated into acute suffering at each menstrual epoch, and a coincident increase of size then manifest, together with the intense tenderness or nausea generally evinced during any examination of the part, are sufficient to enable a correct recognition of the nature of the case to be made by any competent gynæcologist.

Treatment.—When the ovarian hernia takes place at either of the abdominal rings, it may in some instances be reduced by taxis. In the majority of cases, however, these displacements are already irreducible when discovered; and even in the cases in which reduction is possible, the retentive pressure of an ordinary truss is too frequently neither endurable nor effectual. In such instances the extruding ovary should, if feasible, be protected from further protrusion or external injury by a well-fitting hollow truss. But before this an attempt should always be made to lessen the local hyperæsthesia of the generally hypertrophied displaced gland by topical sedative applications, and, if necessary, by leeching, &c.; whilst the constitutional irritation almost always present in such cases should be allayed by suitable constitutional treatment. When, however, these measures prove ineffectual in relieving the persistent, dull, worrying, aching pain so commonly associated with chronic ovarian hernia, and which at each monthly period in these cases becomes accentuated or acute—when, too, the patient's health is endangered by the nervous disturbance and constitutional irritation, we should fall back on extirpation as the only resource available. But this treatment should be regarded as exceptional; nor is the performance of oophorectomy under these circumstances by any means devoid of risk, or to be undertaken without urgent necessity, and until a fair trial has been first made of other remedial or palliative measures.

With regard to the treatment of prolapse of the ovary into Douglas's space, this caution is especially applicable. In considering the management of this displacement, its causes must be carefully borne in view. Pressure from above downwards of a uterine or ovarian tumour, or the traction of a uterine displacement on the broad ligaments, must be removed or relieved before any successful reposition of the prolapsed ovary can be made. When the dislocation is due to some accidental circumstance, or to a relaxed state of the parts occasioned by constitutional causes, we may, with greater probability of permanent success, attempt to return the displaced viscus and retain it *in situ.* For this purpose the patient—being first etherised in order to permit of the necessary manipulation of the generally highly sensitive and tumefied ovary—should be placed in the left lateral semiprone position, when by gentle, steady, conjoint digital pressure through the rectum and vagina, upwards and forwards, we may be able to lift the extruded ovary out of the post-cervical recto-vaginal fossa, and to push it up into its normal position, where it may then be retained by a suitable support. Failing the possibility of such re-position, however, if the local and constitutional effects of the displacement are urgent and otherwise irremediable, the practitioner as a *dernier ressort* must remove the ectopic gland.

Thomas More Madden.

OVERLAYING. SYNON.: Fr. *Étouffer un Enfant.* — Overlaying is an accident which, it is alleged, not infrequently happens to young children, whereby they are killed by suffocation. On an average rather more than four hundred children per annum are registered in London as dying from 'overlying' in bed. The Registrar-General in his report for 1890 states that 1,544 children, mostly in the first year of life, died from 'suffocation in bed'; that this mode of death is on the increase; that it is more frequent in the winter than in the summer; and that the proportion of deaths due to this cause is more than twice as high on Saturday night as on any other night in the week. The only explanation for the pre-eminence of Saturday is the fact that on this day wages are paid and drunkenness is common. The *post-mortem* signs of overlaying are those of suffocation. Evidence that a child has really died from this cause is afforded by (1) the *post-mortem* appearances of death from asphyxia; (2) the absence of any other mortal disease; (3) the absence of evidence of any cause of asphyxia other than overlaying.

The statement that a child has been overlain should be received with caution. It is reasonable to suppose that a vigorous child would escape from a suffocating position beneath the bed-clothes, or the body of its nurse, by its own efforts; or at least succeed, by its crying and struggling, in waking its nurse. On the other hand, a very weakly child, whose lungs possibly have only partially expanded, might be killed by a very trifling cause, such as the position of its mouth and nose against the body of its nurse, or the accidental temporary obstruction of its air-passages by the bed-clothes. A medical witness, before committing himself to a theory of death from overlaying, must consider all the points alluded to above, and must take care not to bring a charge of almost criminal carelessness against a careful nurse, or allow an act of wilful murder to pass under the guise of accidental death.

G. V. POORE.

OXALIC ACID, Poisoning by.—*See* POISONS.

OXALIC ACID DIATHESIS—OXALATE OF LIME CALCULUS.

1. Oxalic Acid Diathesis.—SYNON.: Oxaluria; Fr. *Oxalurie*; Ger. *Oxalurie*.

ÆTIOLOGY.—Oxalic acid, when it occurs in the urine, may be derived from various sources: (1) It may come from certain articles of the vegetable kingdom taken as food. (2) It may be derived from imperfect metamorphosis of the waste tissues of the body. (3) It may be due to the conversion of urea and uric acid after the secretion or the emission of urine. (4) It seems to have been proved that oxalic acid sometimes exists in the blood, and may then simply be eliminated by the kidneys.

CHARACTERS AND COMPOSITION.—Oxalic acid in the urine is always found combined with lime, and is recognised thus: (1) As minute octohedral crystals with cross markings. These crystals assume apparently different shapes, according to their varying position in the field of the microscope. (2) As spheroidal, ovoid, or dumb-bell submorphous masses. These latter may be mistaken for somewhat similar bodies composed of lithates; but the colour of the lithates, and the almost invariably concurrent presence of the octohedra, will distinguish them (*see* MICROSCOPE IN MEDICINE, fig. 107). The urine containing oxalate of lime is always acid, generally of an amber tint, and contains a faint cloud of mucus. This cloud, however, may be so slight as to be unnoticed, and then the presence of oxalates is apt to be overlooked.

SYMPTOMS.—However derived, the presence of oxalate of lime in the urine frequently, or in any considerable amount, cannot but arrest attention and suggest the question: Is there any special condition of the system dependent on or associated with this occurrence? In other words: Is there any peculiar habit of body to which the term 'oxalic acid diathesis' can be rightly applied? Prout, and especially Golding Bird, so fully described the symptoms of nervous exhaustion, dyspepsia, and hypochondriasis, which are said to characterise this so-called diathesis, and so fully impressed the professional mind with the clinical association of these symptoms with—if not their actual dependence on—oxaluria, that the more accurate observations of Dr. Beale, Beneke, and Sir William Roberts, have scarcely yet succeeded in dissipating the error. These observers have proved that, in the majority of cases in which the characteristic symptoms are present, no oxalates are found in the urine; and, conversely, where oxaluria is most pronounced, the symptoms are absent. Oxalate of lime in the urine is often found in persons enjoying good health. From what has been said of its ætiology, its presence is explained in various chronic diseases, such as phthisis, chronic bronchitis, cardiac lesions, &c., in which oxidation is retarded. So, too, oxaluria is present in many conditions of deranged digestion and mal-assimilation, and in diseases which lower nervous tone and power.

TREATMENT.—The frequent or persistent presence of oxalate of lime in the urine, when no organic disease is present, is not easy to remedy. Dietetic habits and the general health must be watched. Rhubarb and other vegetable articles which contain oxalic acid should be avoided, and strict moderation and simplicity in food and drink enforced. Dyspepsia may be treated with the usual remedies—alkalis and the vegetable tonics, and sometimes with mineral acids and iron. Sedentary habits should be exchanged for brisk exercise and sea air. In a word, attention to the health of mind and body, rather than any special drug treatment addressed to the urinary deposits, is required and will best succeed.

2. **Oxalate of Lime Calculus.**—Description.—Mulberry or oxalate of lime calculus is usually of a dark brown, sometimes almost black, colour; generally ovoid or spheroidal in shape; with a rough and tuberculated exterior; and of a hard compact interior. The absolute nucleus is composed of dumb-bell crystals, united by molecular coalescence in, and through the medium of, some viscid organic matter. The influences which control this deposition and growth of calculi have been much elucidated through the researches of Dr. Carter and Dr. Ord, but need not be specially described here. *See* Calculus.

The great insolubility of oxalate of lime favours the chances of its deposition in the renal tubules. It has been detected in the kidneys of the fœtus; it is especially liable to occur during childhood; and this liability decreases as age advances. In England calculi composed entirely of oxalate of lime are rare in the adult, but in India they are comparatively frequent. Mulberry calculus in the young causes intense suffering; but in the adult, notwithstanding the formidable tubercles and rough exterior, the symptoms of stone are often mild; not improbably because these projections become entangled in the muscular columns of the bladder, and the calculus is thereby fixed in position. The symptoms of renal calculus are fully described in another article. *See* Renal Calculus.

Treatment.—Microscopic mulberry calculi, were it possible to detect their existence, could probably be washed away and carried off by diluents and diuretics; but a palpable stone demands surgical treatment only.

W. Cadge.

OXYURIS.—*See* Entozoa.

OZÆNA (*ὄζαινα*, a fœtid polypus in the nose; from *ὄζω*, I have a smell).—*See* Nose, Diseases of.

P

PACHYMENINGITIS (*παχύς*, thick; and *μήνιγξ*, a membrane).—A synonym for inflammation of the dura mater of the brain and of the spinal cord. *See* Meninges, Cerebral, Diseases of.

PAIN.—Synon.: Fr. *Douleur*; Ger. *Schmerz*.

Definition.—Pain is the representation in consciousness of a change produced in a nerve-centre by a certain mode of excitation. It would seem that stimulation of special nerve-fibres or special nerve-centres, and not a mere exaltation of the normal functioning of the sensory apparatus, is necessary to the production of pain. For it will sometimes happen, in disease, that whilst the faculty of perceiving painful impressions made upon certain portions of the skin is wholly, or in great part, lost, touch is felt as well as in health. On the other hand, in hyperalgesia of the surface, where the slightest impression produces exquisite pain, the power of tactile discrimination is actually diminished.

Ætiology and Pathology.—Pain is excited by many agencies applied to the skin—mechanical, thermic, chemical, electric, pathological. Of these it is probably only the last which are able to produce pain when applied to the viscera, bones, and blood-vessels. The situation of the stimulus exciting pain may be at any part of the sensory apparatus, from the end-organ in the skin to the central ganglion; but the feeling of pain is always referred to the periphery of the sensory fibre, no matter what portion of the sensory tract has received the irritation. As regards pain, therefore, which is referred to some part of the interior of the body, it must be remembered that the cause (always some pathological agency) may be operating either upon the termination of a nerve, its trunk, or upon the nervous centre in the spinal cord or superior ganglia. There may be encroachments upon the structure of the nerve-fibre or ganglionic centre, arising from hyperæmia, effusion, or growth in neighbouring tissues.

Pathologically, pain is of at least twofold importance: 1. It causes distress and exhaustion of nervous energy, interferes with sleep, interrupts the appetite and digestion, so that the nutrition of the body is damaged, and thus, if long-continued, it can lead to changes shortening existence; or it may possibly be so severe as of itself to occasion death. 2. Its aid in diagnosis is frequently of higher value than that of any other single symptom.

Varieties and Diagnosis.—It may be useful to refer briefly to a few examples of the diagnostic importance of pain.

Pain in the head.—When of a continuous, dull, aching character, pain in the head may be due to rheumatism of the scalp, and this is especially likely if it be increased by bending the head down. A headache of similar character, and affecting the forehead, may be referred to, and be dependent on gastric derangement. Focussed in one spot, either on the head or face, and darting from that spot, if sharp and paroxysmal, it is likely to be neuralgic. If, in addition, it be accompanied by vomiting and giddiness, it may indicate megrim. Now, megrim, much more often than not, endures for a day only at a time, or a little more, to be repeated after an interval of days or weeks. If, therefore, these symptoms be continued beyond the period of a day or two, they should always be regarded with anxiety, as probably connected with brain-mischief. The use of the ophthalmoscope is most important here. If optic neuritis be discovered, the pain is dependent either on intracranial disease or upon Bright's disease. Should pain in the head be accompanied not only by vomiting and giddiness, but by squint, or some other evidence of a localised paralysis of a cranial nerve, it is almost certainly due to intracranial disease of a coarse kind—tumour, aneurysm, abscess, hæmorrhage, or meningitis. In cases of more or less complete hemiplegia from vascular changes and thrombosis, a varying amount of pain in the head will often remain after the apparent recovery of the patient. Whilst this persists, a guarded prognosis is essential, for much more often than not further mischief will follow before long. In all cases of persistent pain in the head, the urine should be carefully examined, not only for albumen, but also for sugar. Pain of a severe kind, especially apt to attack the back of the head, is often found in the course of Bright's disease. It will then be accompanied by albuminous urine; and the ophthalmoscope will very likely show albuminuric neuro-retinitis. There is also a form of more or less continuous headache, with occasional violent exacerbations, which accompanies glycosuria.

A recurrent pain in the head, of excessive violence, and described as a feeling as though the bones were being crushed, whilst it may occasionally be due to rheumatism, is far more often dependent upon syphilis. Generally speaking, persistent pain in the head, in a person unaccustomed to it, is a symptom which should always be regarded with anxiety, and the use of the test-tube and ophthalmoscope should never in such circumstances be omitted. This should especially be insisted upon if the patient be a female, and if certain concomitant symptoms incline the observer to believe the affection to be hysterical.

In obscure cases the possibility of the toxic influence of lead in causing pain in the head should not be forgotten.

The pain in the head which accompanies chlorosis is often fixed in one spot, and described by the patient as resembling a nail being driven into the head. This symptom not infrequently accompanies hysterical conditions. The pain in the head complained of by school children, as attacking them in their studies, is very often due to some abnormality of refraction, or weakness of certain muscles of the eye, which needs the help of an ophthalmologist to investigate. Pains in the head of a darting, shooting character, are sometimes associated with locomotor ataxy.

Pain in the neck.—This is not at all uncommon, and is due most commonly to rheumatism, probably affecting the large muscles. It is possible, too, that in many cases it depends upon irritation of the loose connective tissue which enables one muscle to glide over another, and which is really an expansion of the lymphatic system. Uric acid, or some equivalent, becoming deposited in this lymphatic space, will excite a little subacute inflammation, and produce a very acute pain. The diathesis of the patient should be inquired into, his urine and evacuations observed, and his mode of living investigated. There may be, too, sometimes pain in the neck from neuralgia. This will be distinguished by its paroxysmal character, and its being independent of muscular movement. Neuralgic pain in the neck is usually accompanied by pain in the district of one or other of the divisions of the brachial plexus in the arm. It must be remembered that pain in the neck may be the first indication of either caries or rheumatoid arthritis of the cervical vertebræ. It may also be associated with an eruption of herpes zoster.

Pain in the chest.—This may be referred to the chest-wall, or to the interior of the cavity. In the former case it is necessary to determine whether the pain be due to muscular rheumatism, syphilitic periostitis, intercostal neuralgia, or the encroachment of an aneurysm or a tumour. Absence of febrile action, as shown by the thermometer, and the entire dependence of the pain upon movement, point to the first of these causes. A node perceived by the finger upon the sternum, clavicle, or ribs, would indicate syphilitic periostitis. The character of the pain, and the presence of tender points, coupled very probably with a history of previous neuralgic attacks in some other part of the body, suggest intercostal neuralgia. Physical examination will detect or exclude aneurysmal tumour. Pleurisy causes a pain referred to the chest-wall, which, as it is particularly marked when the patient coughs, may be confounded with muscular rheumatism or intercostal neuralgia. The elevation of temperature by which pleurisy is accompanied, and the absence of local tenderness, will ordinarily distinguish it without difficulty, even before there are any auscultatory signs. Continued dull pain deep in the chest may indicate an intrathoracic growth, abscess, or aneurysm. Careful physical examination and observation are the means by which the diagnosis of these conditions can be made.

Pain is often experienced about the heart more or less early in the course of acute rheumatism. It may be dependent upon commencing peri- or endocarditis, which will be disclosed by the stethoscope. There is a dull, more or less constant pain about the heart, that occurs in conditions of nervous debility, and is not connected with organic disease of the organ. There is also a rather sharp pain just under the mamma, accompanied by cardiac palpitation, which is often complained of by epileptics, and by persons affected with hysteria. It is not accompanied by any evidence of organic change in the heart, and its origin is probably in the central nervous system. Pain in the heart, of an extremely sudden character, as though the muscle were being grasped, and accompanied by intense apprehension of death, with facial pallor and some dyspnœa, may point to angina pectoris. The pain is not confined to the heart, but extends to the left arm, and to various parts of the chest (*see* ANGINA PECTORIS). The pains in the chest which accompany various diseases of the lungs and pulmonary tubes will require to be investigated with reference to these conditions.

Pain in the spinal column.—Acute pain and superficial tenderness of any of the vertebral spines is a symptom, not of disease of the spinal cord, but of a peculiar state of nervous exhaustion. It is common in hysterical persons, and in others who have from any cause become greatly debilitated. As a rule, there is very little pain in the spine in diseases of the cord unattended by disease of the bony spine. In spinal meningitis the patient usually only complains of pain on movement, and especially if he endeavour to turn over in bed. Light pressure upon any part of the vertebral spines commonly causes no complaint; there may be, however, some uneasiness complained of when they are strongly percussed. Pain of an encircling kind, in a sort of band in the wall of the chest or abdomen, accompanied by what is often described as a 'bloated feeling,' is a serious symptom, and points to myelitis. There should be, however, some other confirmatory symptoms, ere this view is decisively fixed upon. In such a condition there would probably be found more or less weakness of the lower extremities, and possibly some cutaneous anæsthesia below the band of pain. It may happen that an aneurysm encroaches upon the spinal vertebræ, or a malignant growth invades some of them. In such conditions there is often constant and excessive pain, with, not uncommonly, a good deal of tenderness of the surface. The possibility of these conditions should always be borne in mind.

In commencing caries of the vertebræ a 'stinging' pain is often complained of in the chest-wall, and pain may also be complained of on pressing somewhat heavily upon a vertebral spine. In such a case, too, the act of stooping and lifting weights, or of jumping to the ground, is apt to cause complaint of pain in the spinal column.

Pain in the abdomen.—This may, like pain in the chest, be referred to either the abdominal wall or cavity. There may be inflammation and abscess in the abdominal wall. There may be neuralgia of the superficial branches of the lumbar plexus, in which case the pain is paroxysmal and sharp, and may be accompanied by herpes. But pain in this situation is more often myalgic, and will be found to correspond to the insertion of some abdominal muscle which is subject to overstrain or fatigue.

Acute abdominal pain referred to the contents of the belly may be dependent upon internal strangulation of the bowel, in which case it will be accompanied by vomiting, constipation, and probably by abdominal distension, with marked peristaltic writhings of the intestines. Or the cause may exist in a hernia which is strangulated. The symptoms in this case will be much like those above described, and therefore it is in all cases of acute abdominal pain with constipation absolutely necessary to make, first of all, a thorough examination, to ascertain that no hernial tumour is to be found. If pain in the abdomen be accompanied by tenderness on pressure, and be increased by coughing, there is probably peritonitis. In such a case the pulse will be found quick and small, and the temperature somewhat, but not necessarily much, raised. The patient will prefer to lie on the back with the knees bent; and the face will betray anxiety. In hysterical women great abdominal pain and tenderness is often complained of, and it is sometimes not very easy to distinguish this from peritonitis. It is best done by engaging the patient's attention, and noting that there is then no evidence of tenderness at a point which had been previously exceedingly painful. The pain and tenderness may be due to enteritis or perityphlitis, in which case there will be obstinate constipation, a tympanitic state of the whole intestine or the cæcum, and most probably vomiting. Cancerous tumours of various abdominal organs will have to be diagnosed by careful palpation, and discriminated from fæcal accumulation. Colic due to the poison of lead, causing violent abdominal pain without rise of temperature, requires to be distinguished from the symptoms which mark the passage of a biliary calculus. Extreme suddenness and severity characterise the latter, and there is usually more vomiting in the passing of a gall-stone than in colic. But the history will have to be investigated; and the evacuations, if any be passed, should be examined. The absence of a blue line on the gums should be ascertained ere the possibility of the existence of lead colic is abandoned.

Pain in the loins and back.—There are many conditions which give rise to pain in these situations, and which require to be borne in mind in examining a patient. Congestion of the kidneys, or nephritis, will be shown by the scanty, high-coloured urine, containing albumen and probably blood. Renal calculus will be attended by unilateral pain in the loin, following the direction of the ureter, and affecting the corresponding testicle. It is paroxysmal in character, and often horribly severe. The urine will be likely to contain blood, and possibly pus, and will be passed very frequently. As between such a condition and the presence of an abscess or morbid growth in the kidney, the points of diagnosis are not strongly marked, and careful observation will be requisite in order to form an opinion. The presence of a bad stricture in the urethra, by causing retention and over-distension of the bladder with urine, will cause pain referred not only to the hypogastric region, but also to the back.

Lumbago is characterised especially by inability of the patient to rise from his chair without the greatest distress, and only slowly and with difficulty. It may depend upon rheumatism of the muscles, or, still more probably, upon sub-acute inflammation of the connective tissue between the muscles. Or it may be neuralgic in character, in which case it will be acutely stabbing, paroxysmal, and independent of muscular movement.

Pain in the back is frequently caused by flatulent distension of the bowels, and by accumulation of retained fæces. It may be dependent upon a tumour connected with the bowel (especially likely in the sigmoid flexure and rectum), which may or may not be felt by external palpation, or reached by the observer's finger introduced *per anum*. Nor must it be forgotten that an abscess in the wall of the rectum will cause long-continued and severe pain in the back. It is well to remember that an undiscovered hernia (not strangulated) may give rise to little or no inconvenience except pain in the back. So likewise flexions and morbid growths of the uterus, and ulcerations about the cervix, may be the cause of pain, as well as the approach of the catamenial period, which in some women is the cause of great pain in the back.

Pains in the extremities.—These may be due to neuralgia, in which case they will be found to occupy the district of one or more branches of nerves, and to be paroxysmal in character. The pains which affect the extremities and the trunk, but especially the legs, in the early stage of locomotor ataxy, are peculiar in this. A patient who has little complaint to make of his health, will every now and then be kept awake all night, and incapacitated in the day, by sudden, sharp, lightning-like pains darting through one or more limbs, and often severe enough to make him call out. They will occur in paroxysms, lasting hours, days, or, less often, weeks; and will subside as suddenly as they began. With such symptoms the patellar tendon reflex should always be tested. Other pains affecting the extremities are rheumatic; or of the nature of the gnawing and aching pains which occupy the joints in acute inflammation from any cause, including rheumatism, and in arthritis deformans. The joints may also be the seat of pains of a neuralgic character.

A most important contribution to the diagnostic value of pain will be found in a paper by Dr. Head 'On Disturbances of Sensation with especial reference to the Pain of Visceral Disease' (*Brain*, parts i. and ii., 1893).

TREATMENT.—The treatment of pain is so involved in its causation, that but little can here be said with advantage on this point. It may be said generally, that pain ought, if possible, to be relieved, for its continuance is exhausting and mischievous to the nervous system. Rest is, as a rule, the first essential. Local applications, in the form of simple poultices, sinapisms, and counter-irritant or anodyne liniments, constitute the most ready means of relieving pain in many cases. Food of a suitable kind will often be the best means of relieving pain; and where the condition of the stomach prevents its being swallowed, it is frequently desirable to inject sustenance and alcoholic stimulants by enemata into the bowel. Constipation of the bowels, when accompanied by pain, should never (except perhaps in the case of lead colic) be treated by purgatives: belladonna, accompanied by minute doses of opium, is the best treatment. The drugs which have the greatest influence as anodynes are, doubtless, opium, cocaine hydrochlorate, and chloroform; but belladonna, Indian hemp, and various synthetically prepared carbon compounds, are often used with advantage. They all require to be employed with caution. A habit of increasing the dose of opium (even when it is employed in the form of morphine with the hypodermic syringe) is soon acquired. It is undesirable to allow patients to inject themselves. It is well, in all cases, to begin with a small dose, say gr. $\frac{1}{10}$ of acetate or sulphate of morphine—a dose which is stimulant and not narcotic. It is the narcotic dose which apparently is followed by a sort of recoil, suggesting the need for a repetition of the dose, and in larger quantity. *See* NEURALGIA.

T. BUZZARD.

PAINTER'S COLIC.—Synon.: *Colica Pictonum*; Lead Colic; Fr. *Colique des Peintres*; Ger. *Malerkolik*.—A form of intestinal colic, due to the presence of lead in the system; so called on account of the frequency of its occurrence amongst house-painters. *See* Colic, Intestinal; and Lead, Poisoning by.

PALATE, Diseases of.—The affections of the palate are mainly surgical, and therefore it is only necessary to offer some general remarks about them in this article, as those which are more strictly medical are sufficiently considered in other articles dealing with diseases involving the structures forming the mouth and throat, while paralysis of this part is dealt with separately. *See* Palate, Paralysis of.

The palate consists of two parts—namely, the hard palate, and the soft palate with its arches. This structure takes an important share in the performance of deglutition, as well as in articulation. It is liable to be affected by any of the morbid conditions which are met with in the throat, and assists in the production of the symptoms resulting therefrom. If the palate is inflamed or ulcerated, marked soreness or pain is likely to be felt when anything passes over its surface in the act of swallowing. As a rule it can be very readily inspected, and its condition thus made out. The points that demand more special notice with reference to the palate are—that it is not uncommonly the seat of more or less extensive congenital deficiencies, as in the different forms of cleft palate; and that it may be destroyed in various degrees during the progress of ulceration, in some instances a perforation remaining, in others the whole soft palate being removed, or even the hard palate being involved in the destruction. Consequently the two functions above referred to are often seriously impaired. During the act of deglutition, substances tend to pass into the nasal cavities through the posterior nares, especially liquids; while speech is markedly nasal or guttural, and indistinct, or in some cases almost unintelligible, it being impossible for the patient to articulate the words properly. In some cases the features are at the same time more or less distorted.

Treatment.—This must as a rule be directed to the particular disease which affects the palate in common with other adjacent structures. Should it be congenitally deficient, or destroyed by disease, surgical operations are often of the greatest service; or plates or other appliances of different kinds may have to be worn.

Frederick T. Roberts.

PALATE, Paralysis of. — The chief causes of paralysis of the palate are diphtheria (*see* Paralysis, Diphtheritic); degeneration of the nuclei of the medulla oblongata (*see* Labio-glosso-laryngeal Paralysis); growths in the basis cranii; and pressure on the nerves of the medulla. The first two causes usually lead to bilateral paralysis. Unilateral paralysis is commonly due to one of the last two causes. Disease of the trunk of the facial nerve is commonly regarded as an occasional cause of paralysis of the palate, but this is certainly an error; the chief nerve-supply to the palate is from the spinal accessory, as clinical observation and experiments alike have proved.

Symptoms. — In *bilateral* paralysis the palate hangs flaccid, and irritation of the mucous membrane excites no reflex movements. It is not raised in breathing or phonation: a convenient test is to make the patient utter the sound 'ah' in a high tone; the central palate should be raised by the levator. Deglutition is interfered with, the soft palate being no longer raised so as to shut off the posterior nares; and liquids are forced up into the nose by the contraction of the pharyngeal muscles. Speech is also affected: the resonance of the nasal chambers gives to it the 'twang' which only the *n* and *ng* sounds should possess. The explosive consonants cannot be well pronounced, because the open passage through the nose prevents the air being sufficiently compressed to give the sudden sound when the passage between the lips is open. Hence *p* and *b* become *f* and *v* respectively.

Unilateral paralysis of the palate causes little interference with deglutition. The chief muscles which raise the palate meet, it will be remembered, in the middle line of the soft palate, and for this reason one muscle is able to effect sufficient elevation of the whole palate to prevent the regurgitation of liquids. The voice may have a slight nasal twang, but the articulation of the labial explosives is not interfered with. When at rest, the paralysed half is usually a little lower than the other. The uvula is said to be oblique, inclined towards the opposite side. It is, however, sometimes straight in the middle line. A change in form when the azygos contracts may be expected, but is not always to be observed. The chief indication of the paralysis is the unequal movement, which is best recognised during the utterance of the sound 'ah.' The elevation of the middle part being confined to one side, the base of the uvula is drawn a little towards the non-paralysed side, and a dimple forms above the base of the uvula on that side only. By faradisation a difference in the contractility of the muscles may be recognised, but the special apparatus and difficulties of application render this test not one of general usefulness. Unilateral paralysis of the palate is often associated with that of the vocal cord on the same side, and often with paralysis and wasting of the same side of the tongue. This combination is met with especially when there is pressure on the nerves at the anterior part of the medulla. The paralysis of the tongue is, of course, due to disease of the roots of the hypoglossal; that of the vocal cord and palate to damage to the highest roots of the spinal accessory nerve.

Diagnosis.—The recognition of bilateral paralysis of the palate depends on its immobility on voluntary effort and reflex stimulation; that of unilateral paralysis on the inequality of movement in the utterance of certain sounds. Difficulty in diagnosis is due to the frequent inequality of the arches, and obliquity of the uvula. The latter is so common under normal conditions, that no weight can be attached to it as an indication of paralysis. The opinion that the palate is sometimes paralysed in facial paralysis rests apparently upon the uvula being found to be oblique, and observers have been strangely puzzled by the frequency with which the uvula deviates to, as well as from, the paralysed side, and have formed various ingenious theories to account for the relation; the deviation is, in reality, a 'natural abnormality,' and has no connexion with paralysis.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the palate are those of its causes. Locally the muscles may be galvanised by a long electrode, insulated except at its extremity, and furnished with a contact key, so that the circuit is not completed until the instrument is in position. The difficulty of applying electricity for any length of time lessens, however, its practical value as a means of treatment. Food that is semi-solid is usually swallowed better than liquids.

W. R. Gowers.

PALERMO, in Sicily.—Moist, warm, equable. No sudden atmospheric changes in winter; the mean temperature being 55° F. *See* Climate, Treatment of Disease by.

PALLIATIVE (*pallium*, a cover).—A term used in connexion with the treatment of disease, when it is directed merely to the relief or mitigation of symptoms. *See* Disease, Treatment of.

PALLOR (Lat.). Synon.: Fr. *Pâleur*; Ger. *Blässe*.

This term, which signifies whiteness or absence of colour, is generally applied in descriptive medicine and pathology in connexion with the state of the blood-supply of any part or organ. Pallor then denotes extreme deficiency of that healthy colour of the tissues which is referable to the presence of the red corpuscles in the capillaries; and indicates anæmia, whether due to contraction of the blood-vessels, diminution in the quantity of blood generally, reduction in the number of red-corpuscles, or relative deficiency of hæmoglobin in the individual corpuscles. In clinical medicine, pallor is most frequently associated with the visible portions of the surface, especially the face, the lips, and the conjunctivæ; or with parts which may be readily seen by special methods of examination, such as the tongue, fauces, larynx, mucous membrane of the nose, and fundus of the eye. *See* Anæmia.

J. Mitchell Bruce.

PALPATION (*palpo*, I handle gently). A method of physical examination, in which the hands are employed to appreciate certain conditions perceptible by the sense of touch. *See* Physical Examination.

PALPITATION (*palpito*, I beat or throb).—*See* Heart, Palpitation of.

PALSY.—A popular synonym for motor paralysis. *See* Paralysis.

PALSY, SHAKING.—A synonym for paralysis agitans. *See* Paralysis Agitans.

PALUDAL
PALUSTRAL } (*palus*, a marsh).—Of or belonging to a marsh. A term generally used in connexion with malarial or marsh fevers, on account of their frequent ætiological association with marshes. *See* Malaria.

PANCREAS, Diseases of.—Synon.: Fr. *Maladies du Pancréas*; Ger. *Krankheiten der Bauchspeicheldrüse*.

The pancreas is an organ of great importance in the animal economy, as it forms a secretion of essential value in the process of digestion, and probably has other functions. Nevertheless, owing to the comparative rarity of its diseases, their frequent association with other lesions when they do exist, the position and relations of the organ in the abdomen, and other causes, it must be acknowledged that there is no organ in the body which it is more difficult to recognise during life as the seat of disease, at least with anything like certainty. At the same time, it may be remarked that, if more attention were paid to the pancreas by the general body of medical practitioners, our knowledge concerning its morbid states would probably be increased, and we should have more definite and precise data upon which to form a diagnosis. Many seem to forget entirely that there is such an organ, and even when symptoms or signs point to it with sufficient clearness, at any rate as being the possible seat of mischief, they ignore it altogether, and it never seems to enter into their calculation. On the other hand, too much importance must not be attached to the pancreas, and it is especially necessary to guard against being led away by vague theories which attribute the origin of certain special diseases to functional disorders of this organ. During recent years more attention has been given to the morbid anatomy and histology of the pancreas, as well as to its symptomatology, while it has been submitted to some remarkable investigations by experimental physiologists and pathologists. Hence our knowledge concerning this organ has made decided progress, and we may confidently anticipate even more definite results in the future.

Pathological Relations and Symptomatology.—Before considering the diseases of the pancreas individually, it will be expedient to discuss generally the clinical phenomena which may arise when this organ is involved, and this will give the opportunity of referring to certain important pathological relations which it presents. The most striking of the symptoms are due, not only to the implication of the pancreas itself, but also to its effects upon other structures with which it is anatomically so closely related; to their being involved in the morbid condition; or to the intimate relation existing between its vessels and nerves, and those of other organs.

1. **Subjective Sensations.**—Subjective sensations cannot be said, as a rule, to be of much value in the diagnosis of pancreatic affections. They are often absent, even when there is grave disease; and when present are in many cases of a very indefinite character. As regards their site, the localisation of morbid sensations deep in the epigastrium, in the region of the pancreas, would be suggestive of this organ. With respect to their nature and causation, it may, in rare instances, happen that pain is felt in the pancreas itself; or there may be merely an ill-defined sense of uneasiness and discomfort, or of weight and oppression. Deep pressure may then bring out more pain or oppression, or these feelings may only be experienced when such pressure is made. More commonly, however, pancreatic disease gives rise to subjective sensations by its effects on surrounding structures. It may probably cause pain and a more superficial tenderness than usual, by irritating the overlying peritoneum. When the organ is enlarged and heavy, it may produce a sensation of stretching and dragging, amounting occasionally to actual pain, and possibly under these circumstances different postures might influence the sensation, which may be chiefly felt in the erect position. The most important pain, however, connected with pancreatic disease, is that due to implication of the solar plexus and its ganglia, of which the writer has met with striking examples. Sometimes acute inflammation occurs, when the pain is of a severe, and may be of a violent, character; or more commonly the nerves are merely irritated, and this is attended with paroxysms of severe pain shooting in various directions, which may amount to extreme agony. In either case there is a feeling of great oppression, restlessness, and anxiety, with a tendency to faintness, or actual syncope or collapse may take place. The suffering may be very obvious in the appearance of the patient. In one case, observed by the writer, the pain was greatly relieved by pressure. It might be supposed that a paroxysmal pain would be associated with the passage of pancreatic calculi, but of its occurrence there is no adequate proof. It might possibly happen that a continuous dull pain arises from erosion of the spine, as the result of pancreatic disease.

2. **Disorders of Secretion.**—Without entering into any discussion, it may be affirmed that the pancreatic secretion is now generally regarded as of most importance in 'duodenal digestion,' and that it acts upon proteid elements and albumoses, as well as upon starches and fats, the last-mentioned being chiefly emulsionised, and to a slight degree saponified (Allchin). Hence it might be anticipated that obvious and definite consequences would arise from any disorder of this secretion, whether affecting the quantity which is formed or which reaches the intestine, or the quality and composition of the fluid. Such consequences have been attributed to pancreatic functional disorder or organic disease, and these may now be briefly discussed.

To *hyper-secretion* of pancreatic juice has been attributed a variety of pyrosis, and also of diarrhœa, with the discharge of a slimy and viscid fluid, but the writer has never met with any case bearing out such an idea.

A *deficiency* or *absence* of pancreatic secretion from the intestinal canal, or an *abnormal quality* of this secretion, may be attended with phenomena of a more reliable character, although here again caution is needed. It is not unlikely that these disorders may assist in originating symptoms indicating deranged intestinal digestion, especially flatulence, and also diarrhœa or constipation; but for a discussion of this subject the reader is referred to the interesting *Bradshaw Lecture* for 1891 on 'Duodenal Indigestion,' by Dr. Allchin. More important and definite phenomena have, however, been referred to this cause, and these demand fuller consideration. One of the most striking is the presence of a quantity of free fat or oily matter in the stools, or of certain fatty compounds. This symptom has been regarded under certain circumstances as pathognomonic of pancreatic disease. It has been found in a considerable number of cases, and experimental investigations lend support to the importance of the phenomenon. On the other hand, it has been chiefly, though not exclusively, noticed where the entrance of bile into the intestine was at the same time interfered with, and sometimes when this condition alone was present, the pancreas being healthy; while it certainly is not always observed even in grave organic disease of the pancreas, as the writer can testify. The amount of the fat has varied much in different cases, as also have its characters. It has come away like oil, with scarcely any fæcal matter; or, after standing, oil has floated on the surface of liquid fæces, or of water. In other instances the stools have been greasy, or lumps of fat have been discharged, white or pale yellow and tallow-like, and the evacuations have even consisted almost entirely of these lumps. In other cases, again, it has been more or less crystalline, consisting of compounds of fatty acids with sodium, calcium, or magnesium; or an oily fluid was discharged, which condensed on cooling, either around the containing vessel, or on the surface of the fæces. It has been observed occasionally that the fat was far greater in quantity than had been taken as food; this has been accounted for by the absorption of fat from the general system, in connexion with wasting, and its escape into the intestinal canal. Another condition of the stools attributed to want of pancreatic secretion is the presence of an abundance of undigested muscular tissue in them; but it is obvious that this can in no respect be regarded as a reliable sign. Possibly an excessive discharge of peptones in the stools may be due to this cause.

The significance of colourless or clay-coloured stools in relation to pancreatic disease is an important question which has been especially brought forward by Dr. T. J. Walker of Peterborough (*Med.-Chir. Trans.* vol. lxxii. p. 257). In two cases under his observation, copious loose stools were persistently passed, colourless, and of a peculiar putrid odour. There was no jaundice, and *post-mortem* examination revealed that the pancreatic duct was obstructed, while the bile-duct was quite pervious. Arguing from these cases, as well as from other data, Dr. Walker arrives at the following conclusions:—

First: That the formation of the colouring matter of the fæces (hydrobilirubin?) depends on the *mutual reaction of the bile and pancreatic fluid, under the influences met with in the intestinal tract.*

Secondly: That in disease a deficiency of pancreatic juice will, equally with a deficiency of bile, cause the pathological condition of colourless or clay-coloured stools—that is, stools destitute of hydrobilirubin.

Thirdly: Since that portion only of the coloured constituents of the bile which has been converted into hydrobilirubin is excreted in the fæces, while the bilirubin, bilifuscin, and biliverdin not so converted are absorbed, it follows that if hydrobilirubin cannot be produced without the aid of the pancreas, that organ must have an important *rôle* in regulating what proportion of the bile secreted by the liver shall be absorbed in the intestine, and what shall be thrown off in the fæces.

If these conclusions are correct, they have an important practical bearing in different directions. In the present connexion, however, they need only be noticed in relation to the diagnosis of pancreatic disease. Dr. Walker maintains that the passage of colourless stools as a permanent symptom, while every other indication of disordered liver is wanting, is evidence of such disease, and is a valuable aid in diagnosis.

It will not be out of place to refer here to the proved value of the pancreas itself, or of preparations made from it and containing the active principles of its secretion, in aiding digestion in many cases, or in digesting certain foods before administering them, especially according to the plan so admirably worked out by Sir William Roberts (*see* PEPTONISED FOOD). This may possibly help in the diagnosis of pancreatic disease, for it has been suggested that if, with the daily administration of calf's pancreas, the conditions of the stools above described disappear, additional evidence is afforded of the existence of such disease.

3. **Symptoms from Physical Effects.** The intimate relations of the pancreas to important structures in its vicinity give rise to some of the most striking objective symptoms associated with its diseases. Of these, one of the chief is permanent jaundice, which often becomes extreme, due to closure of the bile-duct. In the writer's opinion this symptom becomes under certain circumstances a most important evidence of pancreatic disease. The pylorus or duodenum is also very liable to be obstructed, thus leading to chronic vomiting, often obstinate, with signs of dilatation of the stomach; by pressure on the body of this organ pancreatic disease has been known gravely to disturb its functions, and even to obstruct its cavity; or it has ulcerated through its walls, and given rise to gastric perforation and hæmatemesis. The vessels in relation to the pancreas are also important, as being liable to be obstructed, and thus to give rise to symptoms. The veins are especially to be remembered, namely, the portal, superior and inferior mesenteric, and splenic, which may be pressed upon or closed by thrombosis. Hence may arise ascites, intestinal hæmorrhage, enlarged spleen, and other phenomena, although in the writer's experience they have been absent. The vena cava inferior or the aorta may also be more or less compressed, and in the latter case a pulsation or even a murmur may be transmitted through the pancreas, simulating an aneurysm; indeed, this lesion has been actually caused by the compression of the aorta by an enlarged pancreas; while, on the other hand, aneurysm may cause pancreatic cirrhosis by pressure. By the extension of pancreatic disease, other structures at a more or less remote distance may be interfered with;

thus, the ascending colon has been obstructed, and also the ureter, leading to hydronephrosis.

4. **General Symptoms.**—It is an indisputable fact that pancreatic disease is not uncommonly attended with marked general symptoms, in the direction of wasting, which may reach extreme emaciation, with proportionate debility, and anæmia. In experimental investigations upon animals, complete removal or destruction of the pancreas has been followed by rapid loss of flesh and great muscular weakness, in spite of their being well-fed. What the actual cause of these symptoms may be is a matter of doubt and discussion. They do not depend merely on the want of pancreatic juice, provided other secretions are in sufficient quantity, for both fats and proteids can be digested and absorbed without its aid, while deficiency of diastatic ferment can be made up for by free administration of saccharine foods, which, however, do not prevent the wasting. Dr. Vaughan Harley, in a paper on 'The Pathogenesis of Pancreatic Diabetes' (*Brit. Med. Journ.*, Aug. 27, 1892), attributes the symptoms to 'non-assimilation, consequent upon a form of auto-intoxication arising from the substances normally secreted by the pancreas being retained in the organism, and there forming leucomaïnes, whose toxic effects lead to tissue-waste and muscular weakness.' From a clinical point of view, it must not be forgotten that in cases of pancreatic disease attended with general symptoms there are usually other causes which assist in their production, such as absence of bile from the intestine as well as of pancreatic juice, the nature of the disease itself, interference with the passage of food through the pylorus or along the duodenum, the implication of other structures besides the pancreas, or the presence of severe pain, causing much constitutional disturbance. Patients suffering from grave pancreatic disease are often very low-spirited and despondent.

5. **Changes in the Urine.**—In exceptional cases of pancreatic disease it is affirmed that fat has appeared in the urine as well as in the stools, either in the form of oil-globules, or of a greasy substance, becoming like butter on cooling. This was supposed to be due to the absorption of fat in the process of wasting. Far more important is the fact that various morbid conditions of the pancreas have been found associated with glycosuria or actual diabetes. These conditions include acute abscess, hæmorrhagic pancreatitis, chronic cirrhotic changes, atrophy, fatty degeneration, obstruction of the pancreatic duct by calculi, cancer, and cystic disease. The results of experimental investigations on the relations between pancreatic disturbance and glycosuria are also highly important. The experiments of Von Mering and Minkowski, as well as those of Vaughan Harley and others, have revealed the following facts: Complete removal or destruction of the pancreas in dogs, cats, rabbits, and pigs, is followed by diabetes of a severe form. As soon as the animals recover from the immediate effects of the operation, they suffer from polyphagia, polydipsia, polyuria, and glycosuria, as well as an increased secretion of nitrogen in the urine. As already stated, they rapidly lose flesh, and suffer from great muscular feebleness. They often pass into a state of collapse or coma shortly before death. The urine at this time frequently contains acetone, diacetic acid, and β-oxybutyric acid. In some cases there are remissions in the severity of the glycosuria, and when the emaciation is very advanced, or complications (such as peritonitis) arise, the sugar may be entirely absent. In other cases it entirely disappears shortly before death. Partial extirpation of the pancreas is not followed by glycosuria, even when less than one-eighth of the entire gland is left. Nor does it occur after ligature of the pancreatic duct, or injection of this duct with irritants, at least until atrophy or cirrhosis of the gland occurs. These operations are followed by azoturia, polyuria, and wasting. Diabetes occurs after complete ligature of the blood and lymph vessels connected with the pancreas. These conclusions have been gathered mainly from the paper by Dr. Harley, already alluded to.

Notwithstanding the facts just stated, the connexion between pancreatic disease and diabetes mellitus or glycosuria is by no means universally acknowledged, and different views are held to explain the phenomena observed. The subject was discussed at the Royal Medico-Chirurgical Society in January 1892, on the occasion of a paper read by the late Dr. Tylden, who maintained that the glycosuria was the result of some lesion incidental to the operation for removal of the pancreas; and that there was no relation between diabetes mellitus and a cirrhotic pancreas. Implication of the solar and cœliac plexuses and semilunar ganglia is believed by some to account for the phenomena, and other hypotheses have been advanced. As to the immediate cause of glycosuria in relation to the pancreas, those who recognise this relation also entertain different views. Heyden suggests that there is an increased formation of sugar, due to an increased wasting of the tissue proteids. Lepine and Barral consider that pancreatic diabetes is due to a want of a glycolytic ferment, which, in the normal state, is continually being formed by the pancreas, and poured along with the lymph-stream into the general circulation, there to destroy the sugar. This is the view favoured by Dr. Harley.

6. Physical Signs.—It is only in very rare instances that physical examination can detect the pancreas in health, and most of its diseases do not alter the organ in such a manner as to render such examination of any value in diagnosis. Moreover, even more or less marked physical changes are often difficult of detection, owing to the situation of the pancreas, and to distension of the stomach, or pushing forward of the liver. It may be affirmed that palpation or manipulation is really the only reliable and practicable mode of examination in the investigation of pancreatic diseases, and it must be carried out when the stomach and transverse colon are empty, and the abdominal muscles thoroughly relaxed. In some cases help may be derived from placing the patient on his elbows and knees; and pressure should not merely be made deeply from before backwards, but with both hands laterally from the hypochondriac regions. It may be possible to detect a general enlargement of the pancreas, as a slightly movable swelling, lying across the abdomen in its usual position; but the important condition to be specially looked for is a tumour of the head of the organ, which is deeply situated, always of small dimensions, rounded, smooth or nodular, usually very firm or hard, and firmly fixed, as if it were rooted in the depths of the abdominal cavity. Even if such a condition were found, however, it would be difficult to associate it distinctly with the pancreas alone, but for all practical purposes it would be sufficient for diagnosis. A pancreatic cyst may occasionally be detected by physical examination. The possibility of an enlarged pancreas being the means of communicating a pulsation or murmur from the abdominal aorta has been previously alluded to.

Special Diseases.—Before proceeding to the study of the individual diseases of the pancreas, the reader must make himself acquainted with the foregoing general discussion, and apply the information there given, as it is impossible to attach a definite and precise clinical description to each disease. It is highly probable that there are *functional disorders* of this organ, but they cannot be made out by any positive data. The organic lesions usually recognised may be considered according to the following plan:—

1. Acute Inflammation.—Acute Pancreatitis.—This disease has come more under notice during the last few years, and several cases have been recorded, a number of which were brought together in 1889 by Dr. Fitz, in the New York *Medical Record*. It occurs under different forms, which may be termed respectively *simple*, *hæmorrhagic*, *suppurative*, and *gangrenous*.

Ætiology.—Acute pancreatitis has been attributed to injury over the epigastrium, to abuse of alcohol, and other causes. In a pamphlet recently published, Mr. E. F. Garden has advanced the view that so-called 'influenza' is really 'epidemic pancreatitis.' As regards the hæmorrhagic form, most of the cases have occurred in persons over thirty years of age; and many of the patients had suffered from previous attacks of indigestion, occasionally with severe pain and vomiting. As a secondary affection, acute pancreatitis has been met with in typhoid fever, suppuration having exceptionally taken place in the later stages of this disease; acute tuberculosis; pyæmia and septicæmia; and other febrile conditions. Suppurative inflammation occurs mostly in adults under forty years of age.

Anatomical Characters.—In the simpler and milder forms of acute pancreatitis, the organ becomes injected and hyperæmic, swollen, and abnormally firm; and after these changes it may probably return to its normal condition. Parenchymatous degeneration may be observed in connexion with febrile diseases, the gland becoming filled with granular material, of an albuminoid nature. *Hæmorrhagic* pancreatitis may be associated with previous changes, of the nature of fibrosis, degeneration of the gland-cells, or 'fat-necrosis.' In this variety the pancreas is enlarged, and the interstitial tissue is infiltrated with blood, sometimes with clots. In some cases the neighbouring structures are also hæmorrhagic, and the whole may form a firm mass of considerable size, occupying the upper and posterior portion of the abdominal cavity. The root of the mesentery, the mesocolon, and the omentum may also exhibit hæmorrhages. These structures, as well as the abdominal fat, sometimes present areas of 'fat-necrosis.' *Suppurative* pancreatitis is characterised either by diffuse suppuration, with the formation of small abscesses; or by one or more large purulent collections, the pancreas occasionally being converted into an irregular cyst, filled with creamy pus. An abscess may burst into the duodenum, or into the peritoneal cavity. *Gangrenous* pancreatitis may follow or be associated with the hæmorrhagic form. The organ may be converted into a dark, or slate-coloured, sloughy, fœtid mass; or it lies nearly free in the omental cavity, attached only by a few shreds of fibrous tissue; or it has actually separated, and been discharged through the bowel. Acute peritonitis is often present in the more severe forms of pancreatitis. The solar plexus is likely to be involved, and the semilunar ganglia may exhibit definite changes, being swollen, with the nerve-cells indistinct, and an interstitial infiltration of round cells (Osler).

Symptoms and Diagnosis.—It will be readily understood that acute pancreatitis may be unattended with any definite or characteristic symptoms. In its less severe forms, deep-seated epigastric pain and tenderness, with gastric disturbance, and some degree of pyrexia, might lead to a suspicion of its presence. These symptoms may afterwards subside, or go on to more pronounced phenomena. The clinical description given by Mr. Garden of the supposed epidemic pancreatitis is that of influenza.

Acute hæmorrhagic pancreatitis sets in with a more or less sudden, violent, or even agonising pain, usually in the epigastrium, but sometimes more general over the abdomen. There is much tenderness, with muscular tension, preventing examination. Nausea and vomiting are usually prominent symptoms, with thirst, constipation as a rule, and frequently tympanites. Fever may or may not be present. Other phenomena which have been noted are great restlessness, prostration, hurried breathing, weak and rapid pulse, a tendency to syncope, and early delirium in some cases. The condition rapidly becomes more and more grave, signs of collapse supervene, and the termination is almost always fatal, death usually occurring from the second to the fourth day. A case of recovery is reported by Osler. The grave symptoms in this form of pancreatitis are attributed to the implication of the solar plexus and semilunar ganglia.

Suppurative inflammation of the pancreas has a very indefinite clinical history, and can rarely be recognised. It may start with epigastric pain, tenderness—which may be sharply limited to the site of the pancreas, vomiting, and sometimes prostration. There is irregular fever. Objective signs of abscess are very rare. Death may occur in three or four weeks; or the disease sometimes becomes chronic, with slight or occasional pyrexia. In *gangrenous* pancreatitis death generally occurs in from ten to twenty days, preceded by collapse; but recovery has taken place in exceptional instances, after discharge of the slough by the bowel. Glycosuria may be associated with acute pancreatitis. Distinct signs of peritonitis may supervene during its course.

With regard to *diagnosis*, obviously this must be always very difficult and uncertain. The chief conditions for which acute pancreatitis may be mistaken are acute affections associated with the stomach, liver, and gall-ducts; and, in the graver forms, intestinal obstruction, or certain varieties of perforation, especially that due to gastric ulcer or gall-stones, followed by peritonitis.

Treatment.—But little can be definitely said on this matter. The most obvious indications are to keep the patient at rest; to give only small quantities of liquid food; to relieve the pain and gastric symptoms by means of ice, effervescents, with hydrocyanic acid, opium, or morphine, and similar remedies; to open the bowels; and to give stimulants for the support of the patient, when these are called for. Ice, or, on the other hand, fomentations or poultices, might be applied with advantage over the epigastrium in different cases; and it has been recommended to put on a few leeches. Peritonitis must be treated on the usual principles, if it should be set up.

2. **Chronic Diseases.**—It will be most convenient to indicate, in the first place, the nature and origin of the several chronic diseases of the pancreas; and then to discuss as a whole their clinical characters and relations, and their treatment.

(*a*) *Changes affecting circulation.*—Under this head it will only be necessary to mention that, in cases of general anæmia, the pancreas suffers along with other organs; that in all conditions which impede the portal circulation, whether in connexion with the portal trunk, the liver, or the heart or lungs, this organ becomes the seat of mechanical venous congestion and its consequences; and amongst the latter hæmorrhage is to be noted, which occurs in separate points, the blood subsequently undergoing the usual changes, and its sites being indicated by altered pigment, or by spaces containing coloured serum and having pigmented walls.

(*b*) *Changes in growth.*—Many cases of either general or partial *hypertrophy* of the pancreas have been described; but it is very doubtful whether there is a true hypertrophy of the glandular elements, the increase in size and weight of the organ in these cases being probably due to an increase in the interstitial tissue. *Atrophy* is an undoubted morbid condition to which the pancreas is liable. It has been observed as the result of old age; in cases of general wasting from various causes; in connexion with diabetes, where it may become extreme; or from certain local causes, namely, pressure upon the gland-tissue by morbid conditions in its vicinity, or by diseases within the organ itself, or obstruction of its duct. The degree of wasting varies; but it may be so considerable that nothing is left except a fibrous cord indicating the former site of the pancreas. In lesser degrees the change is often associated with more or less fatty degeneration.

(*c*) *Chronic inflammation. — Chronic pancreatitis.—Cirrhosis of the pancreas.*—That the pancreas is subject to a chronic inflammatory process cannot be doubted, but it is by no means clear what should be included under this term. The condition usually recognised, and which is most common, is that in which the organ becomes more or less *cirrhotic* or *fibroid*, either throughout its whole extent, or in some portions of its substance: the head is very liable to be thus affected. The changes essentially consist in an increase of the interstitial connective tissue, with wasting of the glandular structures; and the organ becomes proportionately indurated, dense, firm, and tough, and may be granular or irregular. Distinct tracts of connective tissue may be visible. Various degrees of the cirrhotic pancreas may result from prolonged venous congestion; chronic alcoholism, especially indulgence in strong spirits; retention of the pancreatic secretion, with dilatation of the ducts; the irritation of morbid growths, especially cancerous or syphilitic; or neighbouring disease, which affects the pancreas either by direct extension, or by causing pressure or irritation. In some of these cases a chronic parenchymatous inflammation seems also to be going on. Dr. Tylden recognised at least two forms of cirrhosis in the pancreas, as the result of microscopical examination—the one coarse and interlobular, often seen in very wasted pancreases, the other fine and intercellular in pancreases not necessarily wasted. The latter form he found chiefly in patients who were the subjects of chronic granular kidney, and he suggested that the pancreatic change might throw light upon some of the symptoms of this disease in some cases, such as polyuria and wasting.

Very rarely the pancreas becomes the seat of chronic *suppurative inflammation*, either by extension from parts around, or from conditions in the organ itself, such as the presence of calculi, or the formation of cysts. As a rule, however, this condition is the remnant of an acute purulent formation. The pus either infiltrates or collects in one or more abscesses, and the latter may burst into the abdominal cavity or other parts, or dry up and become calcareous. Caseous masses may form in the pancreas, associated with similar products elsewhere, in cases of scrofulous or tubercular disease.

(*d*) *Degenerations.*—The pancreas is liable to the usual two forms of fatty change, namely, a *fatty hypertrophy* or *infiltration*, associated with obesity, which, though affecting the interstitial tissue, may eventually cause complete wasting of the glandular structure by pressure; and *fatty degeneration*, which affects the gland-cells themselves; or the two conditions may be associated. In simple fatty degeneration the organ becomes gradually smaller, softened, and flaccid; pale or whitish-yellow or brownish; but its acini are distinct. A fatty emulsion may form in the ducts. The products of degeneration are absorbed or discharged, and coincident atrophy takes place, so that at last the organ may entirely disappear. This degeneration has been noticed as the result of alcoholism, in wasting diseases, and in cases of diabetes. The pancreas may become almost entirely converted into a mass of fat, after obstruction of its duct by a calculus. In the condition termed 'fat-necrosis,' previously alluded to in relation with acute pancreatitis, areas of dead-white, opaque, necrotic tissue are seen about the lobules of the organ.

Amyloid disease may affect the pancreas, but it cannot be said to be of any practical consequence.

(*e*) *Morbid growths.*—Cancer is one of the most important diseases affecting the pancreas. The growth is usually of the schirroid type, rarely of an encephaloid, a melanotic, or a colloid nature. In most cases it is secondary, the organ being usually involved by extension from neighbouring structures, or now and then a distinct growth being formed; but it also occurs as a primary affection, although very rarely. When primary, it appears usually to start in the epithelium of the pancreatic duct. Pancreatic cancer is decidedly more frequent in males than females; and it is rare under forty years of age. The writer has, however, known it to occur in a young man twenty-three years old. Primary cancer has been attributed to injury over the epigastrium. As a rule, the head is first implicated, rarely the body or tail; often the disease remains confined to the head, but in other instances it spreads, so as finally to involve the entire organ, or separate deposits form. When the morbid condition is confined to the head, it presents a more or less rounded tumour, varying in size, but never attaining large dimensions; somewhat irregular or nodular; usually very dense and hard in consistence; and whitish on section. If the entire gland be affected, similar appearances are evident throughout its whole extent; but if not, the unaffected portion may be the seat of atrophy, chronic inflammation, or dilatation of the ducts, with the formation of calculi. Distinct small tumours are found in some instances. Usually the growth exhibits under the microscope a large amount of fibrous stroma. Often the structure is that of a cylindroma or duct-cancer, but sometimes it is of the ordinary glandiform type (Fagge and Pye-Smith).

Pancreatic cancer always affects, in some way or other, neighbouring structures. It may simply press upon them; or it causes irritation, and thus sets up chronic inflammation, becoming adherent to various parts; or the cancer may spread; or destruction and ulceration take place, involving the duodenum, stomach, vessels, peritoneum, diaphragm, vertebræ, or other structures; but not uncommonly the parts are found so matted together at the *post-mortem* examination, that it is impossible to separate them, or to say where the disease began. Obstruction of the bile-duct, which is a frequent event in pancreatic cancer, seems to be due, not so much to pressure as to contraction at the orifice or along the course of the duct, the result of chronic inflammation.

As rare morbid growths found in the pancreas, it will suffice to mention lymphoma or lymphosarcoma; tubercle, though it has been affirmed by some that this is never found in the organ; and syphilitic formations, which may be of the nature of gummata, or of a cicatricial tissue, involving the gland generally or locally.

(*f*) *Obstruction and dilatation of the duct.—Pancreatic cysts.*—The main duct of the pancreas—canal of Wirsung—may be obstructed at or near its orifice; or some of its divisions may be thus affected. The former depends either upon conditions outside the gland, causing pressure, or closing the opening, such as tumours in the vicinity, enlarged glands, a large gall-stone in the bile-duct, or thickening and adhesion due to inflammation; or upon conditions in the gland or duct itself, namely, malformations causing a bending of the duct, calculi, new-growths, cicatricial contraction, or possibly catarrh of the duct. One or other of these conditions also accounts for any localised obstruction. The obstruction will lead to retention of the secretion, with dilatation of the main duct and all its branches, either uniform or unequal, or of limited portions of these, according to the seat of the impediment; and ultimately one or several cysts usually become developed. In the early stage the contents resemble more or less the ordinary pancreatic secretion, but subsequently they become either serous, purulent, hæmorrhagic, caseous, or cretaceous. The walls of the cysts become thickened and indurated, and, by encroaching upon the substance of the pancreas, at the same time setting up a chronic interstitial inflammation, they may ultimately cause complete destruction of the organ. Sometimes it becomes converted into a mass of fat, as the result of the lodgment of a calculus in the main duct.

Pancreatic cysts demand more particular notice, as during the last few years several cases have been reported, in which a cyst of this nature has attained a large size, and has been diagnosed and treated with success. Attention was drawn to the subject by Professor Senn in 1886-87, and an interesting paper was read by Dr. Newton Pitt and Mr. Jacobson before the Royal Medical and Chirurgical Society in 1891, in connexion with a case under their observation (*Med.-Chir. Trans.*, vol. lxxiv.) As to the origin and causation of these large pancreatic cysts, there is often a definite history of local injury, such as a kick, which is supposed to produce some laceration and extravasation of blood. With the latter is mixed the constantly increasing fluid from a torn duct. This probably becomes irritating, and thus excites the formation of a capsule about it (Cathcart). Another theory is that the cysts originate in some digestive or corrosive action of the pancreatic juice upon the tissue of a previously diseased pancreas. A cystic pouch is thus formed, into which hæmorrhage easily takes place, either from a vessel in the wall of the cyst, or from one lying in an intracystic partition which has given way (Gussenbauer and Salzer) They have again been attributed to extension of inflammation along the pancreatic duct to the gland, leading to contraction of the duct-wall and accumulation of secretion.

A pancreatic cyst may attain considerable dimensions, and its walls may become more or less thick and firm. The fluid it contains is of sp. gr. 1010 to 1020; usually turbid, and greenish or brownish in colour, but occasionally clear and limpid, or opalescent and white; and alkaline. It contains from 1·5 to 3 per cent. of albumen, usually, if not always, mucin and a sugar-ferment, and in some cases tyrosin, blood-pigment, and a trace of urea. It is free from succinic acid, which may be present in hydatid fluid. It may emulsify fats; and often contains but a small amount of cell-products. Hæmorrhage is very likely to take place into a pancreatic cyst; and Senn has suggested that such a cyst may be due to parenchymatous hæmorrhage, followed by hæmorrhage from the cyst-wall; or to dilatation of one of the vessels of the pancreas. In rare instances a pancreatic cyst has been known to rupture into the stomach or duodenum.

(*g*) *Calculi and parasites.*—Calculi occasionally form in connexion with the pancreas, either in its main duct or, less frequently, in the branches, or in both situations. There may be but one, or a large number. They may be very minute, or attain the size of a nut or walnut, or even larger dimensions. The concretions are usually white or greyish-white, occasionally dark or blackish, round or oval in shape, rarely irregular or branched, and smooth or rough on the surface. As a rule, they consist mainly of calcic carbonate or phosphate, or of both salts; very rarely of solidified protein substances. They originate from the pancreatic juice, the inorganic constituents of which are precipitated, usually owing to its retention; but it is supposed that the products of catarrh of the ducts, or an abnormal composition of the secretion, may also be the primary cause of the precipitation which leads to the formation of pancreatic calculi. Their effects have been already pointed out in the description of the preceding diseases, and it will suffice to mention that the principal conditions they are liable to produce are dilatation of the ducts and the formation of cysts; inflammation leading to abscesses; chronic interstitial inflammation and its consequences; or inflammation in the structures around. They probably escape in some instances through the canal of Wirsung.

As regards parasites, it will be enough to state that round-worms occasionally find their way into the pancreatic duct.

Clinical History and Symptoms.—It will be easily understood that most of the cases of chronic disease of the pancreas are unattended with any symptoms drawing attention to this organ, or at least with such as are at all characteristic; while a large number present no symptoms whatever, being latent from first to last, the lesion being only discovered at the *post-mortem* examination. Moreover, in the case of the affections which might be expected to originate prominent symptoms, they are so often associated with morbid conditions of one or more of the other organs concerned in the digestive process, or of other structures, that it frequently becomes most difficult or impossible to assign to each its actual share in the production of the phenomena observed. Under any circumstances, several of the chronic pancreatic diseases which have been described can only lead to more or less derangement affecting the formation or escape of the secretion, and all of them tend to produce this result, so that symptoms might be expected to arise from this cause; but those which are regarded as at all significant are only present in comparatively few instances, even of those pancreatic lesions which are of a grave nature.

In addition to what has just been stated, it will only be necessary further briefly to allude to certain points in the symptomatology of those pancreatic affections, in connexion with which more evident clinical phenomena might be anticipated; the explanation of the symptoms has already been sufficiently discussed.

Chronic cirrhosis of the pancreas may be attended with deep-seated epigastric pain and tenderness, constant or increased paroxysmally. It certainly tends to be complicated with symptoms associated with neighbouring structures, such as jaundice, ascites, or signs of obstruction of the pylorus or duodenum; and glycosuria or diabetes might possibly supervene. It very rarely happens that the enlarged pancreas, or its head, can be detected on physical examination. More or less general wasting may be present.

Cancer is clinically by far the most important disease of the pancreas, and the one most likely to give rise to symptoms of a definite character, though even here there is often much uncertainty. Deep-seated epigastric pain is a very frequent symptom at some period or other in the course of a case, and it has been rightly regarded as of much importance; but it must be remembered that it may be absent from first to last, or may only come on late in the progress of the disease. This pain, when present, is also characterised by its intensity, and the difficulty experienced in relieving it. It is usually more or less constant, and of an aching or gnawing character, or lancinating, shooting across the epigastrium, especially towards the right, or backwards towards the shoulder, or all over the abdomen. Sometimes a sensation of burning, or of tightness and dragging, is described. An important feature often observed in connexion with this pain is that it tends to become greatly aggravated in paroxysms, of which the writer has seen some striking examples, where the attacks were most agonising and almost unbearable. It may be influenced by food, coughing, deep breathing, movement, or posture. It is in some instances decidedly worse in the erect and supine postures; and during the paroxysms the patient may bend forward, and press upon the epigastrium, in order to obtain relief. Gastric symptoms are usually prominent in cases of pancreatic cancer, especially nausea and vomiting, and eructations; much importance has been attached by some writers to the occurrence of an abundant watery pyrosis. The tongue frequently continues clean and moist throughout. The bowels are constipated, and fatty stools may be observed; but they are by no means constant. Thirst is sometimes a marked symptom. Jaundice and other phenomena indicative of interference with neighbouring structures are of common occurrence, and persistent jaundice may be the most prominent symptom in cases of cancer of the pancreas. Physical examination is of essential importance in the detection of this disease, and it should be made again and again in doubtful cases, under the most favourable conditions obtainable. In many instances, however, nothing can be detected, at any rate of a definite character; or there may be only a sensation of undue firmness, resistance, or induration deep in the region of the pancreas. Sometimes the enlarged organ can be made out distinctly; or a tumour of the head, having the characters already described. The general symptoms are always of a serious character, namely, emaciation, anæmia, weakness, and depression of spirits, and they often become extreme. There may be distinct signs of the cancerous cachexia.

Calculi in connexion with the pancreas are almost always latent, but they may produce secondary effects causing symptoms. There is no authentic case of colic from the passage of a pancreatic calculus into the duodenum, so far as the writer is aware.

Pancreatic cysts.—When these are of small size they cannot be detected. A large pancreatic cyst may be recognised as a smooth, rounded or globular tumour, deep-seated, and retro-peritoneal, lying behind the stomach and transverse colon in the upper part of the abdomen, and tending towards the left side. It moves more or less with respiration, but is not movable by manipulation, and gives the impression of being attached to some deep structure. The tumour generally feels firm and tense, or elastic, but not distinctly fluctuating. It usually grows slowly, but may develop rapidly, and sometimes attains a very large size. Its relation to the stomach and colon may be made out more definitely by distending these viscera with gas, or the colon with water. The symptoms which may be associated with pancreatic cyst are pain, more or less continuous, with paroxysmal exacerbations; jaundice sometimes, which may disappear when the cyst is aspirated, and return again as it fills; and wasting, which may amount to extreme emaciation. In doubtful cases the tumour may be aspirated, but this must be done with great care; and the fluid thus withdrawn, having the characters already described, is pathognomonic. The occurrence of hæmorrhage into a pancreatic cyst is accompanied with grave, and it may be rapidly fatal, symptoms.

Diagnosis.—Sufficient has been said in discussing the symptoms to indicate how difficult or impossible it must be to diagnose positively, in the great majority of cases, the existence of chronic disease of the pancreas. Cancer and large pancreatic cysts are the affections most likely to be recognised; and some of the others might be suspected under certain circumstances. What has been stated will suggest how they are to be distinguished from each other, but it would be very difficult to diagnose between a cirrhotic and a cancerous pancreas. With regard to the diagnosis of pancreatic lesions from those affecting some neighbouring structure, it must be remembered that these diseases are liable to be involved, and it may then be of little practical moment to determine precisely what structures are implicated. It is necessary to be particularly cautious against referring symptoms connected with the liver or stomach, induced by pancreatic disease, to a morbid condition of either of these organs; while it must always be borne in mind that enlargement of the liver may result from accumulation of bile, due to obstruction of the hepatic duct; and also that dilatation of the stomach will follow narrowing or closure of the pylorus or duodenum. It may be stated as a general rule that serious disease of the liver or stomach will probably reveal itself by obvious signs; and if this can be excluded in certain cases, the diagnosis of pancreatic disease will be appreciably aided. Of course these organs may be involved as well, or secondarily. The painful paroxysms connected with pancreatic cancer may readily be mistaken for the passage of gall-stones, should jaundice be present. If a solid tumour be felt, it may be difficult to distinguish a pancreatic from an omental growth. It must be remembered that an enlarged pancreas may present pulsation and bruit, conducted from the aorta, and thus simulate an aortic aneurysm. A large pancreatic cyst may now be fairly diagnosed by the phenomena already described. Dr. Pitt and Mr. Jacobson lay stress upon its relation to the stomach and transverse colon, in its diagnosis from tumour of other organs or of the main peritoneal cavity. It has been most commonly mistaken for an ovarian tumour. Certain mesenteric, retro-peritoneal, and occasionally other tumours may present some of the physical characters of pancreatic cysts, but aspiration will clear up any difficulty in diagnosis. In conclusion, the writer would insist once more, as bearing upon the diagnosis of pancreatic disease, on the importance of remembering that there is such an organ as the pancreas; and also of making a thorough physical examination, again and again if required, in any case in which disease of this organ is suspected.

Prognosis.—But little need be said under this head. Even if certain forms of pancreatic disease could be recognised, they may not affect life, but no positive opinion can be given. It has been affirmed that chronic pancreatitis is curable in the early stage, but of this there is no real proof; it probably aids in bringing about a fatal result sooner or later in those cases in which it exists. Pancreatic cancer is necessarily a fatal disease, and usually terminates in death within a year after the symptoms have become prominent. A pancreatic cyst has been cured by treatment in several cases.

Treatment.—The indications in the management of cases of chronic disease of the pancreas come within a very limited compass, even if it should be recognised. Rarely can there be any possibility of curative treatment being effectual, although supposed cures of chronic inflammation have been brought forward, obtained by the administration of calomel to act upon the pancreas, of saline purgatives, or of mineral waters of this class; or, when there has been a syphilitic history, by the use of mercury to produce its constitutional effects, or of iodide of potassium. In many cases the employment of saline aperients would be beneficial, to keep the intestinal canal free, and to unload the portal circulation. An occasional dose of calomel or blue pill might also be advantageous. In the large majority of cases of pancreatic disease the treatment would have to be chiefly symptomatic, directed especially to the relief of pain, to the symptoms connected with deranged digestion, and to the state of general wasting and debility. Hence, every case must be treated on its own merits, in accordance with well-understood principles. For the relief of the severe paroxysms of pain attending pancreatic cancer, subcutaneous injection of morphine is the most reliable remedy. The use of artificial digestants might be expected to be of much practical value in the treatment of cases of chronic pancreatic disease. Sweetbreads might be employed as an article of diet, or pancreatic emulsion or liquor pancreaticus might be given; but the previous digestion of the food by means of Benger's liquor pancreaticus is the method likely to be followed by most benefit, and from this plan great advantage may be looked for in appropriate cases.

The treatment of a pancreatic cyst is entirely surgical, and abdominal section with drainage seems to be by far the best method. The cyst has also been removed completely, but this operation has generally proved fatal.

3. **Hæmorrhage.**—This lesion connected with the pancreas demands brief separate notice, but it is chiefly important from a medico-legal point of view. The event occurs suddenly, in a person who is in good health, and from no obvious cause. The symptoms are a severe pain in the upper part of the abdomen, which steadily increases, and is sharp or sometimes colicky; tenderness over this region; nausea and vomiting almost from the outset, which becomes frequent and obstinate, but gives no relief; tympanites sometimes; constipation generally; increasing anxiety, restlessness, and depression; and speedy collapse, with cold surface, cold sweats on the forehead, weak, rapid, and ultimately imperceptible pulse. The temperature is usually normal or subnormal. Death may occur almost suddenly or very speedily. The pancreas is found uniformly infiltrated with blood; and there may be extensive hæmorrhage into the mesentery, retro-peritoneum, or meso-colon.

Frederick T. Roberts.

PANDEMIC DISEASES (πᾶν, all; and δῆμος, the people).—Epidemic diseases which affect groups of several countries or the world generally. *See* Epidemic; and Periodicity in Disease.

PANTICOSA, in the Spanish Pyrenees. — Thermal waters. *See* Mineral Waters.

PAPILLOMA (*papilla*, a nipple, a wart).—A tumour composed of hypertrophied papillæ, either of the skin, or of a mucous or a serous membrane. *See* Tumours.

PAPULA (Lat.). — Synon.: Pimple; Fr. *Papule*; Ger. *Papel.*

Definition.—A minute prominence of the skin, for the most part conical, but often round, and sometimes flat; and resulting from inflammation or from accumulation of secretions.

A distinction must be drawn between inflammatory pimples and non-inflammatory pimples, the latter being simply over-distended follicles. In the classification of skin-diseases adopted by Willan the term *papulæ* represents a group of pimply affections; and he defines the word *papula* as follows: 'A very small and acuminated elevation with an inflamed base, very seldom containing a fluid or suppurating, and commonly terminating in scurf.' He thereby gives the word 'papule' a special signification. A typical physiological papula is presented to us in *cutis anserina*, where the pore of the skin or aperture of a follicle is projected outwards, in consequence of a certain rigidity, which opposes the contraction of the interporous tissue. The pathological papula is similarly located in the follicle of the skin, the prominence being produced by congestion of the vascular coat of the follicle, with more or less exudation into its capillary network.

Erasmus Wilson.

PARACENTESIS (*παρά*, through; and κεντέω, I prick).—Synon.: Tapping; Fr. *Paracentèse*; Ger. *Paracentese.*

Definition.—The operation of tapping any cavity, to draw off fluid or gas.

The term is usually confined to operations on the peritoneum, pleura, pericardium, and cranial cavity; the tapping of cystic tumours not being included. Most of these operations are now performed with the aspirator (*see* Aspirator). All those here described are performed with the cannula and trocar. The more extensive operations on the pleura, such as antiseptic opening, free drainage, trephining the ribs, &c., are described with the diseases which necessitate them. *See* Pleura, Diseases of.

Instruments and Operation. — If the aspirator be not used, the best form of instrument for tapping the pleura or peritoneal cavity is that known as Thompson's syphon trocar. In this the cannula is fixed to the handle, and has a lateral opening about its middle, to which a long india-rubber tube is attached. The trocar is continued through the handle of the instrument and terminates in a button. In the handle the stem of the trocar is surrounded by air-tight packing. The instrument is inserted in the ordinary way, after being soaked for ten minutes in carbolic lotion (1 in 20); the trocar is then drawn back till its head is past the lateral opening in the cannula, through which the fluid will then flow. The india-rubber tube must be carried into a vessel containing carbolic acid solution (1 in 40). The result is that a syphon action is established, of sufficient force to exhaust the cavity operated on, and at the same time the accidental entrance of air is rendered impossible. Should the instrument described not be at hand, the following simple plan, suggested by Reybard, will be found very efficient. The cannula of an ordinary hydrocele trocar is surrounded by a linen petticoat, immediately below its external extremity, from two to three inches in length, which is well soaked in carbolic oil (1 to 10) before the instrument is used. On withdrawing the trocar the petticoat hangs down, forming a channel through which fluids readily pass outwards, but which collapses instantaneously if there is any tendency to the entrance of air. This is especially useful in tapping the pleura. The same result can be obtained by applying a large veil of lint or rag, soaked in carbolic oil, over the cannula the moment the trocar is withdrawn. In tapping the cranial cavity or the pericardium very fine instruments, usually known as *exploring trocars*, must be used. In some cases, when the ribs are very close together, a flat cannula with a lancet-shaped trocar, may be useful. Before using a trocar it should be passed between the finger and thumb to feel if the free edge of the cannula is perfectly concealed by the wider head of the trocar. This is frequently not the case with old instruments, in which the cannula has lost the spring given to it by the two slits at the end. If the cannula project it may push the pleura before it, the head of the trocar only entering the cavity. A cannula and trocar should be always kept separate when not in use, to prevent rusting, and the head of the trocar should be well pushed into a soft cork. A blunt or rusty trocar doubles the suffering of the patient. Immediately before use the two parts of the instrument should be separately well washed with carbolic acid solution (1 in 20), or with some other powerful antiseptic. These precautions are of the utmost importance. A dirty instrument has often caused the death of the patient, by exciting decomposition in the cavity operated on; and real cleanliness can only be ensured by dipping the instrument immediately before use in some powerful antiseptic. A perfectly bright and apparently clean instrument may be in reality coated within and without with microscopic dirt, which antiseptics alone can render innocuous.

In using a trocar the instrument is held under the hand with the end of the handle in the hollow of the palm; the thumb is placed upon the rim of the shield of the cannula, ready to push it off without necessitating the employment of the other hand, and the forefinger is firmly pressed against the side of the cannula, at the point to which it is intended to limit the advance of the instrument. No preliminary incision is required if the instrument is in good order. It will only double the patient's pain, and increase the risk of non-union of the wound. It is advisable to draw the skin aside from its normal position before introducing the trocar, so that the superficial and deep parts of the puncture may not correspond when it is withdrawn. A valved opening is thus made, which can hardly fail to close readily.

Precautions.—When either of the large cavities is tapped, if a large quantity of fluid be rapidly removed, the patient is apt to become faint. These operations should, therefore, be always performed in the recumbent or semi-recumbent position, and stimulants should be at hand, the patient being carefully watched. Should faintness occur the operation must be immediately suspended. If the patient fears the pain of the puncture, the skin may be frozen, either by the ether-spray apparatus, or by the application of a piece of ice dipped in salt.

1. **Paracentesis Abdominis.**—This term is usually applied exclusively to the operation of tapping the peritoneal cavity for ascites, or, in very rare cases, for free gas. When the trocar is used for the relief of a distended bladder, or to empty an ovarian cyst or a hydatid of the liver, the simpler term 'tapping' is invariably used. The operation for ascites is performed in the following way: The patient must be made to empty the bladder immediately before the operation; if there is the remotest possibility that this cannot be done perfectly by natural means, a catheter must be passed. A strip of flannel wide enough to reach from the nipples to the pubes, and long enough to go two and a half times round the abdomen, must be in readiness. Each end is to be torn into four or five tails. The middle of the flannel is then to be applied to the front of the abdomen, and the tails so arranged as to interdigitate with each other opposite the spine. By pulling on the tails on each side a uniform elastic pressure is maintained over the abdomen during the operation, which facilitates the flow of the fluid, and diminishes the tendency to fainting. A circular hole is cut in the flannel at the point at which the puncture is to be made. The patient must be brought to the edge of the bed, and placed in the recumbent position, with the head low. If the quantity of fluid is not great, and the small intestines float up so as to come in contact with the lower part of the abdominal wall, it may be necessary to raise the patient into a semi-recumbent position, in which the intestines will float to the epigastric region. Having put the patient in position, the operator must himself percuss the abdomen between the pubes and the umbilicus immediately before inserting the trocar, and he will, of course, not proceed with the operation unless there is absolute dulness. Having ascertained that everything is in proper order, the skin is drawn a little to one side, and the trocar is plunged sharply through the abdominal walls in the linea alba, at a point midway between the umbilicus and pubes. Other points have been recommended, as the linea semilunaris, but the middle line is generally preferred. As soon as the trocar is withdrawn, the assistants pull firmly on the tails of the bandage, and continue to do so as long as any fluid flows. As soon as the fluid ceases to flow, the cannula is withdrawn, and a piece of lint, soaked in collodion, is applied over the puncture. The corresponding tails of the flannel bandage are then firmly tied together over the

middle line of the abdomen. For ordinary cases the aspirator is in every way inferior to the syphon trocar, and should never be used. If the patient should become faint during the operation the instrument must be withdrawn, the head put as low as possible, and some stimulant administered.

Dr. Reginald Southey has recommended a more gradual evacuation, in preference to the rapid method above described. He employs a very fine cannula, perforated laterally by numerous openings, and provided with a bulb-head and a shield. To the bulb-head is attached a long india-rubber tube. The cannula is inserted in the middle line, and fixed in position by strapping; and the fluid drains slowly away at the rate of about one pint per hour. The cannula may be allowed to remain in position, if necessary, for about twelve to twenty-four hours. Dr. Southey claims for his method the following advantages—simplicity; freedom from pain; absence of any tendency to syncope; and the avoidance of the necessity for bandaging afterwards. Experience has shown that there is no risk of peritonitis.

2. **Paracentesis Thoracis.** — Synon.: Thoracocentesis.—This is required for serous fluid or pus in the pleura, and more rarely for blood or air. Aspiration should always be preferred to the operation by the cannula and trocar (*see* Aspirator). Should the aspirator not be at hand, the syphon-trocar should be used; or, failing that, one of the plans before mentioned must be adopted to prevent the entrance of air during inspiration. The patient must be brought to the edge of the bed, and placed in a semi-recumbent position, well supported by pillows. The spot selected for puncture varies greatly. It is generally agreed that the trocar should never be introduced below the tenth rib on the left side and the ninth on the right, for fear of wounding the diaphragm. The point most commonly chosen is above the sixth or seventh rib, between the digitations of the serratus magnus, which can usually be clearly seen. Should they not be visible, any point may be taken in the proper intercostal space between the mid-axillary line and the junction of the posterior and middle thirds of the lateral aspect of the chest. The trocar must always be kept close to the upper border of the rib, in order to avoid the intercostal nerve and artery. In whatever space the operation may be performed, the lower border of the rib below the space should first be clearly felt: the skin is then to be drawn upwards for the width of the rib, and the trocar thrust sharply in immediately above its upper border. If the instruments are in good order, and the rib can be clearly defined, no preliminary incision is necessary. If, from partial absorption of the fluid, without corresponding expansion of the lung, the ribs have fallen very closely together, it may be necessary to use a flat trocar, with a lancet-shaped head. The precautions as to faintness and the closure of the wound are the same as in paracentesis abdominis.

3. **Paracentesis Pericardii.** — This operation is now invariably performed with the aspirator, as the results of the use of the ordinary trocar have been extremely unsatisfactory. *See* Aspirator.

4. **Paracentesis Capitis.**—This operation has been occasionally performed in cases of chronic hydrocephalus, but without any very marked benefit. It is not safe to use the aspirator, as the vacuum might do unexpected damage to so soft a structure as the brain, while a small trocar may be passed through the expanded hemisphere into the ventricle without risk. The instrument used should be the smallest exploring trocar. An elastic bandage must be first applied, so as to exert a very gentle pressure on the head. The trocar is then introduced at any point where bone is deficient, except in the situations of the sinuses. The best place is at one side of the anterior fontanelle. The middle line must be avoided, not only because of the longitudinal sinus, but because in the vast majority of cases the fluid is contained in the ventricles. The quantity of fluid removed should not exceed two ounces. The elastic pressure must be maintained after the operation, which may be repeated at intervals of four or five days.

Marcus Beck.

PÁRAD, in Hungary. — Sulphate of iron waters. *See* Mineral Waters.

PARÆSTHESIA (*παρά*, a prefix indicating irregularity; and *αἴσθησις*, sensation). A term applied to abnormal sensations experienced by a patient, distinct from mere excess or diminution of feeling; for example, tingling, itching, and formication. *See* Sensation, Disorders of.

PARALYSIS (*παρά*, beside; and *λύω*, I loosen or relax).—Synon.: Palsy; Paresis (incomplete paralysis); Fr. *Paralysie*; Ger. *Lähmung*.

Definition.—Loss of the power of voluntarily exciting the contraction of one or more muscles, is the essential condition met with in all forms of motor paralysis. And, similarly, a loss of the possibility of transmitting impressions, either of the special senses or of common sensibility from various parts of the body, from their seats of peripheric commencement inwards to those portions of the brain which are concerned with their realisation in consciousness, is what is commonly known as 'sensory paralysis.' These latter defects are, however, considered under the head of Sensation, Disorders of. Here attention will be confined to the subject of motor paralysis, to which, indeed, the term 'paralysis' ought to be limited. It is more fitting to speak of loss of sensation than of paralysis of sensation.

Paralysis, Motor.—Motor paralysis may, in different cases, be occasioned by defects in various parts of the neuro-muscular apparatus. Certain primary differences of kind have first to be considered.

(*A*) Certain muscles may not contract because their customary neural incitations are impeded or abortive at their source in the cerebral cortex—as in certain forms of hysterical or functional paralysis, or as a result of definite lesions in some portions of the brain-region just mentioned.

(*B*) Other forms of paralysis result because voluntary motor incitations are impeded in transmission at some part of their course through the nerve-centres below the cortical stratum of grey matter in which they take origin. Under this head are to be included by far the larger number of cases of paralysis actually met with; and according as the situation varies in which the impediment to the transmission of motor stimuli exists, so do we get the paralysis occurring in different forms, that is, affecting different distinctive movements or groups of muscles, with or without certain characteristic associations, such as sensory paralysis or disturbance, alterations in the temperature of the skin over the parts affected, and, after a time, alterations in the nutrition of the muscles whose functions are in abeyance. These very numerous forms of paralysis fall into different classes, according as the disease or injury preventing the proper transmission of motor stimuli occurs (1) in some portions of their cerebral path; (2) in some portions of their spinal path; or (3) in their passage through some of the peripheral nerves, that is, in any part of their passage to the muscles outside the bulb or spinal cord.

(*C*) Lastly, though voluntary motor incitations may be normally generated, and properly transmitted through the nerve-centres and along the peripheral nerves, an incomplete paralysis of certain muscles may still result if such stimuli, owing to degenerative atrophy in the muscles, are incapable of evoking their contraction. In these, as in the other cases, the resulting loss of movement (akinesis) would represent a true paralysis. The fact that such forms of paralysis are often incomplete is dependent upon the peculiarity that some healthy muscular fibres usually remain in muscles which are the seat of atrophic changes (*see* PROGRESSIVE MUSCULAR ATROPHY). Modern research has demonstrated the existence of a group of diseases in which the changes in the muscles are primary. This occurs, for instance, in what is known as 'idiopathic muscular atrophy,' and also in 'pseudo-hypertrophic paralysis.' It must be said, however, that modern research has equally tended to show that in a very large majority of the cases of muscular atrophy such changes are sequential to previous lesions in the anterior cornua of the spinal cord or in the nerves. *See* PROGRESSIVE MUSCULAR DYSTROPHY.

The ÆTIOLOGY and PATHOLOGY of the diverse forms of paralysis will not now be further referred to, but will be discussed in various separate articles. Some general remarks on this subject will be found under the heads of NERVOUS SYSTEM, Diseases of; BRAIN, Diseases of; SPINAL CORD, Diseases of; and NEURITIS, MULTIPLE. Reference may also be made to the various special articles dealing with the pathological causes of brain-disease, and to the articles on the diseases of the different cranial and other motor nerves.

DIAGNOSIS.—The diagnosis or recognition of the cause or nature of any particular case of paralysis is always a many-sided problem. Having previously satisfied ourselves that it is a real and not a merely apparent case of paralysis (due perhaps to some arthritic disease), we have to endeavour to make out to which of the foregoing divisions or subdivisions the instance before us happens to belong. Paralysis of any group of muscles (in the limbs or elsewhere, and howsoever occasioned) may, of course, be either complete or incomplete; and it may be as well here to add that it is the incomplete forms of paralysis in the limbs (cases of '*paresis*' as they are often termed) which are most apt to be confounded with certain weaknesses or motor defects due to joint-disease.

In actual practice the *primary* question as to the nature of the paralysis may be, and commonly is, somewhat simplified, inasmuch as the varieties included under class *A* may be well merged in the first instance with the primary category of class *B* (that is, the cases of paralysis dependent upon defect in some portion of the cerebral path for outgoing motor incitations); just as those of class *C* may be included under the second and third categories of class *B* (that is, the cases in which there is defect in some portion either of the spinal or of the peripheral path for motor incitations). Thus the recognition of the varieties of paralysis included under classes *A* and *C* belong to the secondary or more special problems connected with diagnosis. The so-called 'hysterical' forms of paralysis, for instance, are to be regarded as due to functional perversion rather than to actual structural damage in certain portions of the nervous system. It seems evident, however, that in the first place we should decide whether we have to deal with a disease of the brain or of the spinal cord, before dealing with the secondary question as to whether such disease is of the merely functional or of the structural type.

Thus, for practical purposes the several kinds of paralysis are primarily divisible into three distinct categories, based upon the situation of the damage, lesion, or defective activity by which they are occasioned. We have to do with —

1. *Paralyses of Encephalic Origin* ;
2. *Paralyses of Spinal Origin* ;
3. *Paralyses of Peripheric Origin* ;

according as the cause is one which operates upon or within some part of the great centres within the cranium ; upon or within some part of the spinal cord ; or upon or within some one or more of the nerve-trunks, in parts situated either inside or outside the cranium or the spinal canal.

It will easily be understood that each of these primary groups of paralysis, and especially the first, includes very many varieties, the recognition of which is often a matter of extreme difficulty—only to be achieved after an attentive and minute study of all the details of a case by those who are well instructed as to the anatomy and physiology of the nervous system, and most familiar by daily practice with the estimation of the import of the various signs and symptoms, in the light supplied by such knowledge.

The primary diagnosis should however, in the great majority of cases, be capable of being made by the practitioner with comparative certainty. In so doing he will be guided by the general agreement as to signs and symptoms presented by the case before him with one or other of the semi-combinations now to be mentioned.

1. Paralyses of Encephalic Origin.—These may or may not be ushered in by an apoplectic attack, by an epileptiform fit, or by a series of fits. The paralysis is usually confined to one half of the body, though only certain parts of it are affected, namely, more or less of one half of the face, with the arm and the leg (either incompletely or completely) on the same side, while the muscles of the trunk are comparatively little affected. Where the paralysis is incomplete, the arm is commonly more affected than the leg. Except where loss or impairment of consciousness still exists, or in cases where both sides of the brain are affected, the patient almost invariably retains control over the bladder and rectum. The common sensibility of the same half of the body may for a shorter or longer period from the commencement of the disease be more or less diminished. The electrical irritability of the paralysed muscles is not notably altered. The superficial reflexes are often diminished, and the deep reflexes mostly exalted on the paralysed side of the body. *See* SPINAL CORD, Diseases of.

These are the general characters of a form of paralysis due to unilateral lesions of the brain, commonly known as *Hemiplegia*. It is met with almost as frequently on the one as on the other side of the body, and may occasionally affect both sides simultaneously. A lesion in the right half of the brain produces hemiplegia on the left side of the body, and *vice versâ*.

2. Paralyses of Spinal Origin.—These forms of paralysis usually commence without convulsions or impairment of consciousness, though, like those of the last category, they may be either sudden or gradual in their mode of onset. They are, however, commonly characterised by the implication, to a variable extent, of both sides of the body. In the great majority of cases the lower extremities, either alone or with the trunk-muscles up to a certain level of nerve-supply, are the parts that are paralysed. The arms are much less frequently affected, because a large majority of lesions in the cord occur in its dorsal and lumbar segments. It is common for control over the bladder and rectum (one or both) to be more or less lost. The motor paralysis may exist with little or no impairment of sensibility ; though in many cases sensation, in one or other of its modes, is defective in the paralysed parts. The upper limit of defective or altered sensibility is often marked round the trunk by a sense of constriction, or a feeling as if a band were tied round the body ('girdle sensation'). The electric irritability of the paralysed muscles may be either little altered, or it may, especially in some parts, be modified in the manner to be described in the next section as characteristic of the 'reaction of degeneration'—and in this latter case early and marked atrophy of such paralysed muscles may be looked for.

These are forms of paralysis commonly known by the name of *Paraplegia*. Both sides of the body are usually affected—equally or unequally—because of the frequency with which the lesion, or cause of the disease, involves both halves of the spinal cord. Where this is not the case, however, and the injury or lesion is confined to one half of the cord, in one or other region, a condition known as *Hemiparaplegia* results, in which, in addition to other special characters, there is an absence of any trace of facial paralysis, even though the arm and leg on one side of the body (where the lesion exists high up, in the cervical region of the cord) may be implicated in much the same manner as they are in hemiplegia. Here, however, the paralysis of motion occurs on the same side as the lesion.

3. Paralyses of Peripheric Origin.—The majority of paralyses resulting from disease or injury of motor nerve-trunks are rendered comparatively easy of recognition by the fact that the loss of power is in each case limited to the muscles supplied by particular nerves. This circumscribed nature of the paralysis is a fact of great value for diagnostic purposes—especially when the loss of power is complete rather than partial, because it is in these cases more particularly that we are apt to get another characteristic sign of peripheral paralysis, namely, an altered electrical excitability of both nerve and muscles. Where the injury to or disease of a nerve-trunk is well-marked, so that its fibres are either severed or rendered incapable of conducting stimuli from the centres, owing to pressure or other causes, it is found that within a period of six to fourteen days the following electrical phenomena may be detected: Loss of irritability of the affected nerve-trunk to both electric currents; loss of or greatly diminished irritability of the affected muscles under stimulation by the faradic current, together with an increase of their sensitiveness to the voltaic or continuous current—so that they respond to the latter even more readily than the corresponding muscles of the opposite side. These characteristics, as a whole, together with certain minor peculiarities, constitute the so-called 'reaction of degeneration' (*see* Electricity in Medicine). To these characters must be added the further peculiarity that the muscles thus affected are apt speedily (within two or three weeks from the onset of the paralysis) to show a marked amount of atrophy—a change easily to be appreciated in limb-muscles, and in some of those pertaining to the trunk, but by no means so obvious in the muscles of the face.

Morbid processes involving sensory nerves, special or other, are, of course, characterised by the nature of the special loss of sensibility, or by the area over which common sensibility is impaired or lost in different cases.

And, again, where we have to do with serious disease or damage to mixed motor and sensory nerves, this is detected by the recognition of motor and sensory defects so combined as to be compatible only with impairment of function in this or that mixed nerve.

The above constitute the characters which are in the main to be relied on for the diagnosis of paralyses of peripheric origin, caused by lesions of individual nerves. Still it must not be forgotten that when the ganglion-cells in the bulb or spinal cord, which constitute the nerve-nuclei of the several motor nerves, are diseased, we may have almost precisely the same effects produced as if the nerve-trunks had been damaged in some part of their course—that is, we may have in each case the electrical 'reaction of degeneration' followed by speedy atrophy of the affected muscles. In this case, indeed, where we have disease of an atrophic character limited to the nerve-cells composing the nucleus of a motor nerve or nerves, we should have a form of paralysis, tolerably well typified by 'labio-glosso-laryngeal paralysis,' which might almost with indifference be placed either in the category of spinal or of peripheric nervous disease. The lesion would be, it is true, spinal in seat; and yet it would be attended by all the clinical characters pertaining to disease of the nerve-trunks—and this naturally enough, seeing that the disease would in fact simply affect the proximal extremities of nerve-trunks.

What has just been said will serve to explain how it is that in many cases of paralysis of spinal origin, that is, due to large 'transverse' lesions, seriously damaging the grey matter of the cord, we may get, together with the wide or general distribution of such a paralysis, evidence that *in some* of the muscles the electrical 'reaction of degeneration' may be detected as well as early wasting. These characteristics of peripheral paralysis will, in fact, occur in muscles where the grey matter at the roots of the nerves, by which they are supplied, has been destroyed. In cases of paraplegia due to large transverse lesions limited to the cervical or to the upper dorsal region, we might, therefore, look for and find the 'reaction of degeneration,' with early wasting in some of the muscles of the upper extremities or of the trunk, whilst we should not find these characters, nor be warranted in looking for them, in the muscles of the equally paralysed lower extremities.

Of course, in most cases of paralysis, the patient's personal and family history, as well as the mode of onset of the disease, will help to throw light upon the question whether, in the case before us, we have to do with a paralysis of encephalic, of spinal, or of peripheric origin.

The further characters of paralyses of spinal origin (paraplegias and hemiparaplegias) will be found described in the article Spinal Cord, Diseases of; whilst those of the paralyses of peripheric origin will be found in the various articles on diseases of special motor and sensory nerves, such as the facial, the trigeminus, the sciatic, and many others.

The peripheral type of paralysis, when due to affections not of single nerve-trunks, such as we have hitherto been considering, but to the simultaneous affection of peripheral nerves in many parts of the body (mostly brought about by toxic agencies of different kinds), has, during recent years, been shown to be much more common than was previously suspected. This whole subject is, however, a very complicated one, which will be found treated mainly in a separate article (*see* Neuritis, Multiple), as well as in others, to which references will there be given.

The type of those diseases included under the head of Paralyses of Encephalic Origin will now be more particularly described.

This account of the characters pertaining to an ordinary form of **Hemiplegia** can perhaps best be given by detailing the combination of signs and symptoms produced by disease, either in the form of hæmorrhage or of softening in or near the internal capsule as it passes through one of the corpora striata. We may suppose such disease to be situated on the right side of the brain, when, as a consequence, we should meet with a left hemiplegia.

Characters of Left Hemiplegia from disease affecting the internal capsule in or near the right Corpus Striatum. Where there is a sudden onset of the disease and a large lesion, such as may occur especially in some instances of hæmorrhage, the symptoms may be ushered in by an apoplectic attack; and a condition of unconsciousness may remain, as a result of general brain-shock, for minutes, hours, or even days. Convulsions rarely occur in such a case. Where the hæmorrhage is slighter in amount, or where the causes of softening, in the form of vascular obstruction, are limited in seat and not abruptly brought about, there may be no loss of consciousness whatever at the onset, nor any sensation referred to the head. The patient may perhaps experience a mere momentary vertigo; and sensations of numbness or tingling rather than of actual pain may be felt for a minute or two in one or other limb, or perhaps in both limbs, before their weakness or actual paralysis is detected.

In a case of this kind, or after recovery of consciousness in the more severe form of the disease, the patient will on examination be found to present the following characteristics: (1) An absence of any decided mental disturbance; (2) slight 'thickness' of speech; (3) more or less deviation of the tongue towards the paralysed side, when it is protruded; (4) partial and incomplete paralysis of the facial muscles on the side on which the paralysis of the limbs exists—the angle of the mouth is lower and the naso-labial fold less distinct than on the opposite side, though the two eyes can be closed almost equally well; (5) more or less complete loss of voluntary power over the left arm and leg; (6) a flaccid state of the muscles of these limbs, which are found to respond naturally, or perhaps even a little too readily, both to the faradic and voltaic currents; (7) some slight loss of sensibility, as well as a feeling of numbness, on the paralysed half of the body; (8) slight elevation of temperature on the paralysed as compared with the non-paralysed side of the body—the difference being seldom more than one degree of the Fahrenheit scale.

Of these signs, the thickness of speech, the deviation of the tongue, the paralysis of the face, and the diminished sensibility, soon either grow perceptibly less or actually disappear. In the slighter cases, after some days or a week or two, there may also be some return of voluntary power over the leg and the arm; but in the more severe forms of complete hemiplegia, not proving fatal, any recovery of motor power in the limbs may be delayed for months instead of weeks, and then perhaps the recovery may be only very slight. In the majority of cases, however, the recovery of power begins to show itself in the leg sooner than in the arm; and the muscles about the proximal joints are in each case capable of being called into action before those moving joints which are more remote. Sometimes in the early stages of the disease some amount of rigidity may be met with in the arm or in the leg, or in both simultaneously, which is found to disappear during sleep—'early rigidity'; whilst later on a more permanent form of rigidity associated with organic changes in the muscles and tendons—'late rigidity'—is apt to supervene.

The particular combinations of symptoms met with in different cases of hemiplegia vary in an almost endless manner, as the situation of the brain-lesion varies, and also to a less marked extent in accordance with variations in its magnitude, and in the suddenness with which the lesion occurs. Thus, in regard to variations in the extent and completeness of motor paralysis alone, we may have merely a slight facial paralysis, with some weakness of the arm on the same side, and none of the leg; or the paralysis of arm and face may be more marked, together with slight paralysis of the leg; or paralysis may be pretty complete in all three situations. More rarely the leg may be more completely paralysed than the arm. At other times, from brain disease, paralysis may occur only in the face, in the arm, or in the leg; and then we have what is termed *facial monoplegia*, *brachial monoplegia*, or *crural monoplegia* respectively. But where lesions exist in both hemispheres of the brain, or in the pons Varolii, a double hemiplegic condition may exist—either complete or incomplete, and in the latter case probably unequal in degree on the two sides of the body. Similar variations exist in regard to many of the other concomitants of the hemiplegic state; for example, as regards the amount of mental disturbance, the kind and degree of impairment of speech, the amount of paralysis of tongue and difficulty of deglutition, the amount of paralysis of the face and of implication of the ocular muscles, the amount of impairment of common sensibility and of the special senses, the amount of difference in temperature between the two sides of the body, and the amount of command over the sphincters of the bladder and rectum. Combined in different groups, owing to the different relative development of these or those particular symptoms, we get the characteristics of all the different grades and kinds of hemiplegia actually met with in practice.

To attempt to connect this difference in grouping of the signs and symptoms with differences in the locality of the lesion, is to concern ourselves with the *secondary*, as opposed to what has been previously termed the *primary*, problem of diagnosis. We should then have to consider what is more especially termed *regional diagnosis*, which, however, can only be attempted after careful study has been given to the several distinctive effects produced by disease in the different regions and parts of the encephalon, which will be found detailed in a series of special articles.

In attempting to arrive at a *pathological diagnosis* in any case of paralysis, our attention must be given more to the mode of onset of the affection, and to the state of other organs and parts of the body, than to the signs and symptoms of the established disease, though we are compelled to rely most upon these latter for the establishment of a regional diagnosis. Still these two sides to the problem of diagnosis are often very intimately related to one another, so that it may be essential to consider them concurrently in order to derive from each side of the problem all the light that may be possible for the elucidation or confirmation of the other half of it.

The questions concerning PROGNOSIS and TREATMENT are considered separately under the head of the special forms of paralysis, and of the diseases giving rise to the different kinds of paralysis of encephalic, of spinal, and of peripheric origin.

H. CHARLTON BASTIAN.

PARALYSIS AGITANS.—SYNON.: Shaking Palsy; Fr. *Paralysie Tremblante*; Ger. *Schüttellähmung.*

DEFINITION.—A disease of advanced life; progressive in its course; and characterised mainly by tremors of the limbs occurring independently of muscular exertion, rigidity of muscles, and a tendency in walking to loss of equilibrium.

ÆTIOLOGY.—The causes of paralysis agitans are obscure. It is rarely met with prior to forty years of age, but becomes more and more frequent as life advances. It affects both sexes, but men probably more frequently than women. There is little reason to regard it as hereditary. It has been attributed to violent emotion, to excessive bodily fatigue, and to exposure to cold and wet. It has also been referred to wounds or injuries involving nerves. In many cases no cause is assigned or can be discovered.

ANATOMICAL CHARACTERS.—The disease, no doubt, is one of the nervous centres. But no distinctive lesion has yet been discovered in these parts. Sclerotic and other degenerative changes, evidences of sanguineous exudations in the course of some of the smaller vessels, diseased arteries, and various coarse lesions, have not infrequently been met with in the cord and brain; but the morbid changes hitherto observed have been variable in seat and character, and such only as are frequently present under other circumstances in persons who die in old age.

SYMPTOMS.—Paralysis agitans, with few exceptions, comes on insidiously. The patient is first attacked with occasional tremors in a hand, a thumb, or a foot. These attacks come on irregularly, without obvious cause, and last for an uncertain period. But gradually they increase in frequency, duration, and severity, and spread from the part first involved, until, at length, probably all the limbs become implicated. In most cases the tremors, commencing in a hand or foot, by slow degrees invade the rest of the limb, and thence spread in hemiplegic fashion to the other limb of the same side. Less commonly the affection spreads in the first instance from one leg to the other. And very rarely do both arms suffer, the legs remaining free, or does the affection involve the limbs diagonally. Associated with the tremors, sometimes preceding them, but much more frequently coming on at a later period of the disease, there may always be observed a peculiar rigidity of the muscles. This is often attended with cramp-like pains, and, like the tremors, is liable at first to more or less obvious and prolonged intermissions. It implicates the muscles of the head and neck and trunk, as well as those of the extremities, and the flexor muscles in greater degree than their opponents. Another remarkable characteristic of the disease, always developed sooner or later, is an inability to maintain equilibrium when walking is attempted.

When paralysis agitans is fully developed, and the several phenomena above enumerated are associated, the collective symptoms produce a very remarkable and characteristic picture. The tremors involve the arms and legs; the head and neck remaining, as a rule, absolutely free. They consist of fine and rapid oscillations, which are more or less constant, but liable to exacerbations; cease during sleep; can occasionally be arrested temporarily by voluntary effort; and often occur with exceptional violence when the patient is otherwise at absolute rest. The movements of the hands are peculiar. The thumbs are usually extended, and the fingers flexed upon them; and collectively they move as though the patient were rolling a pencil or crumbling bread. The oscillations, however, are not limited to the hands, but involve the wrists and other joints of the upper extremities. The tremors of the lower limbs, especially when the patient stands, are necessarily transmitted to the rest of the body. In some cases the entire head, or the lower jaw, presents tremors like those affecting other parts of the body. The rigidity, which affects in a greater or less degree all the muscles, imparts a striking character to the patient's attitude and aspect It causes the arms to stand out slightly from the trunk; the elbow- and wrist-joints to be slightly flexed; the hands to be tilted towards the ulnar side, and to rest in front of the abdomen at or near the waist; and the fingers to be flexed or distorted at their several joints. It causes the trunk to incline forwards, as the patient stands or walks; the knees to be slightly bent; and the feet to be extended at the ankles; so that he rests upon his toes. But, above all, it causes the head and neck to be thrown forwards, and to be retained rigidly in that position, and the features to be immobile and inexpressive. This peculiar fixity of the head and neck and face, associated as it is with constant tremors in the limbs, constitutes a very striking feature of the disease. The difficulty of maintaining equilibrium, though no doubt increased largely by the presence of muscular tremors and rigidity, is not wholly due to them, for it may be well developed at a very early stage of the disease. Moreover, it may be long delayed. When thus affected the patient has some difficulty in rising from his seat; and, before he starts off walking, he probably hesitates a little, as though for the purpose of balancing himself. Then, with his body bent forwards, he begins to walk, perhaps with some care, but soon his steps become rapid and short, and he runs forwards in spite of himself, and if not arrested probably falls. Sometimes the tendency of the patient is to run backwards, even though the body incline forwards. Often in these cases, while the patient is being propelled forwards apparently in spite of himself, a sudden pluck at his clothes will reverse or alter the direction of his accelerating movement. These phenomena are not attended with vertigo.

Other symptoms less striking than the above, but of more or less importance, are usually present in shaking palsy. There is generally, even from the first, a great sense of weariness in the affected muscles, especially after exertion or an attack of tremors; but, contrary to what might be supposed, the tremulous and rigid muscles are, as a rule, markedly stronger than their as yet unaffected fellows. The patient, more particularly late in the disease, becomes excessively irritable and fidgety, so that at night especially he finds it difficult or impossible to place himself in a comfortable position; he is apt also to suffer from a painful sense of heat, mainly referred to the epigastrium and back. Speech generally becomes markedly affected, not from loss of language, but from difficulty of enunciation. Words are uttered slowly, and with manifest effort. Associated with this there is often tremulousness of the tongue. But the slowness and difficulty of utterance, which are often associated with slowness and difficulty of deglutition, constitute only one manifestation of the general slowness and difficulty of movement which, for the most part, characterise the disease. Sensation is not impaired; and the patient retains his mental faculties, as well as control over the rectum and bladder.

Diagnosis.—The affections with which paralysis agitans is most likely to be confounded are disseminated sclerosis, and mercurial tremors. But in the former of these the tremors occur only when the muscles are in use, and for the most part involve the head; the limbs early become paralysed; the patient has no tendency to run forwards or backwards; and generally nystagmus is present. In the latter affection there is probably a history of exposure to the fumes of mercury; the tremors involve not only the limbs, but the head and neck, and are symmetrical; and there is an absence of the peculiar gait of paralysis agitans. *See* Mercury, Diseases Arising from.

Progress and Terminations.—Paralysis agitans is of slow and often irregular progress, and usually lasts for many years; indeed it may be many years before it attains its full development. In rare cases it is recovered from in the early stage; but for the most part it is incurable. In its last stage the patient becomes confined to his couch or bed; the muscles waste; the tremors, though generally extreme at the time, occasionally cease; the mental powers fail; bed-sores form; and general prostration ensues. Death is due either to asthenia, or to some intercurrent disorder, more especially pneumonia.

Treatment.—In treating shaking palsy it is of importance to give careful attention to all hygienic measures, and to promote the patient's health, if need be, by tonics. Specific treatment has proved of little or no service. Nervine tonics and sedatives have been largely employed; and those which have found most favour probably are iron, strychnine, and hyoscyamus. The systematic use of baths has occasionally proved of temporary benefit. The persistent application of the continuous galvanic current seems to have been serviceable in some cases. Professor Charcot has recently recommended the use of the vibrating chair.

J. S. Bristowe.

PARALYSIS, Diphtheritic.—Synon.: Fr. *Paralysie Diphthéritique*; Ger. *Diphtheritische Lähmung.*—A peculiar form of motor paralysis, with a variable amount of sensory impairment, which develops in a subacute manner after diphtheria, increases and spreads, and either causes death or gradually passes away.

Ætiology.—The frequency with which diphtheria is followed by this paralysis varies in different epidemics from about 10 to 60 per cent.; on an average, about one-fourth of those who do not die from the primary disease suffer afterwards from definite palsy. It occurs at any age, but is rare in early childhood, and seems to increase in frequency with age. Most cases occur in early life, because most cases of diphtheria occur then. Neither previous health nor severity of the primary disease influences its occurrence. It follows diphtheria of wounds as well as the common form. Paralysis, in various forms and degrees, occurs associated with, or as a sequel of, influenza, typhoid and typhus fevers, relapsing fever, cholera, dysentery, small-pox, and pneumonia; but only in rare instances does such paralysis bear a resemblance, never very close, to that after diphtheria. A similar paralysis has been supposed occasionally to follow tonsillitis, but it is probable that the antecedent sore-throat has been really unrecognised diphtheria.

Symptoms.—The onset is usually in the second, third, or, less commonly, the fourth week after the termination of the primary disease; but it may begin as early as the second day of convalescence, and, in rare cases, even while there is still false membrane in the throat. The first part to be *paralysed* is almost always the soft palate, the affection of which is revealed by the regurgitation, through the nose, of liquids that are being swallowed, and by a nasal tone in the voice, due to the resonance of the nasal cavities, which are not shut off as they should be by the elevation of the palate. The same defect prevents the compression of air in the mouth necessary for the articulation of the explosive consonants, and 'p' becomes 'm.' Soon afterwards, and sometimes first, the patient becomes unable to see near objects distinctly, on account of paralysis of the ciliary muscle. The limbs then become weak; the loss of power is irregular in its course and seat, but more or less symmetrical. It usually increases to a considerable degree of weakness, so that the patient may be unable to stand; but it does not amount to absolute paralysis. It is accompanied by flabbiness of the muscles, and often by distinct wasting in them, which is accompanied, in all but slight cases, by the change in electrical irritability in the nerves and muscles that shows an acute degeneration of the former. The muscles do not contract to faradism (which acts only on their nerves), but contract with undue readiness to voltaism (which acts on the muscular fibres themselves); and the order of response to the two poles, with different strengths of current, is often altered. Reflex action is lost in the affected limbs, including the knee-jerk. The loss of this is indeed, in the majority of cases, one of the earliest symptoms; it may appear before the primary disease is over, and it is occasionally the only indication of an affection of the nervous system. The paralysis, in many cases, is not confined to the palate, eye, and limbs: the trunk-muscles may suffer, including the intercostals and the diaphragm; and the pharynx sometimes loses power, so that swallowing is very difficult. The movement of the vocal cords may be lessened or lost: generally there is weakness of both adduction and abduction, so that the cords remain a little way apart; occasionally there is a preponderant loss of abduction, so that the cords are near together. Both cords are usually affected; in a few cases one only has been weak or motionless. The action of the heart may be rapid or retarded, apparently from an affection of its nerves. Very rarely the tongue, face, or eye-muscles have been weakened.

Sensory symptoms are also common. Loss of sensation in the limbs sometimes occurs early, and is greater than the motor weakness; more often it is subordinate to the latter in time and degree. It involves touch alone; or both touch and pain. It is greatest towards the extremity of the limbs, and generally symmetrical. It may be curiously limited in position, as to the palms and soles, or, when in very slight degree, to the fingers. The pharynx and upper part of the larynx also sometimes become insensitive, and the anæsthesia of the upper part of the latter may increase the danger of weakness of the pharynx, by facilitating the passage of particles of food to the glottis or into the bronchi.

The sensibility of the muscles is also often lessened, and there is frequently distinct *ataxy* or incoördination of movement, apparently in consequence of the deficiency of the afferent impulses from the muscles. Sometimes it exists in all the limbs, but is usually more marked in the legs than in the arms; and it resembles a moderate degree of locomotor ataxy. The resemblance is increased by the invariable absence of the knee-jerk, and the frequency with which there is impairment of sensation.

The *special senses* are seldom affected beyond the common loss of the power of accommodation in the eye. Restriction of the fields of vision has, however, been noted, and very rarely transient deafness. The *sphincters* have been affected in only a few very severe cases.

The *course* of diphtheritic paralysis is irregular and variable. Its onset is, indeed, almost uniformly by the affection of the palate and eye, although, in rare cases, one or both of these parts have escaped, or their impairment has been so slight as to be unnoticed. The order in which the other parts suffer, and the degree attained by the paralysis in each, present no uniformity. As it is passing away from one part, and the patient seems near convalescence, loss of power may commence in some other part and may progress to a considerable degree: as the limbs are recovering, the pharynx may become weak, or the intercostals may fail to afford the needed strength for breathing, or indications of paralysis of the heart may give reason for the utmost concern. When one part, however, has begun definitely to improve, the paralysis does not again increase in it, nor does it return to a part from which it has passed away. The duration of the affection is thus very variable, and may be from two weeks to three months. Death is usually due to weakness from inability to take food, in consequence of paralysis of the pharynx, to asphyxia from the weakness of the muscles of respiration, or to syncope from paralysis of the heart.

Pathology.—The naked-eye changes are confined to indications of congestion, and to minute hæmorrhages in the substance of the brain and spinal cord; very seldom larger extravasations have been found in the brain. The microscope, however, shows a varying degree of acute degeneration of the paralysed muscles, sometimes very intense and accompanied with increase of their nuclei. In a few instances, such intense changes in the muscles have been the only alteration found. On the other hand, the muscles have in some cases presented little change. Degeneration in the nerves is almost invariable. It is usually greatest towards the periphery, but in the smaller branches there may be disconnected tracts of degeneration. Occasionally it extends up to, and even involves, the anterior roots, very rarely the posterior roots. Its extent and degree correspond to those of the paralysis. The affection is one of the nerve-fibres themselves, the connective-tissue elements being little altered, except in the palatine nerves. First the medullary sheath breaks up, and afterwards, in a less extent, the axis-cylinder of the fibres. The spinal cord is often normal, but sometimes slight alterations are found in it, chiefly a granular change in the motor nerve-cells. In extremely acute cases, small extravasations have been found in the nerve-roots. Organisms have been often searched for, but as a rule in vain.

The similarity of these lesions to those met with in multiple neuritis due to toxic substances, simple and organic, together with the absence, in the neighbourhood of the affected structures, of the organisms which are the actual cause of diphtheria, makes it probable that the affection is the result of some chemical substance, circulating in the blood, and produced directly or indirectly by the organisms. This opinion is supported by the analogy presented by other diseases, in which changes in the nerve-elements are associated with specific organisms which have been proved to act indirectly through the production of a chemical poison. Moreover, the opinion has been recently shown to be correct by the investigations of Dr. Sidney Martin, who has found that the disease is associated with the presence of a peculiar 'albumose' in the blood; and that this, injected into the blood of an animal, produces both the symptoms, and the exact lesion in the nerves, of diphtheritic paralysis. He has ascertained facts which suggest that this poison is not produced directly by the organisms, but that these generate a ferment which enters the blood and acts on albuminous substances, especially in the spleen; and that these substances, under the influence of this ferment-like product of the organisms, are transformed into the poison. Apparently, the degree and extent to which the organisms give rise to these chemical processes vary in different cases; and possibly the result is influenced by differences, which we cannot yet otherwise discern, in the elements of the body from which the poison seems to be produced. But the facts ascertained afford a clear explanation of all the chief phenomena of diphtheritic paralysis.

Diagnosis.—Only when the character of the primary disease has not been detected is there any difficulty in recognising the nature of the paralysis; but its successive features are so special, that, even under these circumstances, the cases are few in which a difficulty ought to exist. It is greatest when the sore-throat has been so slight that medical advice was not sought, early paralysis of the palate was absent or unnoticed, and the affection of sight trifling and transient. But the subacute onset of the affection, the state of the muscles, and the distribution of the weakness, are sufficient to suggest strongly its cause. The absence of the knee-jerk is of especial significance, not only in the cases of motor paralysis, but also when sensory loss is the chief symptom, and its peculiar distribution puzzles the observer. The knee-jerk can be obtained only in some of the cases in which there are no symptoms in the legs. Its absence, in cases in which incoördination is the chief symptom, may, however, assist an occasional mistake, that of thinking that the symptoms indicate locomotor ataxy. It is sometimes thought that true tabes has developed, even if the nature of the primary disease was recognised, when the ataxy is of long duration. But it passes away even after several months.

Prognosis.—No case is free from danger to life, which may come on even in cases of slight degree or that seem to be progressing favourably, in consequence of the involvement of the muscles of respiration, of the pharynx, or the heart. Apart from these, the prognosis is good, although it is certain that in every severe case many months must pass before physical strength returns, and a still longer time before the constitution has regained its previous energy.

Treatment.—Extreme care to maintain the patient's strength, by careful feeding and by rest, is necessary in every case, however trifling it may seem, because we can never feel sure that the strength may not be taxed to the utmost by some development of the disease. The difficulty of supplying nourishment is greatest when the need for it is most urgent — when the pharynx is so much weakened that swallowing is difficult or impossible, and dread of choking-attacks constitutes an additional difficulty. It may be necessary to give liquid food by a catheter passed through the nose, or by the rectum. In the latter case, especially, the process of digestion should be commenced, with pepsin or pancreatin, before the enemata are given. Great patience and tact are required in such cases in children to avoid the harmful influence of mental distress. The affected muscles may be gently rubbed, and voltaic electricity should be applied to them if there is conspicuous wasting, and especially if there is loss of faradic irritability. Apart from this loss, however, electricity is not necessary, and may do harm, in the case of children, by the emotional disturbance the application is apt to cause. Tonics, such as quinine, and iron if it is indicated by anæmia, may be given with apparent advantage, and it is possible that strychnine has some influence in promoting the recovery of the nerves. It is, however, doubtful whether it does good in the early stage of the affection, during which the only effectual agent would be one that neutralises the influence of the poison which is at work; and such an agent has yet to be discovered. Little can be done for other symptoms, and, indeed, for most of them little is needed. When the heart's action is unduly frequent and feeble, small doses of digitalis may be given, their effect being carefully watched. In sudden failure of the heart's action, faradisation to the skin of the præcordial region has been recommended; and in paroxysmal dyspnœa and imminent suffocation from the accumulation of mucus in the chest, from paralysis of the muscles of respiration, Duchenne believed that he had saved life by stimulating the respiratory centre by means of the application of faradism to the back of the chest.

W. R. Gowers.

PARALYSIS, INFANTILE. — Synon.: Acute Atrophic Spinal Paralysis; Anterior Poliomyelitis; Fr. *Paralysie Essentielle de l'Enfance* (Laborde); *Paralysie Atrophique Graisseuse de l'Enfance* (Duchenne); Ger. *Kinderlähmung.*

Definition. — Paralysis, acute in onset, various in distribution and extent, followed by recovery in some parts and persistence in others, with rapid muscular wasting and the electrical reaction of degeneration; commonly due to inflammation of the anterior grey matter of the spinal cord.

Ætiology.—This disease is most common in children at an age varying from a few months to a few years; three-fifths of the cases come on in the first three years of life, and hence the name by which it is often known; but it also occurs in older children and young adults, and is indeed met with at least up to middle life. In infancy, males and females suffer with equal frequency; subsequently, the affection occurs chiefly in males. Hereditary influences take but a trifling share in its causation. Season has a marked influence; three-quarters of the cases occur during the hottest third of the year. It often follows exposure to cold, and occasionally succeeds a fall at an interval of a few days. Over-exertion probably predisposes to it. It seldom follows any different malady; in the cases in which it has been thought to be secondary the general illness has really been part of the affection.

Anatomical Characters.—The atrophied muscles are found to have undergone granular or fatty degeneration, with disappearance, to a greater or less extent, of the transverse striæ. Many fibres, however, are simply narrower than normal, and occasionally a mysterious increase in width is found. Oil-globules and numerous fat-cells are also found between the fibres. Ultimately, in the most wasted muscles, fibrous tracts occupy the place of the muscular tissue, but among them a normal fibre, with its striation preserved, can here and there be seen.

It has been shown by the investigations of Cornil, Prévost and Vulpian, Charcot and Joffroy, of Lockhart Clarke and of others, that in fatal cases of infantile paralysis the spinal cord and its nerves are always affected. The few examinations made in the early stage have revealed a condition of acute inflammation of the anterior cornua, varying in degree at different parts, but extending only a short distance into the adjacent white substance. At an interval of years after the onset a condition is found such as acute inflammation would produce: shrinking of the anterior horns corresponding to the most affected muscles, with increase of the connective tissue in them, and disappearance of most of the motor nerve-cells, those that remain being reduced to small angular bodies. The corresponding fibres of the anterior roots are degenerated, and the degeneration can be followed down to the atrophied muscles.

Symptoms.—At the onset of the affection there are commonly symptoms of two classes: the paralysis already mentioned, and indications of general illness, apparently the result of a morbid blood-state—malaise, pyrexia, vomiting, headache, and sometimes general convulsions such as may attend any acute disorder in early life. These vary much in amount and duration; they may be severe, and last for days before the loss of power comes on, or they may be so slight as to be unnoticed. When severe, there is so much prostration that the process of the onset of the paralysis may not be noticed, and it may only be discovered when returning strength reveals local disability. There is frequently pain in the limbs, and sometimes pain and tenderness in the nerves so pronounced as to justify the suspicion of a simultaneous disseminated neuritis; the latter, however, passes away, and the acute paralysis is always due to the lesion in the spinal cord. The paralysis, as a rule, is motor only. Sensation is impaired only in extremely rare cases in which inflammation is so intense as temporarily to affect all the conducting functions of the cord. When sensation is impaired there is always incontinence of urine; bed-sores are almost unknown, even in the acute stage of the disease. A slight local elevation of temperature in the most paralysed parts has been noted in the early stage, but subsequently the affected limb is colder than the other. This is due, at least in part, to the loss of the aid to circulation which, in health, is supplied by muscular action.

Reflex action is necessarily lost in the parts related to the muscles involved. That from the skin is at first abolished where there is weakness, but it returns with or soon after recovery of power in the less affected parts. If the paralysis is persistent it remains absent. The myotatic irritability is lost in the same or even greater degree, so that, for example, no knee-jerk is obtainable if the extensors of the knee are even slightly affected. This loss is due to the interruption of the muscle reflex arc by the disease of the grey matter. In rare cases of cervical poliomyelitis the morbid process may spread into the lateral columns, so that, in addition to the wasting and paralysis of the arms, there may be paralysis without wasting in the legs. In such cases the myotatic irritability in the legs may be increased. After a few months, however, the condition of the legs becomes normal.

When the paralysis of a limb is incomplete, the muscles involved vary in different cases; and as different parts of two or more limbs may be affected, the combinations of palsy which result are extremely varied. Sometimes the muscles affected are those which are functionally associated; more frequently the affection is random; but the commonest condition is an irregular affection of the muscles that are associated in the centre. The degree of affection of the individual muscles also varies, the loss of power in some being absolute, in others only partial. In the legs the paralysis is rarely complete; most frequently it is partial, and the muscles below the knee suffer more often than those above the knee. The calf-muscles are affected less frequently than the anterior tibial or peroneal muscles, and hence talipes equinus is a common form of the deformity that ensues from the contraction of the less affected muscles.

In the arm nearly all the muscles may be involved, but all are seldom entirely paralysed. The intrinsic muscles of the hand often suffer, and either the thenar muscles or the interossei may be most damaged. The muscles of the forearm are frequently affected, but the supinators may escape when the extensors are involved. Of all the arm-muscles, the deltoid is that most frequently affected; it may suffer alone or in association with others. The 'upper-arm type' of palsy, of Erb, is sometimes met with, in which the deltoid, supra- and infra-spinatus, biceps, and supinators, are all involved; but the irregularity of grouping is shown by the fact that the triceps is often affected with these muscles. The serratus magnus is occasionally affected, and the upper part of the pectoralis major (which is normally associated in function with it) may also suffer, while the lower part escapes. The middle part of the trapezius, and other of the scapular muscles, are occasionally involved. The cervical muscles rarely suffer, but the diaphragm is sometimes paralysed; permanent wasting of the intercostals and trunk muscles is rare, although they may be involved at first, and this should be borne in mind, as curvature of the spine has been produced by allowing the patient to sit up while the muscles were still weak. The muscles supplied by cranial nerves are rarely affected; the writer has once seen paralysis of the face on one side, associated with wasting of the limbs, in an otherwise characteristic case, and an instance of the affection of the face and tongue has been recorded by Dr. W. Pasteur.

COURSE.—The course of the disease has been already indicated. There are: (1) the initial stage of paralysis, lasting for a few hours, a week, or even a month; (2) a stationary period, which lasts for a week to a month; (3) a stage of 'regression,' during which the palsy passes away, except from certain parts in which wasting occurs; this period usually occupies from one to six months; and (4) a chronic stage, during which the atrophy continues, slight improvement may occur, but contractures and deformities are developed. These are due to distortion of the articulations in consequence of the contraction and permanent shortening of the muscles that are less affected than their opponents, which become fixed by tissue-changes in them, and by secondary changes in the ligaments of the articulations. It is especially at the foot that these occur, constituting some form of talipes, especially talipes equinus or equinovarus, less commonly talipes calcaneus. In the case of children, the growth of the most affected limb will be hindered, and in the case of the leg this may render the effect of the paralysis more obtrusive by its interference with the gait.

The duration of this stage is indefinite, because, wherever muscular tissue remains and some voluntary power returns, this slowly improves, and the muscles develop under the influence of use, it may be during years. Complete recovery, in even the very slightest cases, is extremely rare, and, on the other hand, death from the disease is equally uncommon. If it does occur, it is in the early stage, and it may result from the initial disturbance before the nature of the complaint is recognised. Occasionally death takes place at the end of the first week or ten days, from universal paralysis, or from some profound associated cerebral disturbance.

Relapses are uncommon, and second attacks are practically unknown. Sequelæ are also rare, although in a few cases some other chronic affection of the spinal cord has come on when the subjects of infantile paralysis have reached adult life. Thus progressive muscular atrophy has been observed to start from a paralysed limb. Similarly, lateral sclerosis and acute and subacute anterior poliomyelitis have occurred in adults, the subjects of old infantile paralysis.

Diagnosis.—A difficulty in diagnosis is only likely to occur in the early stage, when the vomiting, which is so common, is apt to lead to the opinion that the affection is only gastric disturbance; and the pyrexia may cause the case to be regarded as a general febrile affection. The mistake can only be prevented by attention to the state of the limbs, and by giving due weight to any sign of defective power. Later, the wasting, the state of the electrical reactions in the muscles, and the loss of reflex action without any sensory change, will usually be sufficient to allow a definite diagnosis to be made. In the earlier condition, the existence of the paralysis is not unlikely to be overlooked, and the immobility to be ascribed to prostration. But total immobility, and still less local immobility, is not produced by prostration. When the pyrexia ceases, while the loss of power persists or increases, the existence of paralysis is always unmistakable. In adults the danger of a mistake in the early stage is less.

From chronic diseases of the spinal cord the condition is distinguished by its acute onset. Acute transverse myelitis may be closely simulated if the inflammation of the grey matter is bilateral; the age of the patient usually suggests correctly the nature of the disease. The usual form of transverse myelitis also occurs, as a rule, not in one of the enlargements, but in the dorsal region. Difficulty will, indeed, usually be prevented by the recollection of the fact that transverse myelitis in children is always poliomyelitis. The very slow onset of pseudo-hypertrophic paralysis, developing as it does gradually with the child's growth, should sufficiently distinguish it from this disease. Diphtheritic paralysis sometimes offers a difficulty, especially if the preceding sore-throat have been slight or unnoticed, but is distinguished by its gradual onset and special features. The distinction from cerebral palsy is usually easy; in this there is never loss of faradic irritability or of reflex action, nor is there extreme or local muscular wasting. The character of the convulsions also is different; those which take place at the onset of infantile paralysis are general, those which are associated with a cerebral palsy are usually unilateral or commence locally.

The only diseases outside the nervous system which may be mistaken for infantile paralysis are those in which movement is associated with pain, such as hip-joint disease, necrosis of the femur, or the affection known as scorbutic rickets, in which there are symptoms of scurvy associated with those of rickets. A careful examination is usually sufficient to show that pain is all that prevents movement. The preservation of the knee-jerk is often of great significance.

Prognosis.—In the vast majority of cases the disease involves no immediate danger to life. It is probably greatest when there is severe constitutional disturbance, and in consequence of this, before the characteristic paralytic symptoms have been noticed. There is also some danger from after-effects, especially in consequence of the slight power of resistance to other morbid influences which remains after the severe constitutional disturbance connected with the onset.

If the paralysis has remained stationary, that is, has not increased in extent, for twenty-four hours, the danger of further extension is small. As regards the question, What is likely to be the permanent condition?—an answer cannot be given for a week or ten days, and its nature will depend upon the condition found to be present on electrical examination. The muscles which then have lost faradic irritability will certainly waste, will remain for a long time paralysed, and will probably be to some extent permanently disabled. If, however, there is no loss of faradic irritability at the end of this period, but it is apparent at the end of a fortnight or three weeks, the wasting will be slighter in degree, and some ultimate recovery may be expected even in the most affected part. When there is no loss of faradic irritability, the paralysis will pass away in the course of a few weeks or, at most, a few months. But this condition is unfortunately rare.

In the chronic stage, unless there is some sign of returning power within three weeks, very little recovery will occur. The retention of voltaic irritability in the muscles is so far satisfactory as showing that there has been no destructive degeneration in them, and that there are favourable conditions for the exertion of voluntary power. But it does not lessen the grave significance of the existing palsy and the loss of faradic irritability, indicating persistent nerve-degeneration. If, on the other hand, at the end of two or three months, some, however slight, faradic irritability can be detected, improvement is probable, and it may be considerable. It is always necessary to remember that in children an apparently increased disability, referable to arrest of growth, is really compatible with actual improvement.

Treatment.—The treatment in the early stage should be that of the general state, guided by any causal indications that may be detected, such as free sweating and salicylate of sodium in a case distinctly due to exposure to cold. If there is pyrexia, a diuretic may be added. The child should be kept at perfect rest on the side, and warmth applied over the affected part of the cord by poultices or fomentations. When there is spinal pain, marked relief is afforded by these means.

It is very difficult, in such a disease as this, to ascertain the effect of treatment, as there is a natural tendency for the morbid process to cease and for improvement to take place. Full doses of ergot and belladonna have been credited with the power of arresting it, although there is no definite proof that the arrest and the use of these remedies have been anything more than coincident. Either, however, may be employed apparently without fear of harm.

When the acute first stage is over, careful management must be continued for some time, especially in the cases in which the constitutional disturbance has been great. When the acute stage is over, tonics, especially iron and quinine, are needed. Strychnine also may be given in all cases, but it should not be commenced sooner than three or four weeks after the disease has become stationary. As the malady frequently occurs at an age at which rickety conditions develop from any interference with the general health, treatment with the view of anticipating such constitutional effects should be adopted in young children. For this purpose iron and cod-liver oil are especially useful.

The use of electricity is an important part of the treatment, and, in order to prevent its ineffective or harmful employment in unsuitable circumstances, the reasons for its employment ought to be clearly understood. There is no evidence that it can or does influence the process of recovery of the damaged elements either in the cord or nerves. The reasons for its use depend upon the fact that the disease entails nerve-degeneration, and that the related muscular fibres undergo changes in nutrition and ultimately perish if no nerve-regeneration occurs. While the influence normally exerted through the nerves is in abeyance, the muscles are destitute of functional stimulation, and it is with the view of supplying the place of this that electricity is to be used. When both cell and fibre have perished, electricity can do no good; but where there has been damage but not destruction, so that the fibres recover and again become capable of conveying nutritional and volitional influences, electricity is of distinct service in preventing a disproportionate failure of muscular nutrition. Only voltaic electricity can stimulate the muscle when the nerve-fibres are degenerated, and this is consequently the form that must be used. The mode of application is determined by the fact that it is only when the current is interrupted that the muscular tissue is stimulated to contract. One terminal is kept still, the other being stroked down the muscles and lifted from the skin at each stroke. Some place the immobile terminal over the spine, but there is no evidence that the spinal cord is reached in this way. The negative pole will be that most generally useful in stroking the muscles, as the normally greater irritability to the negative pole frequently persists. Of course, soft well-moistened terminals must be used, the skin also being thoroughly softened with water or salt and water, and a current should be used sufficiently strong to produce visible contraction, provided this does not cause distressing pain; if it does, it is better to be content with the strongest current that can be borne without emotional disturbance. The strength used should always be gradually increased.

Systematic rubbing of the affected muscles is also useful. This stimulates the circulation, which is always defective, and probably promotes nutrition. The muscles should be rubbed and gently kneaded daily, upward rubbing being especially useful. Great care should be exercised in keeping the affected limbs as warm as possible; and bronchial catarrh should be guarded against, especially in cases in which the respiratory muscles are involved.

The prevention of deformities of the spine or in connexion with contractures causing displacement at joints must be carefully looked to. Mechanical appliances may have to be ultimately adopted, and not infrequently tenotomy is necessary. But such deformities should as far as possible be prevented by systematic movement and attention to posture. The process of slow improvement, once started, may go on for years by the slow growth of the muscle that has recovered under the stimulus of use, and this improvement may be augmented by various contrivances for allowing the muscle to act to the best advantage.

W. R. Gowers.

PARALYSIS, SENSORY.—*See* Sensation, Disorders of.

PARALYSIS, TOXIC.—Various kinds of paralysis, due to multiple neuritis in the main, are produced by such poisons as alcohol, arsenic, and lead on the one hand; and by the poisons associated with certain specific diseases on the other, such as diphtheria, tuberculosis, variola, and others of the exanthemata. Most of these conditions are described together under the head of 'multiple neuritis' (*see* Neuritis, Multiple; and Paralysis, Diphtheritic). It should be remembered, however, that in the case of arsenic, and still more of lead, paralytic symptoms traceable to poisoning by these substances may be due in some instances, wholly or in part, to degenerative changes in the anterior cornua of the spinal cord. It has been thoroughly established that, in some cases, poisoning by lead leads to pathological conditions of the spinal cord very similar to those met with in chronic spinal paralysis. A similar tendency to involvement of the spinal cord, rather than the peripheral nerves, occurs during or just after some of the acute specific fevers. It is well known that the beginnings of various diseases of the spinal cord are prone to date from such a period.

H. Charlton Bastian.

PARAMENIA (*παρά*, irregularly; and *μήν*, a month).—A term for irregular menses. *See* Menses or Menstruation, Disorders of.

PARAMYOCLONUS MULTIPLEX (*παρά*, indicating on both sides; *μῦς*, *μυός*, muscle; and *κλόνος*, commotion).—Definition.—An affection, occurring in adults, usually ending in recovery, which is characterised by clonic spasm in the muscles of the limbs, symmetrical, but varying in different parts, and often more or less paroxysmal. It was first well described by Friedreich, who proposed for it this designation. Among the cases which have been since observed, there have been many variations from the type of the original case, and the malady is not well defined.

Ætiology.—Little is known of the causes of the affection, beyond the general facts that it occurs chiefly in men, and may begin at any age between puberty and sixty years. It does not appear to be hereditary; cases of clonic spasm in several members of a family have differed considerably from this form. The onset has generally seemed spontaneous; in a few cases it has followed some apparent exciting cause, such as fright, rheumatism, or malarial fever, but such cases have been too rare to suggest more than a general disturbing influence on the nervous system.

Symptoms.—There are sudden spasmodic contractions of the muscles, the same muscles on the two sides usually acting together, but in unequal degree. The contractions on each side involve a single muscle or only part of a muscle, or one or two adjacent muscles, and quickly pass from one part to another. Their frequency has varied from ten to fifty per minute; but they are irregular in time, a series of quick contractions being followed by longer intervals. In some cases tonic spasm has occurred from time to time, but it was not present in the case described by Friedreich. On the other hand, very slight, and even fibrillary, contractions have also been occasionally noticed. The spasm is seated chiefly in the larger muscles, especially the deltoid, biceps, triceps, extensors of the knee, flexors of the knee, and the calf muscles. It is in these muscles that the contractions are sufficiently strong to cause movement; slighter contractions are sometimes observed in the small muscles of the hands and feet. The diaphragm is occasionally involved, causing a peculiar sound, something like hiccough. Voluntary movement lessens the spasm, and occasionally arrests it; it is also diminished by alcohol and by mental excitement. In a few cases the contractions have continued during sleep. They have been so violent in some cases (which are at least allied to this form) that the energetic spasm has thrown the patient from the chair on which he was sitting. As a rule, there have been no other symptoms, in either the nervous or general system. After lasting for several months, or even for a year, the spasmodic contractions have gradually lessened, and, in most cases, have passed away.

Nothing is known of the pathology of the affection. Such clonic spasm characterises the 'electrical chorea,' which occurs in Italy, and is probably the result of a toxic influence, possibly malarial. But this is a fatal disease, and is thus sharply differentiated from 'paramyoclonus.' The latter is probably allied to the peculiar chronic 'senile chorea,' which is occasionally met with in persons who have not yet reached old age, and is sometimes recovered from.

Treatment.—It is not clear that any treatment has modified the course of the malady, which has had a definite tendency, in most cases, either to lessen or to persist. But it has been thought that benefit has been afforded by giving bromide of potassium as a sedative, together with quinine, strychnine, and other nervine tonics. Voltaic electricity has been said to do good in a few instances, a current as strong as the patient can bear being passed from the spine to the affected muscles for a quarter of an hour each day. In very severe cases the hypodermic injection of morphine has been useful. It is probable that phenazone or acetanilide would be beneficial, but the malady is so rare that therapeutical facts can only be very slowly accumulated.

W. R. Gowers.

PARAMYOTONE (Paramyotonia; *παρά*, on both sides; *μῦς*, *μυός*, muscle; *τόνος*, stretching).—This name is applied to a condition characterised by muscular spasm. It is thus applicable to Thomsen's disease, a more common designation of this condition being, however, *myotonia*. Two varieties of paramyotone have been described—the *congenital* by Eulenburg, and the *ataxic* by Dr. Gowers. In the former, several members of the same family were affected, and in some of these the symptoms were present soon after birth. The malady was characterised by transitory tonic spasm, easily excited by cold, and usually dispelled by warmth. The facial muscles were especially liable, and the rigidity was succeeded by weakness. There was no change in the electrical reactions, except that the irritability seemed to be lowered. In the solitary case of *ataxic* paramyotone, described by Dr. Gowers, there was persistent tonic spasm associated with ataxy. There was weakness both of arms and legs, but the incoördination was greatest in the arms. There was also impaired sensibility, distinct for touch and pain, slight for temperature, on the hands and feet, especially the palms and soles. No sign of myotatic irritability could be elicited, but the rigidity was such as to account by itself for this absence. There was no change in the electrical irritability of the muscles. JAMES TAYLOR.

PARAPHIMOSIS (*παρά*, beside; and *φιμοω*, I confine).—SYNON.: Fr. and Ger. *Paraphimosis*.—A morbid condition of the penis, in which the prepuce, having been drawn or forced back behind the glans, cannot be returned, and thus gives rise to a condition of strangulation of the parts in front of it. *See* PENIS, Diseases of.

PARAPLEGIA (*παρά*, incompletely; and *πλήσσω*, I strike).—Paralysis of the lower extremities, usually associated with paralysis of the lower part of the trunk, bladder, and rectum. *See* PARALYSIS; and SPINAL CORD, Diseases of.

PARAPLEGIA, ATAXIC. — The name 'ataxic paraplegia' has been given to a condition in which a lateral and a posterior sclerosis of the spinal cord co-exist. There does seem to be a tendency in some cases for sclerosis to occur simultaneously in these two columns, and thus to constitute a separate morbid entity. On the other hand, such a combination with analogous symptoms may present itself in disseminated sclerosis of spinal origin; as an extension of a primary lateral, or even of a primary posterior sclerosis; whilst something very similar may present itself also in Friedreich's disease (or 'hereditary ataxic paraplegia,' as it is also termed). Looking to the transition forms between these affections, it seems questionable whether any adequate advantage from a clinical point of view can result from the description of a separate morbid condition under the head of 'ataxic paraplegia.' It may be sufficient for us to recognise that, under the various conditions above referred to, we are liable to get a grouping of symptoms indicative of co-existing disease in the lateral and in the posterior columns. *See* SPINAL CORD, Special Diseases of.

H. CHARLTON BASTIAN.

PARAPLEGIA, INTERMITTENT. *See* NEURITIS, MULTIPLE.

PARASITES (*παρά*, upon; and *σιτέω*, I feed).—SYNON.: Fr. *Parasites*; Ger. *Parasit*.

DEFINITION.—This term, in its most extended sense, is applied to those organisms which derive their nourishment wholly or in part from other living beings. Parasites may be vegetable or animal—*phyto-parasites* or *zoo-parasites*; may live upon the surface of, or in the textures or cavities of, the individuals they infest—*ecto-parasites* or *ento-parasites*; and may pass through the whole cycle of their existence in the parasitic state, or only during certain stages of their life.

This definition will include such varied species as tinea and trichina, the various hæmatozoa, and many micro-organisms, which feed upon the living tissues of the hosts they infest; those which subsist on the material prepared by the host for its own nourishment, such as the intestinal worms; and, lastly, those which only temporarily sojourn on the surface of the body, for the purpose of obtaining food, and do not live, for any definite period of their existence, upon or within their entertainer—for example, fleas and gnats.

The majority of these parasites are direct causes of disease, although many may develop to a very considerable extent without giving rise to any symptoms of illness; and a few may be even regarded as normal inhabitants of the body, taking a share in healthy physiological processes, such as duodenal digestion.

A few only of the fungi, such as the blue moulds (*penicillium glaucum*), may be looked upon as a result of a morbid condition, being occasionally met with on the surface of old ulcers, and in old cavities of the lungs.

Parasites, Vegetable.—Vegetable parasites are included under the general term of *fungi*. More accurately they are to be provisionally referred to the three lowest classes of the sub-kingdom Thallophyta—viz.:

i. *Schizomycetes*, or Fission Fungi, which include Micrococcus, Bacterium, Bacillus, Vibrio, and Spirillum.

ii. *Saccharomycetes*, or Yeast Fungi, such as Torula, Mycoderma, and Oïdium albicans.

iii. *Hyphomycetes*, or Moulds, as Mucor, Aspergillus, Penicillium; also the various forms of Tinea, and Achorion Schœnleinii. *See* MICRO-ORGANISMS; TORULA; TINEA; and EPIPHYTIC SKIN-DISEASES.

W. H. ALLCHIN.

PARENCHYMATOUS (παρά, beside; and ἐγχέω, I pour in).—The word *parenchyma* was formerly used to designate the connective tissue of the several viscera; but it is now applied to the protoplasm, or active elements, of a tissue or organ; and morbid processes affecting the actual substance of an organ are hence called *parenchymatous.*

PARESIS (παρίημι, I relax).—A slight or imperfect paralysis of motion. *See* PARALYSIS.

PARONYCHIA (παρά, beside; and ὄνυξ, the nail).—Inflammation in close proximity to a nail. A synonym for whitlow. *See* NAILS, Diseases of; and WHITLOW.

PAROTID GLANDS, Diseases of. *See* MUMPS; and SALIVARY GLANDS, Diseases of.

PAROXYSM (παρά, indicating increase; and ὀξύνω, I sharpen).—This word is used to indicate the periodic attacks or fits which characterise certain diseases, whether regular or irregular, such as ague, gout, and asthma. It is also used to designate the aggravation of certain symptoms from time to time, such as neuralgic pain, colic, and dyspnœa. Diseases characterised by these phenomena are called *paroxysmal diseases.*

PARTIAL (*pars*, a part).—When applied to disease, this term may refer either to its extent, or its degree. Thus we speak of *partial paralysis*; and *partial blindness, deafness*, &c.

PASO ROBLES HOT SPRINGS, San Luis Obispo County, California, U.S.A.—Muriated saline sulphur springs. *See* MINERAL WATERS.

PASSIVE.—This epithet is used by some pathologists in connexion with certain morbid conditions, such as congestion, dropsy, œdema, and hæmorrhage, where there is deficiency of vital power, either general or local, and a want of reaction or resistance in the tissues. Some pathologists employ the term *passive congestion* as synonymous with congestion from obstruction (*see* CIRCULATION, Disorders of; and HYPOSTASIS). *Passive movements* of any part, for instance, of a joint, are movements effected by some agency external to the limb, such as the hands of the practitioner or of the patient himself, in contradistinction to movements produced by the muscles of the affected parts, which are called *active movements. See* MASSAGE.

PATENT FORAMEN OVALE or SEPTUM.—*See* HEART, Malformations of.

PATHOGENIC (πάθος, disease; and γεννάω, I give rise to).—A term applied to the production of a disease, having reference to the mode in which the several causes which lead to it operate in its development.

PATHOGNOMONIC (πάθος, disease; and γιγνώσκω, I recognise).—This word is associated with those symptoms and signs which are specially characteristic of a disease, and the presence of which renders its diagnosis certain. *See* DISEASE, Diagnosis of.

PATHOLOGY (πάθος, disease; and λόγος, a discourse).—Pathology is the name generally accepted for the science of disease, but the subjects which it may include cannot be exactly defined. For ease and disease, well and ill, and all their synonyms, are relative terms of which none can be defined unconditionally. If there could be a fixed standard of health, all deviations from it might be called diseases; but a chief characteristic of living bodies is, not fixity, but variation by self-adjustment to a wide range of varying circumstances, and among such self-adjustments it is not practicable to mark a line separating those which may reasonably be called healthy from those which may as reasonably be called disease.

The impossibility of marking such a line may be tested during changes in any external conditions of life; for instance, in the adjustments of the skin to a widely varying range of external temperatures. Where and when in the changes of skin produced by long contact with water rising from 20° F. to 200° F. would health cease and disease begin? Similarly in the consequences of mechanical injuries. The complete repair and reproduction of injured and lost parts is an excellent instance of health; and in many plants injuries elicit a greater production of healthy structures than would occur in their integrity—as in the leaf of a begonia or a cardamine, in which a fresh shoot may grow from each of many wounds. But while these and similar adjustments to conditions produced by injury may be deemed results and signs of health, many others, such as those which may follow severe crushings and open wounds of limbs, must rather be called processes of disease, even though they may end in some repair of injury. Among all the cases intermediate between these extreme groups of adjustment to consequences of injuries, it is not possible to separate the healthy and the diseased.

In this impossibility of scientific definition the range of pathology is vaguely settled by a general understanding as to what may be called disease, and in this settlement are included all the states which are distant from health, whether they be in the way of diverging from it or in that of returning to it, as in convalescence. And some states are included for which it is hard to assign a better or other reason than that they are not useful to us. When fruits or other parts of plants or animals, which have been made useful by cultivation, revert to their more natural state and become useless to us, they are generally regarded as diseased.

Moreover, in the study of any disease its processes are found, though different, yet not essentially distinct or separable from those of health. Even in the instances of the widest deviations from health, as in the diseases called specific or malignant, a considerable part of the phenomena are due to processes tending towards a reversion to health, and even the changes most averse from health are limited within certain methods not wholly unlike the healthy ones.

In this view pathology may be regarded as an extension of physiology into the study of living bodies in conditions widely unlike those of their ordinary life. Pathology, herein, accepts the conventional limitation of physiology to the study of the nature of living things; but the limitation is convenient more than just. It is not possible to give a verbal definition of the difference between the study of crystals deformed or repairing after injury, and that of monstrosities and the processes of repair in plants and animals. As physiology is not truly limitable from chemistry and physics, so in pathology many processes are illustrated by things abnormal or contrary to general rule in dead matter.

Pathology finds in physiology its basis, the varying standards of healthy structure and function with which its subject-matters are in contrast, and the models and methods of its study; but its range is wider than that of physiology, inasmuch as the conditions giving rise to disease are much more numerous and more various than those of health. Moreover, the deviations from health may reach so far and wide, that the facts and general principles of physiology can only with extreme caution be applied to them. For instance, the greater part of what may be called personal characteristics in respect of health can only be observed in phenomena of disease. It is from observation of these that our knowledge is derived of diatheses or constitutional peculiarities, and of conditions predisposing to overt disease. Of them and their various minglings and alterations by inheritance, and by tendencies to reversion towards health, physiology can give no account; its suggestions cannot be safely used unless completely subject to the test of pathological inquiry.

It seems certain that many erroneous and too narrow systems of pathology have been derived from the beliefs of pathologists that they could safely, from the general truths of physiology or even from some section of them, infer what must be true in respect of disease. Hence, by means of inferences from the parts of physiology for the time being most studied, there have arisen the systems of *vital* and *chemical*, of *humoral* and *neural*, pathology, all containing many truths, but none of them able to stand the test, without which nothing in pathology should be deemed true--the test of a wide and direct study of diseases. It would be well if all systems of pathology which can be thus specially named should be suspected of great error. The science of disease should not be divided or specialised on any other ground than physiology may be, as by the names of *general*, *comparative*, *animal*, *vegetable*, and the like. The study of any one of these divisions, wide as it may be, is not safe unless with frequent reference to the others for their aid; and every study of diseases of one part or of one kind is very unsafe, unless with a constant consciousness of its narrowness and partiality. Even if it could be made sure that many diseases begin in morbid states of the blood or nervous system, or any other chief constituent of the body, it would be nearly as sure that within a few hours, or even minutes, of their beginning the other chief constituents would be involved. For the relations of the several parts are so intimate and, through the nervous system and the circulating blood, their means of communication are so swift, that if one be diseased none can long remain healthy. There is no truth more necessary to be held in pathology, and in its practical applications, than that the health of each part is a necessary condition of the health of all the rest.

James Paget.

PAU, in the Basses Pyrénées, France.—A mild, calm, sedative, winter climate. Mean temperature, 42° F. Absence of cold winds; soil, gravel. *See* Climate, Treatment of Disease by.

PECTORILOQUY (*pectore*, from the chest; and *loquor*, I speak).—A physical sign, connected with vocal resonance, heard on auscultation in some limited parts of the chest. The sounds of the voice in pectoriloquy are directly conducted to the ear, so that the words spoken by the patient may be distinctly recognised by the observer, as if proceeding from within the chest. *See* Physical Examination.

PECTORILOQUY, WHISPERING. — *See* Whispering Pectoriloquy; and Physical Examination.

PEDICULUS.—Three species of lice are parasitic on man: (1) *Pediculus capitis*; (2) *Pediculus vestimenti vel corporis*; and (3) *Pediculus pubis*.

1. **Pediculus capitis.**—This species of pediculus infests the head, especially the occiput; and deposits its eggs on the shaft of the hair, usually not far from the root. The ovum is a small oval, semi-transparent body, somewhat cupped at its free extremity, and very firmly attached by a short peduncle to

the hair. The young are hatched in about five days. The louse when full-grown is about a line in length, the female being larger than the male. The head, thorax, and abdomen, which is oval, are distinct. The head is furnished with two short antennæ, and large, black, prominent eyes. Springing from the thorax are six well-developed legs, armed with strong claws, with which the animal grasps the hair. On the back of the male is seen a conspicuous, elongated, conical organ, the penis. The animal is of a semi-transparent, dirty-white colour, and is covered with short scattered hairs.

2. **Pediculus vestimenti.**—This species closely resembles in shape and general appearance the pediculus capitis, but is of larger size. It infests the underclothing, with a preference for that of a woolly kind, and it attacks and irritates the parts of the skin that are covered by clothes. The ova are deposited, not on the hair of the skin, but on the wool or fibre of the clothing, and the young are hatched in about five or six days.

3. **Pediculus pubis.**—This is much smaller and relatively shorter than either of the other species, and the line of separation between abdomen and thorax is less marked. The abdomen is short and rounded, which gives the animal a crab-like shape. Like the other species, it has six legs, armed with strong claws for grasping the hair. This louse infests the pubic region, and occasionally the axilla and hairy parts of the body and face, especially the eyelashes. The ova are found firmly attached to the hairs near the roots.

The different species of pediculi do not bite, as they have no jaws; but they pierce the skin and draw blood by means of a sucking apparatus or *haustellum*, and in this way they derive their sustenance from the human body. Regarded in a pathological aspect, the presence of pediculi is described as a disease under the name of *morbus pedicularis*, or *phthiriasis*. *See* PHTHIRIASIS.

ROBERT LIVEING.

PEDILUVIUM.—*See* BATHS.

PELLAGRA (πέλλα, the skin; and ἄγρα, a seizure).—SYNON.: *Erythema Pellagrosum*; Fr. *Pellagre*; Ger. *Pellagra.*—An erythema of the skin, indigenous to hot countries, and common among the peasants in Italy, Spain, and the South of France, which makes its appearance on the parts of the body most exposed to the light, especially the back of the hands, the neck, and the breast. *See* ERYTHEMA.

PELODERA.—A genus of 'free nematoids,' one species of which (*P. setigera*, Bast.) was found *post mortem* by Dr. Charlton Bastian as a parasite in the muscles of a boy who died of a febrile epidemic disease on board the 'Cornwall,' off Purfleet, in 1879, and whose body was exhumed after two months for examination. The suggestion was advanced that the pelodera was the cause of the fatal disease. This is, however, mere conjecture; and all distinct evidence as to the mode of infection, and as to the existence of the parasites in the body during life, is wanting.

PELVIC ABSCESS.—DEFINITION.—An abscess situated in the pelvis, and generally connected with some uterine or rectal affection.

ÆTIOLOGY.—The causes of pelvic abscess are: (1) Breaking down of tubercles; (2) Suppurative action, the result of broken-down hæmatocele or suppurating ovarian or extra-uterine cyst; (3) Inflammation of the pelvic peritoneum; and (4) Inflammation of the cellular tissue in connexion with the uterus, Fallopian tubes, ovaries, broad ligaments, and rectum, or the general cellular tissue of the pelvis. Malignant disease of or about the womb is sometimes accompanied by suppuration in the line of the lymphatics.

Pelvic peritonitis and cellulitis being often combined, pelvic abscess may arise from the joint action of these causes; and, indeed, after an abscess has arisen, it is very difficult, if not impossible, to differentiate as to its primary origin.

SYMPTOMS.—Pain of a shooting character, with increased local tenderness, accompanied by rigors, sweating, and pyrexia, supervening upon the symptoms of pelvic cellulitis or of pelvic peritonitis, will generally indicate the onset of the affection. *See* PELVIC CELLULITIS; and PELVIC PERITONITIS.

An abscess having arisen in the pelvis, it conforms to the same general laws as abscesses in other parts, its extension depending upon the relative firmness and tension of the surrounding tissues, an abscess generally burrowing in the direction of least resistance. Thus pelvic abscess may open in the following positions, singly or combined: 1. Through the abdominal walls and saphenous openings. 2. Into the pelvic viscera, as the bladder, rectum, vagina, or urethra. 3. Through the floor of the pelvis, near the anus. 4. Through the pelvic foramina, either obturator or sacro-ischiatic. 5. Through the pelvic roof into the peritoneal cavity. 6. Into the lumbar region, in the position of the kidney.

Such are the many and various courses which an abscess originating in the pelvis may take. Fortunately some of those enumerated are rare, such as opening into the peritoneum. No doubt its starting-point has much to do with its subsequent course, which admits of explanation chiefly on anatomical grounds. Should an abscess open into the peritoneum, then our trouble will no longer be with the abscess, but with the peritonitis that ensues, so that we may lose sight of the primary disease in the gravity of the secondary lesion.

Should the abscess open into the rectum, we shall have a discharge of pus and fæcal matter from the bowel, often of a most fœtid character, especially if there be entry of gas into the abscess. On its opening into the bladder long-continued cystitis may supervene. Should a communication become established between these two organs, we shall have the indication of fæcal matter present in the urine.

Treatment.—Pelvic abscess must be treated as deep-seated abscesses in other parts of the body in the early stages, namely, by inducing pointing by hot fomentations or poultices; but when matter has formed the treatment will vary somewhat, according to the position the abscess takes: 1. When the abscess is threatening to point above Poupart's ligament, it is generally wisest not to use the lancet until the skin is seen to be definitely implicated; but when suppurative symptoms are well defined, it is a better plan to cut down with a scalpel, make a small opening, enlarge it with forceps, and, having washed out the cavity with antiseptics, to put in a drainage-tube and treat as usual in such cases. 2. When the matter is burrowing down the leg, or away from the pelvis, beneath the fasciæ, it must be treated according to the usual rules laid down in surgery for deep-seated abscesses beneath fasciæ, but the earlier we open the better. 3. Should the matter be in the floor of the pelvis, bulging into the vagina and rectum, and highly irritative symptoms exist, then it will be advisable to employ an aspirator, and, if pus be clearly observed, to open with full-sized trocar and cannula. When the fluid is evacuated, it is well to pass up a drainage-tube, carefully withdrawing the cannula, and leaving the tube in position, through which the cyst should be washed out twice daily with an antiseptic fluid, such as some preparation of iodine; the tube can be removed when the discharge ceases to flow. By some it is advised to make a free incision at first, plugging with antiseptic cotton or gauze, after washing the cavity out. Should hæmorrhage have occurred in the cyst, the difficulty of evacuation of its contents will be great; in this case it has been recommended to lay open the cyst with a bistoury.

The posture the patient assumes is also of importance—the pus should gravitate to the opening; thus, supposing the opening in the rectum or bladder, then the vertical posture will expedite the cure. In the same way any other position may be assumed which fulfils this end.

But of late there has been a tendency at an early period to explore, either by abdominal section or by dissecting down, according to the position of the pus. No doubt there are advantages in so doing, and thus serious burrowing is prevented, though diffuse abscess is less common than formerly when depletive measures were more used in the early stages. When the pyogenic cyst wall is thick and hard there is less danger of rupture or diffusion, but when it spontaneously opens it is often only partially emptied; and later on, after apparent cure, it re-gathers and discharges perhaps a third time.

A bandage round the upper abdomen assists in compressing the pus-cavity.

The general health must always be kept up by the administration of tonics, good food, and stimulants, so as to counteract the exhaustion due to the prolonged suppuration.

J. Braxton Hicks.

PELVIC CELLULITIS.—Synon.: *Parametritis* (Schroeder, Virchow, and Matthews Duncan); *Perimetritis.*

Definition.—An inflammation of the cellular tissue surrounding the pelvic organs, both in the male and female, but much more frequently in the latter, and therefore more especially of the areolar tissue in connexion with the uterus and its appendages. Various views have been held with respect to the pathology of pelvic cellulitis, each author giving a name according to his idea of its origin; though, indeed, two distinct affections, pelvic cellulitis and pelvic peritonitis, are described under the general name of pelvic cellulitis.

Ætiology.—The causes of pelvic cellulitis are many and various, but it may be broadly stated that it may arise from any irritation to the mucous membrane, either of the uterus, vagina, or rectum, whether septic or benign. Of these the principal are traumatic, and consequently most cases are seen in connexion with the puerperal state, such as lacerations of the vaginal portion of os and cervix uteri, and after operations connected with the female genital organs; but in some persons, due no doubt to some remarkable idiosyncrasy of the patient, the passage even of a sound, or the retention of a pessary, slight cause as it may seem, is in itself sufficient to excite all the phenomena of pelvic cellulitis. Of the other than traumatic causes may be mentioned sexual excess, dysmenorrhœa, suppression of the menses, and gonorrhœa.

Anatomical Characters.—It was not until Nonat and Bernutz began to study the subject of pelvic cellulitis that any progress can be said to have been made in regard to its pathology. Nonat seems to have considered that the pelvic cellular tissue was chiefly the seat of this affection; whilst Bernutz, writing shortly afterwards, denied that the cellular tissue was in any way affected, and described it as an affection of the pelvic peritoneum; hence we have the term 'peri-uterine phlegmon' of Nonat, and 'pelvi-peritonitis' of Bernutz. Virchow, and Matthews Duncan, following his suggestion, have used the terms 'parametritis' and 'peri-metritis,' 'para-' signifying an inflammation of the cellular tissue, 'peri-' an inflammation of the serous membrane surrounding the uterus. Schroeder uses the term 'pelveo-peritonitis' in much the same way as Bernutz, and adopts the 'parametritis' of Virchow. Cruveilhier, Champonierre, and Tilt have pointed out the share which they believe the lymphatics play in this disease, and to this they give the name of lymphangitis. The terms 'pelvic cellulitis' and 'pelvic peritonitis' appear in the Nomenclature of the College of Physicians, and we see no good reason to alter the names. Pathologically, no doubt, the distinction can be made in most cases, but clinically some difficulty arises, and many and various have been the computations as to their relative frequency. Schroeder points out that, even pathologically, the false cyst in pelvic peritonitis may become so thickened as to resemble that of pelvic cellulitis; and as the majority of cases tend towards resolution, and as there is a clinical difficulty as to diagnosis, coupled with their frequent co-existence, there must always be some diversity of opinion as to their relative frequency.

Pelvic cellulitis being caused, as we have said, by some irritation of the genital organs, the question as to the mode of its production, and the part which the different tissues take in its transmutation, has been frequently discussed. Some, after the suggestion of Dance, supposed that the venous system acted the part of the carrier in conveying the *materies morbi*. For a long time the profession were content to receive this as an explanation of the phenomena, until Cruveilhier and Champonierre showed the part which the lymphatics played in this disease. Besides this, there is reason to believe that, in those cases where the passage of a sound and such-like simple irritants are the cause of pelvic cellulitis, the nerves must play an important part, to account for such a rapid effusion of so much plastic material; although some insist that in all cases sepsis is the cause.

Pelvic cellulitis begins by an exudation of an albuminous nature into the cellular tissue. This, as in other cellular inflammations, may become absorbed, the fluid portion first, and the more solid portion at a later period; or, instead of ending in resolution, it may take on a retrograde metamorphosis, and end in abscess.

The exuded material thrown out in pelvic cellulitis follows the same steps wherever it may be situated in the pelvis, although its name and clinical symptoms vary according to its topographical distribution. But inasmuch as the effused material is thrown out into the cellular tissue near such a sensitive organ as the peritoneum, the inflammation is liable at any time to spread to and involve this membrane, by reason of its continuity. The peritonitis may either become localised, or may spread and involve the whole membrane, giving rise to general peritonitis; when the latter result occurs it is generally due to a septic cause, frequently spreading with extreme rapidity. It is highly probable that lymphangitis plays an important part in cases of this kind.

Symptoms.—A small amount of pelvic cellulitis may in itself give rise to very slight symptoms, perhaps merely a sense of uneasiness in the lower portion of the abdomen. This is often the case in slow recovery from the lying-in state, and may be overlooked, a vaginal examination not being deemed necessary, the symptoms varying much according to the rapidity and the quantity of the exudation. Should a large quantity be exuded, the most prominent symptoms will be more severe, namely, more or less tenderness on deep pressure, with dull aching pain in the pelvis, languor, and pyrexia; along with these there may be obstinate constipation and pain in defæcation. Dysuria also may be a prominent symptom. The presence of the last two symptoms will depend upon the situation of the effusion, and its pressure on the rectum and bladder.

Physical signs per vaginam.—In the early stage, there being only an effusion of fluid, its detection will be difficult; but as the matter becomes more solid, we shall be aware of a dense mass, usually limited to one or other side of the uterus, but if the amount be large, entirely surrounding the organ. This effusion is generally in the layers of the broad ligaments, either attached to or separate from the uterus, but usually fixed to it; and when the effused matter has had time to consolidate, it is of considerable hardness, similar to that of a uterine fibroid. but generally irregular in outline, often following the form of the roof of the vagina. A uterus fixed by hard, irregular, and immovable swelling is considered by some as pathognomonic of pelvic cellulitis. Pain running down the legs, on flexion and abduction of the thigh, owing to implication of the lumbar and iliac glands, and of the cellular tissue around the psoas and iliacus muscles, simulating hip-joint disease, is also a valuable diagnostic sign in some cases.

At the onset the temperature generally rises in the evening to 101° or 102°, rarely higher, and is lower in the morning.

The pulse is full in the benign cases; but in the septic form it is dicrotic, and towards the end in fatal cases becomes extremely so. The pulse and temperature form a valuable guide as to the state of the case. Favourable cases may recover in a few days, but generally go on for weeks or months, absorption gradually taking place, its duration depending much on the general state of the patient and the amount effused. But should the case break down and end in abscess, the presence of this will be shown by increased pyrexia, probably rigors, and localised pain of a shooting character. For the signs of inflammation extending to the peritoneum, *see* Pelvic Peritonitis.

Diagnosis. The diagnosis of pelvic cellulitis from the diseases with which it may be most readily confounded will be found in the articles on Pelvic Hæmatocele, and Pelvic Peritonitis.

Treatment.—When the pathology of pelvic cellulitis is fully considered, it will be seen that the treatment must depend upon the stage to which it has advanced. In the acute stage we should employ salines, and sedatives for the relief of pain, such as opium, chloral hydrate, and also quinine in full doses; and locally, hot fomentations applied to the lower part of the abdomen, and hot opiate and antiseptic injections given *per vaginam.* Iodoform suppositories are likewise useful employed continuously, combined with morphine if there is much pain. Leeches are often applied with much benefit to the groin, perinæum, or, still better, to the os uteri—three or four at a time, thereby removing any temporary congestion of those parts. The bowels are better moved by an enema than by purgatives given by the mouth, which if active may cause extension of the inflammation to the peritoneum. When the inflammatory action has subsided, the re-absorption of the plastic material which has been thrown out is assisted by the administration of tonics, as iron and quinine. Iodide of potassium is much relied on by some practitioners, and may be given with advantage combined with tonics; but probably the best means of promoting absorption is by restoring the general health by every method possible. The Americans and Germans recommend the vaginal douche night and morning for about twenty minutes; they believe that it acts as an absorbent as well as a sedative. In the septic variety much success has attended the exhibition of large doses of quinine, five grains every four hours having been given with advantage. In all cases rest is imperatively called for, even after the inflammatory stage is past.

J. Braxton Hicks.

PELVIC HÆMATOCELE.—Synon.: Peri-uterine Hæmatocele; Retro-uterine Hæmatocele; Pelvic Thrombus.

Nature.—Nélaton described this affection as a tense bloody tumour situated in Douglas's *cul-de-sac*, which pushed the uterus forward towards the symphysis pubis. Afterwards every bloody tumour in connexion with the pelvic organs came to be so described by some authors. Thus Dr. Robert Barnes classes ruptured uterus with an effusion of

blood into the peritoneal cavity as an example of pelvic hæmatocele.

Any effusion of blood which takes place either from ruptured uterus or from other organs is not by most authorities now considered as true pelvic hæmatocele; indeed, blood effused from the liver, kidney, or other organ which has found its way into Douglas's pouch, might thus be included under this name. Pelvic hæmatocele consists of two varieties, to which the names of (1) *retro-uterine hæmatocele* or, better, *intra-peritoneal hæmatocele*, and (2) *pelvic thrombus* or *hæmatoma*, have been given. The first of these affections may be described as an effusion of blood into the retro-uterine sac, subsequently shut off from the rest of the peritoneum by an effusion of plastic material. The second variety, *pelvic thrombus* or *hæmatoma*, is an effusion of blood into the cellular tissue of the pelvic organs, and more especially of that in connexion with the uterus. Even with this limitation of applications, the frequency of pelvic hæmatocele has been variously stated by different authors; thus Scanzoni and Schroeder reckon it a rare disease, whilst Zeyfurt reckons it as occurring in 5 per cent. of all uterine cases. Inasmuch as most cases recover, the diagnosis must depend solely on a careful analysis of the clinical history.

It is well, however, that we should distinguish between the two affections, and we shall employ the term *thrombus* as applying to an effusion of blood into the cellular tissue around the uterus, and the term *retro-uterine hæmatocele* to blood which has gravitated into the peritoneal pouch between the uterus and rectum. These distinctions are important, inasmuch as they can in most cases be discovered both clinically and pathologically.

A. **Retro-uterine Hæmatocele.**—Ætiology.—The causes of retro-uterine hæmatocele are as follows: (1) Rupture of the uterine wall from any cause, including aneurysms and varices; (2) rupture of the Fallopian tubes from extra-uterine fœtation, and varieties of ectopic gestation; (3) ovulation with hæmorrhage; (4) rupture of varices in ovarian tumour; and (5) rupture of other viscera in the abdominal cavity.

Symptoms.—These will be the same as in the rupture of any viscus, and the escape of blood into the peritoneal cavity. Thus, there will be sudden onset of pain; pallor, with prostration and collapse, greater than can be accounted for by the anæmia; often vomiting, which is at times excessively severe. Nothing can be felt at first on physical examination, owing to the liquid state of the blood; but as the blood coagulates, hardness will supervene, displacing the uterus—the amount and direction of the displacement depending on the position which the blood assumes. This, as has been pointed out, is generally to be found posteriorly, thus pushing the uterus forward, towards the pubes. In a short time inflammatory action may be set up, so as to limit the blood-effusion, and in this case it will not be of a severe peritonitic type; but, on the other hand, general peritonitis may be established, which may end fatally; or, again, the inflammatory process, having become limited by plastic material, may gradually become absorbed, or it may follow the usual course of pelvic abscess.

B. **Pelvic Thrombus.** — ÆTIOLOGY. Pelvic thrombus arises from the contusions and lacerations resulting from normal and abnormal labour, from severe concussions of the pelvis, from interruption or suppression of the menses, from sexual excitement, and from rupture of the tube in extra-uterine fœtation between the layers of the broad ligament; or from hæmorrhage from diminished resisting power of the vessels, in the hæmorrhagic diathesis, scorbutus, or purpura.

Hæmorrhage which has thus arisen may follow the usual course of extravasated blood, namely, coagulation and absorption, or proceed to the formation of an abscess.

SYMPTOMS.—These will depend on the amount of the effusion and its position. In general the quantity will be less than in retro-uterine hæmatocele. It is generally greater when it occurs in the layers of the broad ligament, which it may separate to a very considerable extent, reaching sometimes to the level of the umbilicus. However, blood effused into this position is necessarily under some restraint, though the pain would be thereby increased.

In this, as in the affection just described, we have a sudden onset of symptoms, but we do not have such marked anæmia, for the amount of the effusion is hardly so large. And we miss those symptoms of severe collapse which depend upon an effusion of blood into the peritoneal cavity. In fact, here we have more the symptoms of hæmorrhage *per se*, the effusion being situated outside the peritoneum, and therefore more restrained. We seldom have symptoms of peritonitis supervening, but rather those due to the displacement which the mass occasions, and consequent tension. The effusion may either be absorbed, or it may end in abscess, which pursues the usual course of pelvic abscess. *See* PELVIC ABSCESS.

DIAGNOSIS.—These swellings, produced by blood-effusion, are liable to be confounded with many other troubles about the uterus. The most frequent position is in either broad ligament, where they may simulate fibroma, ovarian tumour, and especially cellulitis of the same part. The next position in frequency is behind, in the cellular tissue between the uterus and rectum, where the hæmatocele may imitate retroflexed uterus, or a tumour in Douglas's pouch. When the hæmorrhage is found at the roof of the vagina, or between the bladder and uterus, it gives the physical characters of a fibroma in the anterior wall, of pregnancy, or of cellulitis. It will thus be seen that the diagnosis depends much on a clear clinical history, either from the patient or her friends, which in some cases is difficult to obtain. In all cases of sudden accession of anæmia and collapse it is important to inquire carefully into the state of the menses, and to examine as to any pelvic tumour.

TREATMENT.—This divides itself into two parts, the first of which will be the arrest of the hæmorrhage (should it still be going on); and the second, the application of such means as tend to resolution and absorption of the coagulum. The first indication will be fulfilled by absolute rest, and the administration of hæmostatics, such as gallic acid, lead, turpentine, and other like remedies on which we are wont to place reliance for internal hæmorrhage, combined with an opiate. But inasmuch as vomiting is often a severe and prominent symptom, and medicines are with difficulty kept down a sufficient time to be of service, the opiate may have to be given by the rectum or hypodermically. Ice-bags or, if these are not at hand, cold lotions, should also be applied to the lower part of the abdomen, or even introduced *per vaginam.* At the same time a little ice may be given to suck. Stimulants, however, and hot drinks must be avoided. If, from the suddenness and severity of the collapse, it is supposed that a rupture of the cyst of an extra-uterine fœtation, or rupture of a varix of a twisted pedicle of an ovarian tumour, has occurred, it will be best to open the abdominal cavity, and treat the cause according to modern abdominal surgery; and this especially if, a tumour having already been observed in this region and rupture of an extra-uterine cyst supposed to be the cause, or rupture of an ovarian varix, it may be otherwise advisable to perform abdominal section.

The hæmorrhage having ceased without operation, we must still enjoin rest for some time, to prevent its recurrence, and to admit of the blood being absorbed.

In fulfilling the second indication, namely, the resolution of the extravasation, little will be required beyond keeping the system in good general health by the administration of tonics. Iron and quinine are of much service. Some practitioners rely on iodide of potassium as an absorbent; it may be given combined with quinine. Should a recurrence of the hæmorrhagic symptoms take place at different periods, the bromides and iodides have been considered of some value in quieting the action of the ovaries. But this recurrence shows a high probability of the case being one of ectopic gestation, and it would be safer to open the abdominal cavity before it is too late.

If the case unfortunately end in abscess, the proper treatment will be that of pelvic abscess. *See* Pelvic Abscess.

J. Braxton Hicks.

PELVIC PERITONITIS.—Synon.: Perimetritis (Bernutz, Virchow, and Matthews Duncan).

Definition.—A local inflammation of that portion of the peritoneum which surrounds the pelvic organs, and especially the uterus and broad ligaments. *See* Pelvic Cellulitis.

Ætiology.—Pelvic peritonitis is often found as an extension from pelvic cellulitis, in both the puerperal and non-puerperal states. In the non-puerperal state it is associated with uterine flexions and versions; various operations on the genital organs; rupture of ovarian cysts; abscess of the ovary; escape of blood from the Fallopian tube; extension of irritating secretions along the Fallopian tube from the uterus, such as gonorrhœa, pus (pyo-salpinx); bursting of the tube; malignant disease; and tubercle.

Anatomical Characters.—Here, as in cellulitis, the part which the veins, lymphatics, and nerves take is still open to controversy; but the lymphatics, no doubt, take the most important part in those cases where the change commenced in cellulitis. But the relative frequency of the tubes as a source of peritonitis is still in doubt, though as conveyers of irritating material they bear a very important part.

Whatever the origin of the peritonitis, we have, in the first place, an effusion varying in character—either serous, plastic, or purulent. The serum may either be absorbed, or become encysted by plastic material, and form a false cyst, which, in an unhealthy condition, may be of a pyoid nature, forming an abscess having the usual characters of pelvic abscess.

But there is this difference from the exudation of pelvic cellulitis and that of pelvic peritonitis, namely, that in cellulitis the exuded material may be absorbed, leaving but few, if any, relics of the bygone inflammation, whilst in peritonitis the fluid portion is chiefly absorbed, leaving very often strings or bands of adhesions matting together the various organs. A not uncommon occurrence is for the uterus, if previously retroflected, to be bound down posteriorly to the sacrum, but it may be equally fixed in any other direction in which effusion has been poured out. The effect of these adhesions is sometimes curious, for the ovary has been found rent from its attachment, and fixed to the pelvic brim posteriorly. These adhesions may stretch and give rise to no permanent displacements, but at other times they are irremediable. Pregnancy seems to have most influence in their removal; and, indeed, this has been suggested as a method of cure. In the same way they may hinder the action of the uterus in labour, and cause pain by their rigidity, though they often hinder conception or give rise to abortion, and sometimes to severe and even fatal obstruction of the bowels. The influence of adhesions should always be borne in mind after any case of pelvic peritonitis.

Should the case end in abscess, it may open in any of the ways given under the head of Pelvic Abscess.

Symptoms.—In chronic and subacute cases of pelvic peritonitis, the symptoms are usually obscure, the patient (often after childbirth) complaining only of a dragging sensation at the lower portion of the abdomen. These cases frequently pass unnoticed, rest in bed and other remedies sufficing to effect a cure.

In acute cases, the symptoms begin with complaint of a severe pain, increased by pressure, with fixedness of the abdominal muscles in the lower portion of the abdomen, or the coils of the intestine may be seen mapped out. Along with this there is usually a wiry pulse; but if the disease be of septic origin, it may be dicrotic. The temperature is usually above 102°, but varying night and morning. We may also notice a Hippocratic expression of the countenance. Should this become marked we should have reason to fear an extension to the general peritoneum. At the same time we may have constipation, and generally severe vomiting; and by pressure of effused material on the bladder and rectum, there may also arise constipation and dysuria. *Per vaginam*, we may discover a tumour laterally high up in the pelvis, and not easily felt, both on account of the distance from the examining hand, and from the severe pain to which examination gives rise.

But, again, it must be pointed out that cases do occur in which nearly all the symptoms are wanting, although the attack may be of a most malignant type, the rapid pulse and pyrexia, coupled with a peculiar expression of the countenance, being almost our only guide. A vaginal examination fails to give us any indication as to its nature, owing to the matter being purulent and fluid. These cases are almost always of septic origin.

Diagnosis.—Pelvic peritonitis may be diagnosed from pelvic cellulitis by the following considerations:—

Pelvic Cellulitis.

1. Tumour easily reached; generally easily and early felt *per vaginam* in neighbourhood of broad ligament, and also above pelvic brim.

2. Abdominal pain, increased by deep pressure.

3. Temperature usually not above 102°; pulse large, soft, dicrotic in septic form.

4. Retraction of thigh with abduction. Pain down leg.

5. Nausea; vomiting, not excessive.
6. Not accompanied by tympanites.
7. Marked tendency to suppuration.

Pelvic Peritonitis.

1. Tumour not noticeable for some days.
2. Abdominal tenderness of an acute kind, quickly increased on pressure. Form of coils of intestines mapped out on abdomen. Fixation of abdominal muscles.
3. Temperature above 102° usually; pulse wiry in benign, dicrotic in septic form.
4. Pain down leg and retraction of thigh never present.
5. Nausea; vomiting excessive.
6. Tympanites present in severe cases.
7. Constipation, often marked.
8. Suppuration not often present.

Treatment.—In all cases of pelvic peritonitis, whether acute or chronic, our chief point is rest, and this cannot be too rigidly insisted upon. The stage of the disease, whether chronic or acute, will indicate the amount. Should the case be of a subacute nature, then reclining on a couch will be all that is necessary; but should, on the other hand, the case be acute, however limited in area, then it is essential that we should order absolute rest in bed, as little movement as possible being allowed. In chronic cases this point must be left to the discretion of the physician; it will be for his consideration what part the local condition bears in relation to the general health, and whether continuance of the local trouble will not cease on restoration of the general health.

The next point to be considered—and we know of none in which so much mischief is done by want of appreciation of the true condition—is the administration of purgatives in the acute forms. The same rule holds good here as in the treatment after an operation for hernia, namely, that any increased peristaltic movement of the intestines is liable to cause an extension of the peritoneal complication. We must bear in mind that what the inflamed peritoneum wants is rest, to lessen the friction of the surfaces; and should any unhealthy matter be present, time is urgently required for the effusion of a limiting plastic material, to shut it off from the rest of the abdominal cavity; and after its formation, still further repose is necessary to prevent its being broken down. Thus it is that we find our sheet-anchor lies in the administration of full doses of opium, which not only allays the sensitiveness of the peritoneum, but limits the peristaltic movement of the intestines. If the bowels are unrelieved for fourteen to eighteen days, no harm will accrue. A mild enema of olive-oil and gruel will be the best measure to adopt where necessity requires relief.

In the more chronic cases, for the same reason, we should never purge our patient, for there is always a risk of extending the inflammatory action to the general peritoneum; a mild laxative daily, or, better, an enema, will answer every purpose.

If, from the severity of the constitutional symptoms and the absence of the local, we have reason to believe that we have a case of septic origin to deal with, quinine must be given in large doses, say five grains every four hours, by mouth, by the bowel, or hypodermically. Very marked results have attended the exhibition of this drug in cases otherwise almost hopeless. Sixty grains a day have been given without ill result—indeed with the cure of the patient. Should the peritonitis appear to be of a purely sthenic form, the employment of the old remedy, mercury, will generally be found to be a valuable addition to that of the opiates, at any rate for a short time; but in any case great caution is required lest diarrhœa be induced. In this form the employment of leeches to the abdomen will also assist in the reduction of the inflammation. Care, however, must be observed not to debilitate the patient. Hot opiated fomentations to the lower part of the abdomen in all cases afford great relief. But of late, in cases where there is reason to believe that the inflammation has originated in some local disease, as pyo-salpinx or ovarian suppuration, and where the symptoms are severe or have been recurrent, it is advised that exploration of the peritoneal cavity should be made, the unhealthy cause removed, and the cavity well cleaned or flushed with sterilised water. Should the case lapse into a chronic state, iodide of potassium may be of some service in aiding the absorption of the inflammatory products. The bromide has also been given with the idea of lessening congestion and quieting the action of the ovaries.

At a later date much good will result from the administration of tonics, and from change of air, the local trouble being often kept up by the general condition.

In recurrent cases, where an exploratory abdominal operation is refused, or where it is for other reasons undesirable, the use of antiseptic injections *per vaginam*, or the use of iodoform pessaries, or those of kindred sort which extend their influence beyond their position, inserted into the upper vagina daily, will be found of much service in preventing recurrence. Or the inside of the uterus may be swabbed out with iodised phenol, tincture of iodine, or the solution of perchloride of mercury, after dilatation of the os and cervix. For doubtless the morbid material, in many instances, starts from the interior of the uterus—in cases particularly of small os and cervical canal.

Such are the chief indications of treatment. Vomiting, dysuria, and other complications must be treated on general principles.

J. Braxton Hicks.

PEMPHIGUS (*πέμφιξ*, a bladder).—Synon.: Pompholyx; Fr. *Pemphigus*; Ger. *Blasenkrankheit*.

Definition.—A somewhat rare skin-disease, of indefinite duration; in which blebs or bullæ, containing serous or sero-purulent fluid, form in greater or less numbers on various parts of the body and limbs; burst; dry up, and produce crusts; and finally disappear, leaving temporary stains.

Ætiology.—Pemphigus occurs about once in 500 cases of skin-disease in England. It is much more frequent in children than in adults, and most frequent in the first eighteen months of life. In adults all ages are nearly equally disposed to it.

In childhood females seem slightly more disposed than males. Pemphigus foliaceus is more frequent in women. Neither geographical distribution, season of the year, nor any special diet or habits of life seem to affect the development of the disease. It occurs in persons of all temperaments, and in the healthy as well as in the delicate. No definite relation can be traced between derangements of the kidneys and pemphigus, nor between the latter and the gouty or rheumatic diatheses. In a few instances there has been a distinct relation between pregnancy and the outbreak of bullæ. Pemphigus is never endemic. Various epidemics, chiefly among children, have been described by trustworthy writers, of which the latest occurred in 1869 at Halle, and in 1874 in Paris, both in new-born infants, but it seems doubtful whether these were cases of true pemphigus, and not rather allied to varicella. Outbreaks of pemphigus have appeared in more than one case to be determined by a local injury, such as a puncture of the finger. There are one or two instances known in which the disease has been transmitted hereditarily.

Bullous eruptions frequently occur in connexion with lesions of the nervous system, either central or peripheral, for example, general paralysis, sclerosis of the lateral columns, locomotor ataxy, or injury to nerves.

Pemphigus is a non-contagious disease, and all attempts to transfer it from one person to another, by inoculating the contents of the bullæ, have failed.

Anatomical Characters.—In pemphigus the capillaries of a circumscribed portion of skin are dilated with blood, and this hyperæmia is followed by exudation from them of serous fluid, which infiltrates the papillæ and the cells of the rete mucosum, and finally makes its way beneath the epidermis, so as to raise and separate its uppermost layers from the parts below, thus forming a bulla or bleb. The parts of the epidermis which are connected with the hair-follicles resist the pressure longest, but at length give way, and their remains then hang from the under-surface of the covering of the bullæ as small threads or processes.

The contents of the bullæ consist at first of nearly pure serum, which gives on heating a flocculent deposit of albumen; later on the fluid contains numerous pus-cells, probably due partly to migration of white blood-corpuscles, and partly to proliferation of the rete cells. Occasionally it contains small quantities of blood exuded from the surface of the cutis. The reaction is at first neutral, but is faintly alkaline in the older bullæ. The bullæ have been found to contain micro-organisms, phosphates, chlorides, cholesterin, urea, uric acid, &c., but not in sufficient quantities or with sufficient constancy to confer any ætiological importance.

No *post-mortem* examination has as yet revealed any constant alteration in the organs or tissues which would account for pemphigus. General anæmia, and wasting of the muscles and other parts, have been found in uncomplicated cases, while some patients have died of intercurrent pneumonia and of phthisis. In more than one instance amyloid degeneration of the liver and spleen has been found, just as in other chronic wasting diseases.

Description.—Pemphigus may occur without apparent assignable cause in a previously healthy child or adult. The bullæ may form on a perfectly normal skin, or else a circumscribed portion of skin becomes hyperæmic, and the epidermis over it is raised by a rapid effusion of serum into a bulla, which enlarges quickly, so as to overhang its base. The bullæ are mostly hemispherical in shape, and may reach the size of an orange, or larger; but, as a rule, they vary from that of a pea to that of a hazel-nut or walnut. Their contents are at first clear and transparent, but in a day or two they become milky and opaque, and finally purulent. The coverings, previously tensely filled, burst; and the discharge dries into flat yellow-brown or blackish crusts. The bullæ tend to a symmetrical distribution on the two sides of the body. They may also spread peripherally, fresh bullæ forming at the edge of the crusts or stains of old ones. There is no areola at first, but as the contents become purulent, a narrow red areola is seen. At the same time as the skin is affected, small bullæ sometimes form on the mucous membrane of the mouth, nose, and pharynx; and they have been seen with the laryngoscope on the posterior surface of the epiglottis. They have also been found *post mortem* on the mucous membrane of the bronchi and of the intestines, and are probably the cause of the diarrhœa and bronchitis from which pemphigus patients sometimes suffer. Pemphigus has a marked tendency to recur at longer or shorter intervals, each outbreak being made up of a number of successive crops of bullæ. A few bullæ may in no way affect the general health, but if they are numerous they may be preceded by rigors and fever—102° to 103° F.—and even by delirium and other cerebral symptoms in children. The disease may terminate after one or two attacks, or may recur at intervals and with increasing severity for years, until the patient is reduced in health and strength, and finally dies in a marasmic state, or of some intercurrent disorder.

Classification.—We may divide pemphigus into four main varieties: (1) *P. neonatorum*; (2) *P. acutus*; (3) *P. chronicus*; and (4) *P. foliaceus*. Other varieties, such as *P. solitarius*, when only one bulla exists at once; *P. gangrænosus*, where ulcers succeed the bullæ; and *P. pruriginosus*, where itching is a conspicuous symptom, have been described, but they scarcely merit detailed notice. *P. vegetans* is described as a very fatal form of the disease, which begins as white patches in the mouth or pharynx, bullæ afterwards appearing on the hands, feet, axillæ, and groins, and fungating into papillary outgrowths, secreting a viscid offensive discharge. It has been thought to be of syphilitic origin.

1. *Pemphigus neonatorum* is an acute bullous eruption occurring in infants, not to be confounded with syphilis, but due probably to septic causes, in connexion with the surroundings during lying-in.

2. *Pemphigus acutus.*—By this we understand a bullous eruption which occurs only once in the same individual, has a short duration of from three to six weeks, and generally terminates in complete recovery. The existence of such cases, which was at one time doubted, is now certain. In its general symptoms *P. acutus* resembles the acute specific diseases. There is a prodromal stage, a rigor and great prostration; and albumen may appear in the urine (Senftleben). Fatal cases have occurred.

3. *Pemphigus chronicus seu vulgaris.*—This, the *P. diutinus* of Willan, is the most usual form, and the one to which the above description mainly corresponds. This form may assume a malignant character by the number of bullæ present at one time, and by their prolonged duration and rapid recurrence, so that the patient's health is undermined.

4. *Pemphigus foliaceus* (Cazenave).—Under this name has been described a form of pemphigus of a peculiarly malignant character. The bullæ are irregular in outline, flat and flaccid, and purulent from the commencement. Other bullæ form round each central bulla, or else the latter spreads peripherally *per continuum*, until at last the whole surface of the body may become involved. At the same time the skin does not heal over the situation of the older bullæ, but remains moist and raw, and covered either with crusts like those of impetigo, or else with the loosened coverings of the bullæ, which form large lamellæ or scales, from which the disease derives its name. The scales have been likened to flaky pastry. This form is happily extremely rare, for it is always fatal. *P. foliaceus* may assume the characters above described from the first; more often the disease develops from an ordinary *P. chronicus*.

Complications.—Pemphigus has been seen occurring simultaneously with small-pox and with purpura. Several cases have been reported in which a form of pemphigus occurred in the early weeks of pregnancy, and continued until delivery. In one case the disease recurred during several successive pregnancies. *Pemphigus pruriginosus* is a name which has been given in cases where the disease has been accompanied by severe pruritus, probably a form of the disease formerly described as hydroa, now known as dermatitis herpetiformis (Duhring).

Diagnosis.—The fully developed eruption of pemphigus is too characteristic for it to be mistaken for any other disease. The diagnosis may be difficult at the onset, when only a few bullæ have appeared, or else towards the termination of an attack, when only scabs or stains are left; in the first case the absence of cuniculi will distinguish it from some rare cases of scabies of a purely bullous form. At the outset it may be also necessary to distinguish its bullæ from those occurring in erysipelas, from the use of artificial vesicants, from burns, and from the friction of shoes, clothes, or contiguous portions of skin. The bullæ of herpes iris invariably commence on the backs of the hands and feet; run a rapid course; and assume a concentric circular character. The bullæ which not infrequently occur in anæsthetic leprosy can scarcely give rise to difficulty, when taken in connexion with the maculæ and other phenomena attending it. In long-standing cases of pemphigus, portions of skin which are extensively denuded of their epidermis may take on a considerable resemblance to eczema rubrum; but the history, the emaciation and weakness of the patient, the dark staining of the skin, with absolute absence of infiltration and only slight irritation, will render it easy to form a decided opinion. Syphilitic pemphigus is distinguished from true pemphigus by occurring only in new-born children; by involving principally, though not exclusively, the palms and soles; by leaving the mucous membranes unaffected; and, lastly, by forming thick crusts when the bullæ burst, under which deep ulcers form. The diseases which are most likely to be confounded with ordinary pemphigus are erythema (bullous forms), urticaria bullosa, hydroa, and varicella bullosa. *P. foliaceus* may simulate eczema rubrum, lichen ruber, and pityriasis rubra in their later stages, and when the skin is extensively involved.

Prognosis.—This is favourable in the early attacks, but doubtful as to the ultimate result, since it is impossible to say whether the disease may end with a single attack, or go on to gradual exhaustion of the patient's strength in the later ones.

Treatment.—No specific remedy for pemphigus has as yet been discovered; the nearest approach to one is arsenic, which in some cases of relapsing pemphigus, especially in early life, exerts a marvellous action on the disease, not only removing all traces of it for the time, but restraining its further invasion during long periods (Hutchinson). In other cases all drugs are equally powerless. The treatment which finds most general approval consists in the administration of tonics, especially quinine or bark and iron, and in supporting the strength of the patient by nourishing food and wine. Locally, ointments of zinc or boric acid may be tried, but probably lotions of lead or calamine will give most relief, combined with dusting powders, such as starch and zinc, or powdered cimolite. Pricking the tense bullæ sometimes relieves. In the pruriginous form, preparations of tar, and warm baths, may be tried. In some cases bran baths, and in others alkaline baths, have been found beneficial, but it is impossible to lay down any line of treatment suitable to all cases.

Edward I. Sparks. Alfred Sangster.

PENIS, Diseases of.—Synon.: Fr. *Maladies de la Verge*, or *du Penis*; *Krankheiten der Ruthe*, or *des Penis*.—Taken in the widest sense, the diseases of the penis include a number of conditions which are separately described in this work, such as diseases of the urethra, gonorrhœa, balanitis, gleet, syphilitic and other sores of venereal origin, and priapism. For a discussion of these subjects the reader is referred to the articles under their several designations. In this place there remain for consideration the following morbid states: (1) Congenital Abnormalities; (2) Phimosis, congenital and acquired; (3) Adherent Prepuce; (4) Preputial Calculi; (5) Paraphimosis; (6) Inflammation from various causes; (7) Gangrene; (8) Herpes Præputialis; (9) New-growths, benign in character; (10) Cancer and other Malignant Growths; and (11) Elephantiasis.

1. Congenital Abnormalities.—Various abnormalities of the penis are from time to time met with, which are more or less important according to the difficulties in micturition or sexual intercourse to which they may give rise, and the consequent ill effects upon the personal comfort and general health. Among these may be mentioned certain rudimentary conditions of the whole organ, associated or not with defective development of other parts of the genito-urinary apparatus, such as—undue smallness or even deficiency; disproportionate largeness; torsion or lateral deviation; in extremely rare cases multiplication (double or triple penis); abnormalities in excess or deficiency of particular parts of the organ; epispadias; hypospadias; and phimosis. The three last named require special notice.

(*a*) **Epispadias.** Definition.—A condition in which, from arrest or defect in development, the upper parts of the urethra and corpus spongiosum are wanting, and the corpora cavernosa are not properly closed together; and in which, consequently, the penis appears more or less completely fissured or opened along its dorsal aspect, and the floor of the urethra is exposed.

This condition is most frequently associated with ectopia vesicæ (*see* Bladder, Diseases of); but the defect may be limited to the penis. In most instances the prepuce is long and pendulous below the glans; and this is important, inasmuch as it may often be advantageously used in remedial plastic operations.

Symptoms and Effects.—The attendant inconveniences and discomforts, such as the continual flow or incontinence of urine, and unfitness for sexual congress, though varying somewhat in degree with the extent of the defect, are so great and so constant, that any reasonable attempt at remedy by plastic operation may be considered justifiable. It must be confessed that such attempts have hitherto resulted much more frequently in failure than in success. In some cases, however, much good has been effected; and in other cases the patients have been enabled to wear apparatus by which their discomfort has been materially diminished. For a description of the various methods adopted, reference must be made to surgical works.

(*b*) **Hypospadias.**—Definition.—A condition in which, from defective development of the urethra and of the corpus spongiosum, the urethra opens on the under-surface of the penis, at a variable distance behind the glans; and in which, during erection, the penis arches more or less downwards and backwards. The prepuce usually forms a kind of flap, which overhangs, but does not surround the glans.

Symptoms and Effects.—The opening of the urethra, which is often very small and slit-like, may be situated either, first, immediately behind the glans; secondly, at any point in the under-surface of the body of the penis; or, thirdly, just in front of the scrotum. In the first case—by no means an uncommon condition—no material inconvenience results: micturition and sexual intercourse can, as a rule, be fairly well accomplished; and there is no call for surgical interference beyond the enlargement, if needful, of the urethral orifice. But in the second and third class of cases, in which the urethral orifice is far back, the urine passes down the thighs or backwards; complete sexual intercourse is rendered difficult, painful, or altogether impossible; and the semen cannot be properly intromitted. Such a state of things often occasions great mental distress, and, thereby, impairment of health; and it may become justifiable and desirable to attempt to remedy to some extent the defect by surgical operation. A great variety of methods have been devised and practised, the details of which will be found in surgical treatises. Most of them have resulted in complete failure. But in some few instances very considerable improvement has been effected, within the experience of the writer. As a rule, operative measures should be delayed until adult life is reached.

2. **Phimosis, Congenital and Acquired.** — Definition.—A condition, often congenital and hereditary, but not infrequently acquired or exacerbated as the result of inflammatory processes, in which the orifice of the prepuce is so small as to render it difficult or impossible to uncover the glans properly and to the full extent.

(*a*) *Congenital phimosis.*—In some cases the orifice is a mere pinhole, or even scarcely discoverable; in others more or less of the glans may be exposed to view. Associated with this, as a congenital condition, there is often elongation of the prepuce, usually shortness and tightness of the frænum, and as a rule also undue smallness of the urethral orifice.

It is very important that the existence of congenital phimosis should not be overlooked or ignored, for at all periods of life more or less serious troubles may arise from it; and accidental circumstances, such as injury, inflammation, ulceration, may easily convert a comparatively slight *congenital phimosis* into a severe so-called *acquired phimosis.* At all ages phimosis is liable to interfere with free micturition—in severe cases from mechanical obstruction (sometimes the prepuce gets distended, bladder-like, during attempts at micturition), in less severe, or even comparatively slight cases, from reflex irritation and spasm. The bladder consequently may not be properly evacuated, and gradually cumulative mischievous results may ensue.

Symptoms and Effects.—In infancy and childhood frequent attempts to pass water, accompanied by straining and sometimes screaming; the passage of a small stream, or of a small quantity at a time followed by sudden stoppage; subsequent dribbling of the water; irritation and inflammation about the prepuce; and pulling at the penis—these are signs and symptoms accompanying and suggestive of phimosis in the first place, however closely they may simulate the indications of stone in the bladder. General irritability and deterioration of health, the production of hernia by frequent straining, balanitis, the formation of subpreputial calculi, the acquirement of the habit of masturbation, and reflex paralyses, are among the evil results that may arise.

In adult life, local discomfort, slowness of micturition, imperfect evacuation of the bladder, with all its probable consequences; smallness (from adhesions and compression) of the glans; difficulty, want of pleasure, or even actual pain in sexual intercourse; and liability to infection during impure intercourse, are troubles more or less constantly affecting the subject of phimosis; and to these may be added, in more advanced life, increased liability to cancer of the penis. As to this last named risk there is no doubt in the mind of the writer, judging from his own observation, as well as from the recorded observations of others, although of late it has been disputed.

Treatment. — In comparatively slight cases of phimosis the prepuce may be gradually stretched, and its orifice dilated to the needful extent, by frequently repeated gentle efforts at withdrawing it, and by inserting, between times, strips of dry or oiled lint between it and the glans, or by the use of one or other of the mechanical contrivances that have been suggested. In the more severe cases resort to operation is needful. And it would probably be better if radical operation were resorted to at once in all doubtful cases. The methods variously adopted are: (1) Forcible tearing; (2) Linear incision to greater or less extent; (3) Excision of a portion of the prepuce; and (4) Circumcision. The first method is clumsy and altogether to be condemned; the second is easy to perform, but often leaves the part in an awkward condition; the third is incomplete, and rarely satisfactory in effect; the fourth, if carefully and skilfully carried out, is uniformly successful, yields excellent results, and, as a rule, is to be recommended.

The best method of performing circumcision consists in first slitting up the prepuce along the median line on the dorsal aspect, by means of a bistoury or scissors, guided by a director, to a point on a level with or rather behind the corona, and then starting from this point, and with scissors cutting all round, dividing skin and mucous membrane evenly together, the skin and mucous membrane being stretched and held by broad-bladed forceps. As a rule, the frænum should be cut; indeed, in most cases it is better to excise a portion, or the whole. In the infant, sutures are not necessary; but in the adult it is better to stitch the edges of the skin and mucous membrane together by very fine sutures inserted as close to the edges as possible. Inrolling is thus prevented, and if the sutures are tied very tightly they will ulcerate out, and the pain and trouble of removing them will be avoided. The simplest dressing only is requisite; but the parts must be kept scrupulously clean, and free from all irritation.

(*b*) *Acquired phimosis.*—This condition may arise as a result of repeated attacks of inflammation, with or without chancrous ulceration, followed by induration, thickening of the prepuce, and contraction of its orifice. It is most frequent in those who have had slight congenital phimosis.

TREATMENT.—Circumcision is the proper treatment in all cases if the inconvenience and trouble should be at all considerable.

3. **Adherent Prepuce.**—In some cases of phimosis, and occasionally even in some cases in which the preputial orifice is not unduly small, the mucous membrane of the prepuce adheres, to a greater or less extent, to that of the glans. The smegma and other secretions are thus confined; and considerable local irritation, accompanied by more or less severe symptoms, may be set up. Such symptoms often closely simulate those of stone in the bladder.

TREATMENT.—The foreskin must be drawn gradually back, the adherent surfaces being separated during the process by the flat end of a probe or other thin blunt instrument; the confined secretions must be removed; the parts washed; the prepuce replaced; and strict cleanliness enjoined, the prepuce being daily withdrawn and replaced after washing. In severe cases circumcision should be performed.

If this condition be overlooked during infancy, the adhesions become firm and dense, and seriously impede the growth of the glans. Their division in the adult may require the use of the knife during circumcision.

4. **Preputial Calculi.**—The subpreputial secretions, if allowed to remain and accumulate, occasionally undergo changes, and become formed into hard concretions, which give rise to more or less serious discomfort and inconvenience. The diagnosis is easy and simple. Such concretions are found to consist mainly of phosphate of lime and ammonio-magnesian phosphate, with a variable amount of organic matter. Many cases are on record in which preputial calculi, remarkable for their size and number, have been removed. After slitting up the prepuce and removal of the calculi, circumcision should be performed.

5. **Paraphimosis.**—DEFINITION.—Paraphimosis is a condition in which a tight foreskin, having been forced back, during coitus or otherwise, has led to strangulation, œdema, and inflammatory swelling of the glans and a portion of its own mucous membrane and skin. The appearance presented is most characteristic, and cannot be mistaken.

TREATMENT.—Reduction must be effected at the earliest possible moment. If the case be neglected, severe inflammation, ulceration, and sloughing to greater or less extent, followed by more or less permanent deformity, are liable to ensue. The method ordinarily adopted consists in grasping the body of the penis between the middle and forefingers of both hands, drawing the foreskin forwards, and at the same time compressing and pushing back the glans by both thumbs. This method is very painful and not always readily successful. A better method, which very rarely fails, consists in slowly bandaging the glans (beginning at the extremity), and all the swollen parts, with a piece of narrow elastic webbing, the effect of which is gradually to empty the engorged vessels and squeeze out the serum from the swollen parts. On the removal of the bandage after a few minutes, reduction is, as a rule, very easily effected. The process may be facilitated by a few needle or lancet-point punctures, made before the application of the bandage, to allow escape of serous effusion, and so diminish the swelling.

In some neglected cases it may be needful to divide the constricting band by means of a bistoury. In attempting this, it must be borne in mind that the constriction is not immediately behind the glans, but behind the swollen portion of the preputial mucous membrane.

After reduction, cooling and soothing applications (as, for example, lead and opium lotion) should be used, and the question of circumcision should be subsequently entertained.

6. **Penis, Inflammation of.**—SYNON.: *Penitis*; *Cavernitis.*—Inflammation of the penis in its totality is comparatively rarely met with except as the result of injury, or in association with severe venereal diseases. In some instances it is said to have been induced by excessive sexual intercourse, and in other instances by persistent masturbation. Many cases, however, are on record in which it has occurred in association with the sequelæ of exanthematous fevers and diphtheria.

Inflammation of the penis occurs sometimes in *gouty subjects*, and may give rise to thrombosis in the corpora cavernosa or corpus spongiosum, or to fibrous deposits leading to indurations in the sheaths, or to hard nodules, which are very slow to disappear.

Diabetics are also liable to inflammation of the penis.

TREATMENT must be conducted on general principles, due regard being paid to the cause or condition in connexion with which the inflammation has arisen. If the patient survive, the part may recover under appropriate management.

7. **Penis, Gangrene of.**—Gangrene of the penis, except as the result of injury, or

constriction by ligature, rings, &c., in the majority of cases has followed impure sexual congress during a depressed general condition. In some cases it has occurred in association with small-pox, typhus, and typhoid fevers and diphtheria. Death has been the common result. In some cases life has been preserved, though the part or some portion has been lost.

8. **Herpes Præputialis.**—This is a vesicular eruption, occurring on the cutaneous or mucous surface of the prepuce, running its course in about a week, but liable to recur at irregular intervals. A similar eruption sometimes occurs on the glans. *See* HERPES.

The due recognition of this affection is important, because its appearance after doubtful intercourse often excites alarm, and may lead to mischievous treatment. *See* SYPHILIS; and VENEREAL DISEASE.

TREATMENT.—The simplest treatment only is requisite. The avoidance or prevention of all irritation by the clothes or otherwise, and sometimes a little sedative lotion, are, as a rule, all that is needful.

9. **Penis, Benign New-Growths of.**—*Cystic*, *vascular*, *fibrous*, *horny*, *fatty*, *sebaceous*, and other new-growths of benign character are occasionally situated on the penis. They may be left uninterfered with, or may be got rid of by operation, according to the inconvenience they cause, and the indications afforded. *Bony formations*, *calcareous deposits*, and *fibroid nodules* in the fibrous sheaths of the corpora cavernosa are of rare occurrence. The discomfort they have in some instances caused has necessitated their removal by operation, which has been successfully accomplished.

Papillomata, or warty growths, are not infrequently met with in persons of uncleanly habits. In the majority of cases they are associated with venereal disease; but they may arise independently of such association, especially if the prepuce be long and due regard be not paid to cleanliness. They may be few and scattered, or many and massed 'cauliflowerlike' together. Sometimes they entirely surround the corona, and sometimes in patches or continuously cover more or less completely the mucous surfaces of the prepuce and glans. In some instances the diagnosis between such growths and papillary epithelioma is not obvious; ulceration of surface indicates the latter.

TREATMENT.—Removal by curved scissors, or twisting off by forceps, is the most speedily effectual treatment of papillomata of the penis. But if the warts are few and small, they may be made to shrivel and dry up and disappear by repeated applications of oxide of zinc, calomel, tannic acid, or burnt alum, and the pressure of dry lint between the foreskin and glans. Cleanliness is essential.

10. **Penis, Malignant Growths of.**—Cancer in the male subject in a considerable proportion of cases primarily affects the penis. By far the most common form is *epithelioma*; and the most common seat of first appearance is the glans, or the part of the preputial mucous membrane nearly or immediately adjoining. In comparatively rare cases *scirrhus* is described as having commenced 'lump like' in some part or other of the body of the organ. In still more rare cases, '*soft cancer*' (probably small round-celled sarcoma) has been recorded as having occurred in young subjects after injury, and the diagnosis from suppuration in the corpus cavernosum has at first been doubtful. Sarcoma and melano-sarcoma have been met with in a notable number of cases, affecting primarily, as a rule, the fibrous sheaths of the corpora cavernosa.

Epithelioma seldom appears in the penis before the age of forty, most frequently between the fiftieth and sixtieth years. In 161 cases out of 243 the sufferers had been the subjects of phimosis. In some few instances the origin of the malady has been attributed, rightly or wrongly, to marital connexion with wives suffering from cancer of the uterus. Epithelioma is first noticed as a small warty outgrowth, early ulcerated; or as a flat excoriated surface, with slightly indurated base, occasionally disposed to bleed, and sometimes painful. Scabs form from time to time, which, when removed, leave exposed a gradually extending ulcerated surface. Sometimes what seemed a benign papillomatous growth ulcerates, and assumes a malignant character. The malady persists and progresses in spite of treatment, infiltrating and destroying. The discharge is thin and sanious, bloodstained and offensive. The ulcer is irregular in outline, with more or less everted hard edges; and the induration extends into the surrounding parts. Sooner or later the inguinal glands become infected, and the general health seriously deteriorates.

DIAGNOSIS.—The diagnosis of cancer of the penis from any form of venereal ulceration is, as a rule, sufficiently easy. Difficulty can scarcely arise, except in the comparatively rare cases in which there is exuberant warty growth before obvious ulceration.

TREATMENT.—The only treatment worthy of consideration consists in amputation of the penis, well behind the point to which the disease has extended. If the inguinal glands have become infected, they should be removed at the same time, if practicable. If they are affected to such an extent as to render their removal impracticable, amputation of the penis can do little, if any, lasting good. Sarcomatous growths may sometimes be successfully removed with their immediate surroundings, without amputation of the whole organ, as has been done in two cases by the writer.

11. Penis, Elephantiasis of.—Elephantiasis of the penis is almost always associated with elephantiasis of the scrotum, and may demand simultaneous treatment by operation. *See* ELEPHANTIASIS ARABUM.

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PENTASTOMA DENTICULATUM.—The larval form of this arachnid occasionally inhabits the liver; it has been found in the spleen, lung, intestine, and kidney. Its body is 4 to 5 mm. long, and 1·5 mm. broad; it possesses about nine segments, with spiny margins. The mouth is surrounded by four hooks, with chitinous sheaths. Remnants of the larva, usually hooklets, are occasionally found *post mortem*, embedded in cretaceous nodules the size of peas. This parasite has no clinical significance. J. BLAND SUTTON.

PEPTIC GLANDS, Diseases of.—*See* STOMACH, Diseases of.

PEPTONISED FOOD.—This term may be used as the equivalent of the phrase 'artificially digested food.' In natural digestion albuminoid substances are changed into peptones, and starchy matters into dextrine and sugar. These processes are of a purely chemical nature, and they can be imitated outside the body very closely by means of artificially prepared digestive juices. An extract of the stomach, or of the pancreas, in water, has approximatively the same powers as the natural secretions of those organs. Hence it is possible for us to subject articles of food beforehand to complete or partial digestion; and to administer such artificially digested food to our patients. In cases where the natural digestive powers are more or less in abeyance, it would be an obvious advantage if we had at command a supply of food thus modified, and yet not so changed as to have lost its agreeable appearance and flavour. Nor is there anything repugnant to physiological science or to the custom of mankind in such a proposal. The essential acts of digestion are not vital operations, but chemical transmutations; and the theatre of these operations is on the surface of the gastric and intestinal membrane, and not in the true interior of the body. In the practice of cooking we have, as it were, a foreshadowing of the art of artificial digestion; and although the latter art may never pass beyond the needs of the sick and debilitated—may never serve the healthy and robust—it is not more absolutely alien from the life of animals in a state of nature than is the art of cooking. The practice of cooking is an exclusively human practice, and it is now spread among all the races of mankind, whether civilised or uncivilised; and among the higher races the two most important groups of alimentary substances—albuminoid and starchy matters—are eaten almost exclusively in the cooked condition.

Now the changes impressed on articles of food by cooking are not merely mechanical; nor are they confined to alterations in the appearance and savour of the food. By far the most important changes produced by cooking consist of certain chemical transformations, whereby several of the chief alimentary principles are rendered incomparably more amenable to the action of the digestive juices than in the uncooked state. In a sense we may speak of cooked food as food which has undergone the preliminary stage of digestion. This preliminary stage is accomplished for us of the human race by the artificial aid of heat; but in the case of all the lower animals it has to be accomplished by the labour of their own digestive organs. The affinity of digestion to the process of cooking goes even much beyond this. It has been shown experimentally that albumen, when subjected to the prolonged action of superheated steam, yields a substance resembling peptone, and that starch when similarly treated yields dextrine and sugar. So that it would not be inappropriate to describe digestion as the process of cooking carried a step further.

Methods of Preparation.—Peptonised or artificially digested food may be prepared, either by following the gastric method with pepsin and hydrochloric acid, or by following the intestinal method, and using extract of pancreas. The latter method yields by far the better results. The pancreas acts not only upon albuminous substances, but also upon starch. Pepsin, on the other hand, is quite inert in regard to starch. Moreover, the products of artificial digestion with pepsin and acid are much less agreeable to the taste and smell than those produced by pancreatic extract. By the latter method articles of food can be profoundly peptonised with little deterioration of that agreeable savour which makes them inviting to the palate. The writer will, therefore, in what follows, confine himself to the pancreatic method, and describe the modes in which food may be partially digested beforehand, and yet constitute an acceptable nourishment for invalids.

The first necessity is to procure an active extract of the pancreas. Water is the proper solvent of the digestive ferments; but, in order to obtain a stable preparation, some preservative agent must be added to prevent decomposition. After a trial of various media the writer has come to the conclusion that, on the whole, the best solvent is dilute spirit. A mixture of one part of rectified spirit with three parts of water answers every purpose. The pancreas of the pig yields the most active preparation; but the pancreas of the ox or the sheep may be employed, if that of the pig is not obtainable. The pancreas of the calf also yields an extract which is active on albuminous substances, but it is not active on starchy materials. In procuring a supply of pancreas from the butcher, it is well to remember that the word 'sweetbread,' which is the English vernacular for pancreas, is likewise applied to the thymus gland; and that the genuine sweetbread of the kitchen is the thymus of the calf. Butchers distinguish the true pancreas as the 'liver sweetbread,' and it is by this name alone that the pancreas must be asked for in the shambles.

Mode of Preparation of Extract of Pancreas or Liquor Pancreaticus.—The pancreas is first well freed from fat, and cut up into small pieces with a knife or a pair of scissors. It is then mixed with four times its weight of the dilute spirit, put into a well-corked wide-mouthed bottle, and set aside for a week. The mixture should be well agitated at least once daily. At the end of a week the mixture is strained through muslin, and then filtered through paper until it is clear.

A very active extract of pancreas is now prepared on the large scale by Mr. Benger, under the name of *Liquor Pancreaticus*, and sent out by Mottershead & Co., chemists, Manchester. As it is a troublesome matter to get a supply of pancreas from the butcher, and as the filtration of the product is a tedious process, it will be found much more convenient to employ Mr. Benger's preparation, if it can be procured, than to rely on home manufacture. In the succeeding instructions for the preparation of peptonised food it will, therefore, be supposed that a supply of Benger's liquor pancreaticus is available.

Directions for the Preparation of Various Kinds of Peptonised Food.—The articles which are most easily prepared, and are most likely to be serviceable to invalids, are the following:—

Peptonised Milk.—A pint of milk is diluted with a quarter of a pint of water, and heated to a temperature of about 140° F. Should no thermometer be at hand, the diluted milk may be divided into two equal portions, one of which is heated to the boiling-point and added to the cold portion, when the mixture will be of the required temperature. Two teaspoonfuls of the liquor pancreaticus and ten grains of bicarbonate of sodium are then added to the warm milk. The mixture is poured into a covered jug, and the jug is placed in a warm situation under a 'cosey,' in order to keep up the heat. At the end of an hour, or an hour and a half, the product is boiled for two or three minutes. It can then be used like ordinary milk.

The object of diluting the milk is to prevent the curdling which would otherwise occur, and greatly delay the peptonising process. The addition of bicarbonate of sodium prevents coagulation during the final boiling, and also hastens the process. The purpose of the final boiling is to put a stop to the ferment-action when this has reached the desired degree, and thereby to prevent certain ulterior changes which would render the product less palatable. The degree to which the peptonising change has advanced is best judged of by the development of a peculiar bitter flavour, which is always associated with the artificial digestion of milk. The point aimed at is to carry the change so far that the bitter flavour is just perceived, but is not unpleasantly pronounced. As it is impossible to obtain pancreatic extract of absolutely constant strength, the directions as to the quantity to be added must be understood with a certain latitude. The extent of the peptonising action can be regulated, either by increasing or diminishing the dose of the liquor pancreaticus, or by increasing or diminishing the time during which it is allowed to operate. By skimming the milk beforehand, and restoring the cream after the final boiling, the product is rendered more palatable.

Peptonised Gruel.—Gruel may be prepared from any of the numerous farinaceous articles in common use—wheaten flour, oatmeal, arrowroot, sago, pearl-barley, pea or lentil flour. The gruel should be well boiled, and made thick and strong. It is then poured into a covered jug, and allowed to cool until it becomes lukewarm. Liquor pancreaticus is then added, in the proportion of a dessert-spoonful to the pint of gruel, and the jug is kept warm under a 'cosey' as before. At the end of a couple of hours the product is boiled, and strained. The action of pancreatic extract on gruel is twofold—the starch of the meal is converted into dextrine and sugar, and the albuminoid matters are peptonised. The conversion of the starch causes the gruel, however thick it may have been at starting, to become quite thin and watery. The bitter flavour does not appear to be developed in the pancreatic digestion of vegetable proteids, and peptonised gruels are quite devoid of any unpleasant taste. It is difficult to say to what extent the proteids of the meal are peptonised in this process. The product gives an abundant reaction of peptone; but there is a considerable residuum of undissolved material. Most of this, no doubt, consists of insoluble ligneous tissue, but it also contains some unliberated starchy and albuminous matter. Peptonised gruel is not generally, by itself, an acceptable food for invalids, but in conjunction with peptonised milk (peptonised milk-gruel), or as a basis for peptonised soups, jellies, and blancmanges, it is likely to prove valuable.

Peptonised Milk-gruel.—This is the preparation of which the writer has had the most experience in the treatment of the sick, and with which he has obtained the most satisfactory results. It may be regarded as an artificially digested bread-and-milk, and as forming by itself a complete and highly nutritious food for weak digestions. It is very readily made, and does not require the use of the thermometer. First, a thick gruel is made from any of the farinaceous articles above mentioned. The gruel, while still boiling hot, is added to an equal quantity of cold milk. The mixture will have a temperature of about 125° F. To each pint of this mixture two or three teaspoonfuls of liquor pancreaticus, and ten grains of bicarbonate of sodium, are added. It is kept warm in a covered jug under a 'cosey' for an hour or hour and half, and then boiled for two or three minutes, and strained. If the product has too much bitter flavour, a smaller quantity of the liquor pancreaticus must be used in the next operation. Invalids take this compound, as a rule, if not with relish, at least without any objection.

Peptonised Soups, Jellies, and Blancmanges.—The writer has sought to give variety to peptonised dishes by preparing soups, jellies, and blanc-manges containing peptonised aliment. Soups may be prepared in two ways. The first way is to add what cooks call 'stock' to an equal quantity of peptonised gruel or peptonised milk-gruel. A second and better way is to use peptonised gruel, which is quite thin and watery, instead of simple water, for the purpose of extracting the soluble matters of shins of beef and other materials employed in the preparation of soups. Jellies may be prepared by simply adding the due quantity of gelatine or isinglass to hot peptonised gruel, and flavouring the mixture according to taste. Blancmanges may be made by treating peptonised milk in a similar way, and then adding cream. In preparing all these dishes it is absolutely necessary to complete the operation of peptonising the gruel or the milk, even to the final boiling, before adding the stiffening ingredient. For if pancreatic extract be allowed to act on the gelatine, the gelatine itself undergoes a process of digestion, and its power of setting on cooling is thereby utterly abolished.

Peptonised Beef-tea.—A pound of finely minced lean beef is mixed with a pint of water, and ten grains of bicarbonate of sodium are added thereto. The mixture is then simmered for an hour and a half in a covered saucepan. The resulting beef-tea is decanted off into a covered jug. The undissolved beef-residue is then beaten up with a spoon into a paste, and added to the beef-tea in the covered jug. When the mixture has cooled down to about 140° F. (or when it is cool enough to be tolerated in the mouth), a table-spoonful of the liquor pancreaticus is added, and the whole well stirred together. The covered jug is then kept warm under a 'cosey' for two hours, and agitated occasionally. At the end of this time, the contents of the jug are boiled briskly for two or three minutes, and finally strained. The product is then ready for use. Beef-tea prepared in this way is rich in peptone It contains about 4 per cent. of organic residue, of which more than three-fourths consist of peptone; so that its nutritive value in regard to nitrogenised materials is nearly equivalent to that of milk. When seasoned with salt it is scarcely, if at all, distinguishable in taste from ordinary beef-tea.

Peptonised Enemata.—Pancreatic extract is peculiarly adapted for administration with nutritive enemata. The enema may be prepared in the usual way with a mixture of milk and gruel, or milk, gruel, and beef-tea. A dessert-spoonful of liquor pancreaticus is added to it just before administration. In the warm temperature of the bowel the pancreatic ferments find a favourable medium for their action on the nutritive ingredients with which they are mixed; and there is no acid secretion (as in the stomach) to interfere with the progress and completion of the digestive transformation. Experience has satisfied the writer that this method of administering nutriment is a valuable resource when the stomach is obstinately intolerant of food, or when there is obstruction in the higher portions of the digestive tract.

Uses of Peptonised Food.—The employment of food which has been wholly or partially peptonised is indicated when the natural digestive powers are from any cause enfeebled or suspended. The most striking benefits have been observed in cases of gastric catarrh with pain and intolerance of food; in gastric ulcer; in the anorexia and dyspepsia associated with valvular heart-disease; and in the various forms of pyloric and intestinal obstruction. Good results have also been obtained in cases of defective nutrition and intestinal irritation in infants. In using peptonised food it is well to remember that it does not keep well, especially in warm weather. Accordingly it should either be prepared twice a day, so that it may be never more than twelve hours old; or, if a quantity sufficient for the twenty-four be prepared at once, the portion which remains over at the end of twelve hours should be re-boiled. WILLIAM ROBERTS.

PEPTONURIA.—A condition in which the urine contains peptones. *See* ALBUMOSURIA.

PERCUSSION (*percusso*, I strike).—A method of physical examination, performed by striking gently some part of the body, especially the chest or abdomen, for the purpose of producing certain sounds or tactile sensations. It may be performed either by the finger or fingers of one hand striking the surface directly, or indirectly—the fingers of the other hand being interposed; or by means of a special instrument or instruments. *See* PHYSICAL EXAMINATION.

PERFORATIONS AND RUPTURES.—It will be convenient to discuss these lesions together, but only from a general point of view, the more important perforations and ruptures connected with particular organs being treated of in their appropriate articles. The word *rupture* is used here in its true significance, and not in the popular sense as applied to hernia. *See* RUPTURE.

DEFINITION.—Though there is no absolute distinction between *perforations* and *ruptures*, there are certain differences by which they are usually broadly recognised.

The term *perforation* is generally applied only to an artificial opening produced in a hollow organ or tube; seldom, and only under special circumstances, to a lesion affecting a solid tissue. Moreover, it implies that the opening is a small one, or, at any rate, does not reach large dimensions. Again, the mode in which the lesion is produced has, in some instances, to do with the definition of a perforation. Thus, if the opening results from injury by a pointed instrument, or by any other agent which would cause more or less of a puncture, such as a fractured rib penetrating the lung, it would be called a perforation, and in this case the term would apply also to a solid organ or tissue. Finally, the slow destruction of certain structures by aneurysms and other tumours often terminates in an aperture being formed, which is then called a perforation. This is well exemplified by the opening formed in the sternum in some cases of aortic aneurysm.

A *rupture* may be associated with any structure, and often involves solid organs, as the liver, as well as firm tissues, such as muscles. It implies a lesion of some size, which may reach any dimensions, being more of a tear or rent than a puncture. There is also associated with the term the idea of spontaneous production, or of the lesion originating from within, or from the effects of some compressing, distending, or lacerating injury, rather than a penetrating one.

ÆTIOLOGY AND PATHOLOGY.—The causes of perforations and ruptures, and the pathological conditions under which these lesions occur, may be thus summarised:—

1. *Injury.*—This often comes from without, and may then be of different kinds. The forms of injury most requisite to notice are perforating wounds; severe compression of the body, as between railway-buffers, which may cause extensive rupture, even of solid organs, without any external mark of violence; violent concussion, as in the case of the brain; and straining, which is especially liable to cause rupture of muscles or arteries. To this category of injuries also belong various causes of perforation or rupture acting from within, such as corrosive agents which have been swallowed, bones and other foreign bodies similarly introduced, calculi, hardened fæces in the intestines, and worms. Cases have now and then occurred in which important internal organs have been penetrated in the attempt made by showmen to swallow swords and other instruments. Similar lesions might possibly be produced also in connexion with surgical operations. 2. *Violent actions.*—Voluntary muscles have by their own excessive action led to their rupture, as in cases of tetanus. The uterus has been known thus to rupture itself. In rare instances the healthy lung has given way from violent cough. 3. *Destructive and degenerative processes.*—These are important causes of perforations and ruptures of various kinds, and they include ulceration or gangrene, as of the stomach or intestine; suppuration, leading to the formation of an abscess, either associated or not with an organ, and which may burst into various internal parts, or externally; cancer; acute fatty degeneration and softening of organs; and chronic fatty, atheromatous, or calcareous degeneration. Some of the conditions mentioned are in themselves essentially destructive; others produce such changes that they render a rupture liable to occur from very little extra force or pressure, such as that which arises from a slight strain, a cough, or the act of vomiting or defæcation, as is well exemplified by the heart and arteries. Even in the case of the destructive processes, some exciting cause may lead to the actual perforation or rupture, such as one of the acts mentioned above, or, in the case of the alimentary canal, the injudicious administration of solid food, or of articles which give rise to flatulent distension. Moreover, after ulceration a cicatrix may be left, which for a time is very liable to give way from slight causes, as sometimes happens in connexion with typhoid fever. The appendix vermiformis is an important structure which has to be borne in mind as liable to perforation from destructive processes. The perforation of the lung which sometimes happens in cases of phthisis is a good illustration of the effects of changes of this kind. 4. *Gaseous and liquid accumulations.*—These may alone lead to rupture of hollow organs or tubes, of the walls of cavities, or of cysts, by causing extreme distension, as may be exemplified by the occasional rupture of the intestines from over-distension, of an emphysematous lung, of the bladder from an accumulation of urine, of the renal pelvis in cases of hydronephrosis, of a distended gall-bladder, of a pleuritic effusion, of a hydatid, pancreatic, or ovarian cyst, or of an aneurysm. Some slight strain or injury may be the immediate cause of the lesion in several of these conditions. 5. *Pressure.*—A tumour of any kind may cause perforation of various structures, as the result of its mechanical pressure. In the case of an aneurysm the pulsation assists

in producing the lesion. In this way the most resisting tissues may be destroyed in course of time, and serious consequences are liable to ensue. 6. *Spontaneous.*—In the case of muscular tissues and arterial structures spontaneous ruptures are supposed to happen occasionally, but probably in all such cases there has been previous degeneration, which may be regarded as the real cause of the rupture.

Anatomical Characters.—It must suffice to mention here, in a general way, that the morbid appearances consist of those presented by the perforation or rupture itself; and of the effects resulting therefrom. The former vary much in extent and character in different cases, and no comprehensive description can be given of them. As regards the effects produced, there may be none, but very commonly hæmorrhage takes place; or the contents of a hollow viscus, or of a fluid collection, may accumulate in some abnormal situation, and these usually set up inflammation, should the patient live long enough, the results of which will be evident on *post-mortem* examination. In the case of slow perforation of structures by tumours, various effects may be produced, of an irritative or destructive character. Particulars on these points are given in other appropriate articles. In the case of the lung, perforation is likely to lead to the escape of air into the pleura or cellular tissue, thus giving rise to pneumothorax or subcutaneous emphysema. On the other hand, liquid accumulations may open into the lung, and thus be found in the air-passages, or they may produce more or less serious effects upon the pulmonary tissues.

Symptoms.—It is not intended here to describe the symptoms which occur in connexion with traumatic injuries, but merely to point out those likely to be noticed in different cases which come under observation in medical practice. Under certain circumstances a perforation or rupture may take place without any obvious symptoms, even when it affects an important structure. This may happen, for instance, even when an opening forms in a hollow viscus, such as the stomach or intestine, provided it has become previously adherent to some solid organ, or to another part of the bowel, with which it then forms a communication. On the other hand, very speedy or even sudden death may ensue, as when a large aneurysm or the heart ruptures. The symptoms to be anticipated are those due to the actual lesion itself, and those resulting from the consequences mentioned under the anatomical characters. As regards the lesion itself, if it is suddenly produced, the event is usually attended with immediate marked symptoms. Of these, one of the most common is a sudden pain at the seat of mischief, often very intense, but varying in its characters. When a muscle ruptures, a feeling is frequently experienced as if a severe blow had been struck, and power is lost at once in the affected part. This is well exemplified in cases of rupture of the gastrocnemius, an accident which is not uncommon in connexion with the game of lawn tennis. When a hollow viscus or any fluid collection bursts, or when gas escapes, a sensation as if something were being poured out is often noticed by the patient. At the same time the general system usually suffers more or less gravely, as evidenced by faintness or actual fainting, or by signs of shock or collapse, from which the patient may never rally, if the structure involved is of great importance in the vital economy, or if continuous hæmorrhage should be going on. The symptoms above indicated may be repeated if the lesion should extend after an interval. It may be mentioned that when rupture of an abdominal organ takes place from severe compression of the body, there may be no symptoms of the event at the outset, and only the development of grave collapse indicates what has happened. The occurrence of hæmorrhage into internal parts, or the escape of the contents of the viscera or of a fluid accumulation, may be obvious on physical examination. Should the patient survive in cases of rupture into internal parts, local and general symptoms pointing to the occurrence of inflammation may be expected to supervene. For instance, in the case of the abdomen there would be signs of peritonitis, or of localised inflammation in some part of the cellular tissue, probably ending in suppuration. In perforation of the lung, symptoms and physical signs of pneumothorax appear, or subcutaneous emphysema may become evident in exceptional cases. When an opening is formed between some collection of fluid and any organ or channel which communicates externally, such as the air-passages or the alimentary canal, such fluid is likely to be discharged in different ways, and this may be a favourable mode of termination, leading to a cure. In the case of slow perforation by a tumour, should it take place in an outward direction, the lesion will probably become evident on clinical examination; if internal structures are affected, the process of destruction may be accompanied with continuous pain or other symptoms; and subsequently clinical phenomena indicative of implication of various structures arise, either suddenly or gradually. For example, when an aneurysm or solid growth destroys any part of the spinal column, this is attended with a continuous aching or grinding pain; and when the canal is perforated, symptoms arise indicating that the spinal cord is involved.

Diagnosis.—It is scarcely practicable to offer any useful general remarks under this heading, and it must suffice to notice the following points. The difficulty of diagnosis varies much in different cases, being sometimes very easy, in other instances more or less obscure or impossible. The practitioner should always be prepared for the possibility of cases of sudden perforation or rupture of internal structures coming under his notice, of which he may have no previous knowledge. Under such circumstances a careful inquiry into the previous history may reveal the presence of symptoms of known conditions, likely to lead to such lesions, which would clear up any obscurity; but there is often no such history. There ought to be no difficulty, as a rule, if the damage occurs from some recognised cause, such as certain kinds of injury; or if it supervenes in some case under the care of the practitioner for a disease liable to be attended with perforation or rupture of some part, such as typhoid fever, gastric ulcer, an internal abscess, or an aneurysm. In the case of slow perforation, it is very important to be able to recognise the meaning of symptoms which may supervene from this cause.

Prognosis.—Any rupture or perforation taking place internally must always be regarded as immediately more or less dangerous to life, and not uncommonly the termination is necessarily fatal. Much will depend on the structure involved, the extent of the lesion, and its direct and remote consequences. Caution must in every case be exercised in giving a prognosis, for some patients recover when such a result might not be anticipated; and especial care must be taken in offering an opinion should the diagnosis not be quite clear. In the case of ruptures or perforation taking place externally, or affecting structures not essential to life, such as the muscles of a limb, the prognosis of each case must be determined on its own merits.

Treatment.—In the case of sudden internal perforations or ruptures, the first principle in treatment should be to counteract the immediate effects of the lesion, alleviating pain, while at the same time rousing and stimulating the patient by appropriate remedies. Opium or morphine and alcoholic stimulants are of great service, and they may often be advantageously introduced into the system by means of enemata, or, in the case of morphine, by subcutaneous injection. Heat to the extremities, sinapisms, and similar applications are also frequently of much value. The patient should be kept quiet; and it may also be of essential importance to endeavour to keep an organ which has been perforated, such as the stomach or intestines, in an absolute state of rest, by withdrawing all food, and checking peristaltic movements by opium or other agents. The same principle applies to some parts of the body, such as a limb, if a muscle or a vessel have been ruptured; and here the position of the limb is often of much consequence. Other appropriate measures will suggest themselves in different cases. Some special interference may be indicated. For instance, it might be clearly allowable to open the abdomen in certain cases; to strap or puncture the chest to relieve pneumothorax; or to cut down and tie a ruptured artery. Hæmorrhage resulting from a lesion of this kind in internal parts may sometimes be checked by the constant application of ice externally, over the corresponding part of the body. The subsequent treatment of cases of rupture or perforation must be determined by the effects that they produce, which must be dealt with according to their nature, each case being considered on its own merits. The same remark applies to cases of gradual perforation by tumours and other morbid processes. Frederick T. Roberts.

PERICÆCAL ABSCESS.—An abscess in the cellular tissue around the cæcum. *See* Perityphlitis.

PERICARDIUM, Diseases of.—Synon.: Fr. *Maladies du Péricarde*; Ger. *Krankheiten des Herzbeutels.*

The pericardium proper is a membranous bag, one part of which—the visceral layer—closely envelops the heart and the roots of the great vessels connected with it; while the other—the parietal layer—is loosely reflected round that organ, and has its external surface intimately united with a dense fibrous sheath which passes upwards, and is gradually lost upon the external coats of the vessels, whilst it is continuous below with the central aponeurosis of the diaphragm. A serous fluid bedews the interior of this sac, and facilitates the movements of the heart, so that both in structure and function the pericardium may be regarded as a joint—somewhat modified, no doubt, to suit its internal position, as well as the nature of the parts with which it is connected.

The morbid conditions of the pericardium will be discussed in the following order: (1) Dropsy; (2) Inflammation; (3) Gas in the Pericardium; (4) Malformations; (5) New-Growths; and (6) Pericardial Adhesions.

We may first, however, refer to a condition of the pericardium which can hardly be described as pathological, consisting of slight opacities, which are termed *milk-spots.* These are frequently observed upon the pericardium after death, but they give rise to no clinical symptoms, and are merely to be regarded as callosities due to attrition. The most common situation is at the base of the right ventricle in front, but they are also found on the apex, and are occasionally seen as white stripes upon the auricles, and along the course of the coronary arteries. Such *maculæ albidæ* are most common on large, strong, and hypertrophied hearts, but they are not altogether confined to these. When due solely to attrition, these spots are formed by a mere thickening or condensation of the normal tissue; but now and then they are found to consist of a thin layer of fibrinous matter which may be peeled off, leaving the pericardium beneath opaque, but otherwise natural. In the latter case, of course, these spots cannot be regarded as simple callosities, but as the results of some trifling local pericarditis, running its course without symptoms and of no clinical importance, except as affording a probable explanation of those temporary basic frictions which are occasionally to be heard in those otherwise in apparently good health, so far at least as the heart is concerned.

1. Pericardium, Dropsy of.—Synon.: Hydropericardium; Fr. *Hydropéricarde*; *Herzbeutelwassersucht*.

During life and in health the serosity bedewing the internal surface of the pericardial sac exists in an appreciable quantity, so that an ounce or two of fluid found in it after death is not to be regarded as anything abnormal. When, however, the fluid present amounts to as much as five or six ounces, or more, the condition is morbid, and is termed *hydropericardium*, or dropsy of the pericardium. The contained fluid is a yellowish, greenish, reddish, or reddish-brown serosity, containing from 1 to 3 per cent. of albumen, and occasionally a trifling amount of fibrinous matter, which coagulates on simple exposure to the air—*hydrops lymphaticum* (Virchow, *Gesammelte Abhandlungen*, p. 108). The colour of the fluid is due to the amount of blood-colouring matter infused through it; and the reddish, or reddish-brown coloration is specially present when from any cause, such as the co-existence of scurvy, the colouring matter is more readily diffused than usual, or in those exceptional cases where the walls of the capillaries are so altered by nutritive changes as to rupture.

All the phenomena present in dropsy of the pericardium are similar to those associated with a corresponding amount of inflammatory effusion, and will be referred to under that head. Hydropericardium is a possible occurrence in all diseases, whenever there is, from physical causes, a tendency to transudation of serum into the cavities of the body. According to the nature of that cause it may be either an early or a late phenomenon, and it frequently only attains any considerable proportion during the act of dying. When dropsy occurs from venous congestion due to disease of the heart, or to disease of the lungs, such as emphysema or cirrhosis, some degree of hydropericardium is not uncommon as an early symptom; but when the dropsy results from hydræmia produced by chronic organic diseases of the spleen, liver, or kidneys, or by the exhaustion due to cancerous or tubercular diseases, the pericardial effusion is usually a late symptom.

Treatment.—The treatment of hydropericardium resolves itself into the treatment of the diseases upon which it depends; and it is only when the fluid becomes suddenly effused, in a quantity so large as to threaten death by suppression of the heart's action, that an independent treatment by paracentesis may be found necessary. Such sudden effusion occasionally, but only very rarely, takes place in the course of the acute albuminuria following scarlatina, or even in the more chronic albuminuria, the result of intratubular nephritis.

2. Pericardium, Inflammation of.—Synon.: Pericarditis; Fr. *Péricardite*; Ger. *Herzbeutelentzündung*.

Acute inflammation is the most serious, if not the most frequent, affection of the pericardium.

Ætiology.—This disease, though occasionally idiopathic, is much more frequently secondary in its character. So-called idiopathic pericarditis is usually associated with pleurisy, frequently with bilateral pleurisy, and is not uncommonly latent so far as any direct symptoms of pericardial implication are concerned. Secondary pericarditis may be the result of wounds from without or from within—through the œsophagus; of blows and contusions on the præcordial region; of abscesses perforating from the lung, or from the liver—through the diaphragm; of enteric fever, variola, scarlatina, and pyæmia in all its forms; of the spreading by contiguity of the inflammatory process from neighbouring organs, such as the lungs, pleura, or costal periosteum. It may accompany the local development of cancer or tubercle; or may be due to rheumatism, or to one or other of the chronic forms of Bright's disease. By far the larger proportion of cases of pericarditis occur in connexion with the two last-named diseases, in about the ratio of two of rheumatic pericarditis to one of renal pericarditis; all other forms lumped together forming an infinitesimal and incalculable fraction. In rheumatism, pericarditis occurs early; occasionally precedes the joint-affection; and though no period of the disease can be regarded as free from the tendency to this so-called complication, just as any joint may be implicated at any period, yet experience teaches us that the heart-joint is most usually affected within the first week of the rheumatic onset. In renal disease, on the other hand, it is most usually a late phenomenon, being only too frequently the immediate precursor of that fatal uræmia which its occurrence serves to precipitate.

The pathology, symptoms, signs, and treatment of pericarditis, however it may arise, are all very much alike, and may be conveniently treated of together.

Anatomical Characters.—The morbid anatomy of pericarditis is simple enough. Very early pericarditis is rarely seen except as associated with Bright's disease, and then at first we have merely vascular injection, with a few shreds of lymph visible about the roots of the great vessels. In a few days, in those dry forms of the disease where but little fluid is effused, the whole surface of the heart may be covered with a thin fibrinous layer, which may, even at this early stage, have connected together the visceral and parietal layers of the pericardium somewhat firmly (Wilks). More usually there is some serous exudation mingled with the fibrinous matter, which then is found covering the pericardium in a reticular or honeycomb pattern, which Laennec has likened to the appearance presented on suddenly separating two smooth pieces of wood between which a small pat of butter has been forcibly compressed. The serous effusion may occasionally amount to several pints; it is always turbid from the molecular fibrin suspended in it; and is of a yellowish, greenish, brownish, or reddish colour. When along with any considerable layer of lymph upon the pericardiac surfaces, there is much fluid effused, the surface of the lymph is covered with shaggy processes floating in the fluid, these processes sometimes presenting a mammillated appearance. In a very short time a fine network of capillaries is developed in the fibrinous exudation; and the rupture of these newly developed capillaries now and then gives rise to what is termed 'hæmorrhagic pericarditis,' in which the fluid, and even the solid lymph, is deeply stained with the blood-colouring matter. This also happens when pericarditis is associated with purpura or scurvy; and now and then, from similar causes, layers of coagulated blood are found alternating with layers of unstained lymph.

When the disease does not prove fatal, the exudation may be entirely re-absorbed, or it may become organised, or other changes may occur. First of all, the excess of fluid and the molecular fibrin become absorbed; then the coagulated fibrin may become worn away by the continual play of the heart, and gradually entirely absorbed; and a complete cure may be thus effected, leaving at the most only a slight thickening or opacity of the pericardium. But such a cure is only possible when the amount of exudation has been inconsiderable. More usually, connective tissue is gradually developed in the fibrinous layers; either locally, giving rise to partial adhesions, which about the base of the heart are more dense, but at the apex are often drawn out to fibrous strings; or the two layers of the pericardium may be so closely united that they can only be separated with considerable force, and now and then, after the lapse of some time, they cannot be separated at all, the cardiac muscle being torn in the endeavour. Occasionally pus, or the cheesy or calcareous remains of such a deposit, may be found, encysted, as it were, between the adhering layers of the pericardium; and it sometimes happens that this calcareous layer envelops the whole heart, which then seems to be converted into bone. Laennec, Louis, Allan Burns, and others relate cases of this kind, and the heart described by Burns is still preserved in the anatomical museum of the Edinburgh University. In every fibrinous exudation within the pericardium there is at a particular stage a certain amount of all those elements present which may become pus, and these give rise to a milky opacity of the fluid, or, if present in sufficient number, may metamorphose the whole exudation into pure pus. This may be only a transition stage; the pus-cells may break down, a pathological cream may be formed, and the whole may be ultimately entirely absorbed. But true purulent pericarditis, though a rare occurrence under any circumstances, is most frequently fatal, and seems to occur chiefly in connexion with serious general disease, or to accompany the rupture of local abscesses, pulmonary or hepatic, into the pericardium. What has been termed an 'ichorous exudation' in the pericardium, is simply a putrefaction of that already existing, which becomes brownish in colour and stinking. It may arise from entrance of the air into the pericardium after paracentesis conducted without antiseptic precautions; but it is also believed that such putrefaction may arise in patients greatly enfeebled by exhausting diseases, such as cancer, without any entrance of air into the pericardium. An exudation that has become ichorous may corrode the pericardium; is incapable of further metamorphosis; and is usually speedily fatal by the development of pneumo-pericardium. *See* 3. Pericardium, Gas in.

Symptoms.—The symptoms of pericarditis are of comparatively little importance, because they are frequently entirely absent in those so-called idiopathic forms of the disease which are probably always fatal, as well as in renal pericarditis, which is fatal in the majority of cases; whilst even in rheumatic pericarditis, in which the mortality is at the most only about 16 per cent., and is *nil* according to some authors (Bamberger, &c.), the symptoms, though rarely absent, are generally not very well marked or distinctive. As a rule, if pericarditis be associated with any other serious disease, such as pneumonia, pleurisy, or rheumatism, the symptoms are apt to be swamped by those of the primary disease. In other instances, the advent of the pericarditis is indicated by a rigor, a rise of temperature, a feeling of anxiety and oppression at the chest, and the occurrence or increase of dyspnœa. The decubitus is usually dorsal, and syncope is liable to be induced on raising the patient. There is pain in the cardiac region, with palpitation of the heart. The pulse is at first full and frequent, always compressible, frequently irregular, usually dicrotic, and rapidly becomes feeble; and there is a general exacerbation of all the symptoms of the already existing disease. Occasionally the restlessness and anxiety indicative of cardiac implication pass into delirium, which may be low and muttering, wild and maniacal, possibly accompanied by delusions, and which may be associated with tetanic or clonic spasms, or with convulsions ending in extreme exhaustion, or in death by coma. The occurrence of delirium in the course of rheumatic fever ought at once to direct attention to the heart; and the sudden occurrence of spasms or coma in chronic renal disease is only too frequently found to be associated with pericarditis; both of these phenomena being probably caused by the saturation of the blood with the products of retrograde metamorphosis, due to the sudden development of this inflammation. It is only in the very rarest instances that we have that extreme oppression of the chest, violent pain in the cardiac region, hiccough, fainting, and livid countenance, coupled with delirium, and extremely rapid dicrotic pulse, which constitute the classical portrait of pericarditis; and even in those rare cases in which these symptoms are observed, they are rather due to the association of pericarditis with an already existing serious disease, than to the pericarditis itself. In most cases physical examination gives us the first intimation, and in all cases the only reliable information, as to the existence of pericarditis. In all diseases, therefore, in which pericarditis is a possible occurrence, we must carefully examine the cardiac region from day to day, or more often, that we may at once ascertain its occurrence; while at all times, the slightest pain in the chest, or most trifling oppression of breathing, ought to be a sufficient warrant for a most careful physical examination of the chest, because men have been known to go about their ordinary duties —with difficulty, no doubt—even while pericarditis existed.

Physical signs.—Whenever on auscultating over the cardiac area we hear a friction-sound, we are justified in assuming the probable existence of pericarditis. And the probability of this surmise is increased just in proportion as we can eliminate all sources of fallacy, and associate it with those symptoms already described as indicative of pericarditis, and with the other signs presently to be described as having the same significance. A friction-sound due to pericardial roughness may be heard over any or every part of the cardiac area, in front or behind. Its most usual position is over the base of the heart in front, and once heard in that position no amount of subsequent effusion suffices to efface it. The sound of such a friction appears superficial, close to the ear; it may resemble only a slight sound of rubbing, the crackling of paper or parchment, or the creaking of new leather; or at times it may simulate so closely the blowing sound of a valvular murmur as to be indistinguishable from such a murmur by the sound alone. Occasionally a friction-sound is persistently absent throughout the whole course of the disease, and that even where there is abundance of fibrin effused. It is difficult to account for this. Some suppose it to be due to mere softness of the fibrin; more probably feebleness of the heart's action has a good deal to do with it, as well as some alteration of the parts—especially the lungs—overlying the heart, which may render them bad conductors of sound.

Friction-fremitus may occasionally be detected by the hand placed over the præcordia, but this is not always to be felt. Apart from fremitus, within the first few days of the onset of the disease, we perceive by palpation an unusually forcible and turbulent action of the heart, which is also occasionally irregular, and is due to inflammatory irritation of the cardiac muscle. By-and-by, as the inflammation progresses, cardiac debility sets in, and the pulsation becomes less forcible, while in most cases it is still further obscured by the occurrence of fluid effusion, which separates the apex from the anterior wall, with which the base of the heart always remains in contact. In this way we have produced that phenomenon which is termed 'displacement upwards of the apex-beat,' because the more the true apex is pushed inwards by the effusion, the part of the heart actually in contact with the chest-wall approaches more closely the base of the ventricles. Should the heart be greatly hypertrophied, its impulse may remain distinct throughout the whole course of the disease, the fluid accumulating behind it and not in front.

So long as the serous accumulation is inconsiderable, there is no alteration of the percussion-sound; but whenever this attains an abnormal amount, it is revealed by an increase of the cardiac dulness; and in the ordinary dorsal decubitus of the patient this is first observed at the base, in the line of transverse dulness along the level of the fourth rib. By-and-by, however, the ordinary pyramidal dulness of the heart, base upwards, becomes reversed, and we have a pyramidal dulness with the base below and the apex upwards; and this apex may rise as high as the clavicle, or even above it. The base, on the other hand, may in these cases extend beyond the ordinary position of the apex-beat to the left, especially if the patient be made to lie upon his left side; but it is mobile, and on turning the patient on his right side the dulness leaves the left and passes towards the right. Very great emphysema of the lungs may obscure this dulness, but cannot altogether annihilate it; but of course this method of diagnosing pericardiac effusion can only be put in force when both pleuræ are free from fluid. The fluid effusion, even when confined to the pericardium, may amount to several pints, and its pressure may not only embarrass the heart's action, but may also so compress the lungs, particularly the left one, as to give rise to considerable dyspnœa; and the hindrance thus presented to the free passage of the blood through the lungs may give rise to considerable systemic venous congestion, which is readily observed in the turgid condition of the jugular veins.

As a rule, inspection gives us little, if any, information in regard to the existence of pericarditis. Should the quantity of fluid effused be very considerable, and the chest-walls flexible, some vaulting of the pericardial region may be observed, due to the effacement of the intercostal spaces, the ribs being occasionally also more widely separated than usual, at least apparently so; and the whole præcordial space under these circumstances takes a less share than ordinary in the respiratory motions. Undulatory movements due to waves of fluid, as described by some, are never seen; such movements, if visible, depend upon the wobbling of an enlarged and feeble heart, and not on any fluid waves.

Diagnosis.—A friction-sound has been hypothetically supposed to be occasionally due to mere dryness of the pericardiac membrane. Possibly this may be the case, but it has never been proved. Even if it be the case, then such dryness, associated with the symptoms described, can only be an early stage of inflammation. Apart from these, it may or may not be an indication of commencing inflammation, and must be watched and treated accordingly. It has also been alleged that calcareous concretions and tubercular and carcinomatous roughnesses may give rise to a friction-sound. Associated with the symptoms described, any friction-sound, even presuming such a possible origin, must be regarded as a form of pericarditis, whilst apart from these symptoms it must still be watched with suspicion. The most difficult cases to diagnosticate are those in which the friction-sound is due to pleurisy alone, and is yet audible during cardiac action, when the respiration is temporarily suspended. This is a rare occurrence, but it does happen, and the diagnosis is almost impossible. The subsequent progress of the case may show that the pleura is certainly affected, but that is no proof that the pericardium is not also implicated; or the pericardium may be assuredly diseased, and yet the friction-sound may be solely due to pleurisy. The general symptoms and the condition of the pulse count for something, but the diagnosis between pleurisy and pericarditis is, in such cases, manifestly a difficult one, only to be solved by the further progress of the case. Now and then we have a friction-sound audible towards one or other side—usually the left—of the pericardium, during suspension of the respiratory movements, the base of the heart being entirely free from friction; and in these circumstances the probability seems greatly in favour of the strictly pleural nature of the disease. But even in such cases a perfectly accurate diagnosis is impossible. There is never any real difficulty in determining between a valvular murmur and a frictional pseudo-murmur, because in the case of the latter the sound is restricted to the cardiac area, and usually only to a small portion of that, not being propagated to any extent out of its position of maximum intensity, and then only equally all round, and not in any of the definite lines in which valvular murmurs are propagated. Moreover, the position of maximum intensity of a frictional pseudo-murmur never coincides with that of any valvular murmur, except occasionally with a diastolic aortic one; while, of course, the natural sounds of the heart are never replaced by the pseudo-murmur, though they may be partially obscured by it, and all the secondary results of the valvular lesion simulated are entirely wanting.

Prognosis.—The prognosis in pericarditis is not unfavourable; one in six, or about 16 per cent., is mentioned by some as the ordinary mortality; but Bamberger makes the questionable assertion that pericarditis associated with rheumatism or other curable disease invariably terminates favourably, though the mortality is always large when it is associated with Bright's disease and other incurable affections, the fatal termination of which is hastened by the pericardiac affection. Pericarditis, like any other acute inflammation occurring in an otherwise healthy individual, may be expected to run a favourable course if not unduly treated; and the danger to life is to be calculated by the seriousness of the co-existing complications, and the age and state of the vital powers of the patient. The unfavourable phenomena are, a large quantity of effusion, great dyspnœa, feeble heart's action, small and irregular pulse, lividity, delirium, and other nervous symptoms.

Treatment.—The treatment of pericarditis must be regulated to some extent by the nature of the disease with which it is concomitant. If it concur with pneumonia or pleurisy, it may safely enough be entrusted to the remedies employed for these diseases; or should it accompany rheumatism, then we must treat it as part of the rheumatic affection. Those who have shown the smallest percentages of deaths have been the least perturbative in their treatment, as we might reasonably expect. A rheumatic pericarditis ought therefore to be treated simply as part of a rheumatic affection; but inasmuch as pain implicating the heart has a decided tendency to depress its action, it is of the utmost importance to relieve it at once. With this view a large warm poultice should be applied over the heart; and morphine injected subcutaneously, and repeated by the mouth, or subcutaneously, at regular intervals, so as to keep the patient free from pain. Perfect rest must be enjoined. Should there be much dicrotism of the pulse, or any tendency of the heart to fail, then digitalis should be administered at regular intervals, in doses sufficient to keep up the cardiac action, such as ten minims of the tincture every four hours; and with this may be conjoined the use of hydrate of chloral in ten-grain doses, which is not more useful as a sedative than as an antiphlogistic, and which may very well replace the morphine, having the additional recommendation that it does not interfere with the secretions which demand attention, nor promote the sweating so troublesome in rheumatism. Where it may be considered advisable to give an alkali, such as potash or ammonia, with the digitalis, it cannot be combined with the chloral, but must be given separately. In recent times, salicin and the salicylates have been employed with success in the treatment of rheumatism. They do not prevent the occurrence of pericarditis, but their use is not contra-indicated by its presence. Blisters are frequently recommended in pericarditis, but they tend to irritate the patient and to excite his heart's action.[1] We must, in fact, treat the pericarditis as part of the general rheumatic attack, only requiring a little more attention than usual in the way of warmth, and relieving pain; and all the past history of this disease proves that we shall in this way be more likely to promote a favourable termination of the disease, than by jeopardising our patient by dangerous and uncertain medications.

Where the amount of fluid effused is very great, or when the symptoms seem to point to the presence of pus, it may become a question whether paracentesis should be performed or not. The results of this operation hitherto have not been very satisfactory, but that is no reason why it should not be resorted to if it seem necessary, especially as it can nowadays be so easily done by means of one or other of the aspirators. The patient should be placed in the recumbent position, and the needle entered between the fourth and fifth ribs, about half an inch to the left of the sternum, the operation being performed antiseptically, and the fluid drawn off slowly. For this reason we should be careful in our choice of an aspirator, as one having a powerful vacuum might induce syncope, by withdrawing too rapidly from the heart a pressure to which it has become accustomed. A dilated heart has been said to have been punctured, instead of a distended pericardium, but in the present day such a mistake is scarcely possible, though it must be carefully guarded against. It now and then happens that after the acute symptoms pass away, the pericardium remains obstinately distended with fluid, and it is, perhaps, chiefly in these cases that *paracentesis pericardii* presents the most hopeful prospects. *See* PARACENTESIS.

3. **Pericardium, Gas in.**—The putrefaction of an exudation has been supposed to cause the development of various gases within the pericardium, and the production of so-called *pneumo-hydro-pericardium.* This, however, seems to be a very doubtful cause of a very rare condition. It is readily recognised by the clear tympanitic percussion-note over the usually dull cardiac area, with a metallic gurgling accompanying the cardiac movement. Pneumo-hydro-pericardium is now generally believed to be caused by the entrance into the pericardium of gases from the stomach and intestines, or of air from the œsophagus or lung, or *ab externo*, through some wound, or from the breaking into the pericardium of pus, or broken-down cancerous masses, affecting some of the neighbouring organs. With the air there enter into the pericardium a multitude of morbific germs. Inflammation is thus started, followed by exudation, generally of a purulent character, but sometimes serous, and in weakly and cachectic individuals possibly bloody — a hæmo-pneumo-pericardium.

4. **Pericardium, Malformations of.**—These malformations are described in the article HEART, Congenital Misplacements of.

5. **Pericardium, New-Growths in.**—Both tubercle and cancer may become developed in the fibrinous layers of a pericarditic exudation, as a rule secondarily to the occurrence of these processes in other organs. This is a very rare circumstance, however, as is also the occurrence of tubercular or cancerous nodules of a secondary character in the substance or on the surface of the pericardium itself, with which a secondary pericarditis speedily becomes associated. In either case, but particularly in the former, the fluid in the pericardium is usually of a hæmorrhagic character when associated with the development of cancer. Tubercular, and more frequently cancerous, masses are occasionally formed in the lungs or mediastinum, and pressing upon the pericardium give rise to pericarditis, which reveals itself mainly by the signs of effusion, and without any direct symptoms of cardiac implication. Such cases are not often recognised during life. The prognosis is always fatal; and the treatment palliative only.

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[1] It would be well to mention that in the earlier stage of the disease, and under favourable circumstances, leeches might be applied with marked benefit.—EDITOR.

6. **Pericardial Adhesions.**—Pathologically speaking, the most important of all the terminations of pericarditis is adhesion of the two layers, which in its most exquisite form was described by the ancients as congenital absence of the pericardium. This is a state of matters impossible to diagnose, though it may be surmised; and too often it escapes even a surmise, unless the previous history of the case be well known. Very rarely there remains a permanent depression over the cardiac area, the result of pre-existing pericarditis, and subsequent adhesion of the visceral and parietal layers and also of the superjacent pleura. More frequently, but still rarely, this state of matters is revealed by a systolic depression of the parts over the cardiac apex. Even more rarely—because the result of a more extensive inflammation—we have a systolic depression over the scrobiculus cordis, caused by adhesion of the two layers of the pericardium to each other and to the pleura covering the diaphragm, and concomitant adhesion of the diaphragm to the liver.[1]

It can be only rarely that extensive pericarditis exists without a simultaneous myocarditis, and the results of the latter affection were formerly too frequently referred to the pericarditis itself. An adherent pericardium occurring in early life may hamper the future growth of the heart, and may thus produce one form of so-called atrophy of the heart, with all the consequent results of impaired nutrition. But it is only when the subpericardiac layer of muscular fibres has been involved in the inflammation, that we may have atheromatous or fibrous changes taking place; and, as the result of these, encasement of the heart in a calcareous wall; a local or, more rarely, a general thin and fibrous condition of the cardiac muscles; and either local aneurysmal or general dilatation. These results are, however, rare. Hypertrophy is not always to be regarded as the result of pericardial adhesion, but of a concomitant lesion which may be present, or of some other cause; for though pericardial adhesion may co-exist with cardiac hypertrophy, it does not necessarily give rise to it. In a large proportion of cases simple pericardial adhesion is to be regarded as not productive of any appreciable results of an untoward kind.

G. W. Balfour.

PERIHEPATITIS (*περί*, around; and *ἧπαρ*, the liver).—Inflammation of the capsule of the liver. *See* Liver, Inflammation of.

PERINEPHRITIS (*περί*, around; and *νεφρός*, the kidney).—Synon.: Fr. *Périnéphrite*; Ger. *Perinephritis*.

Definition.—An acute or chronic disease of the cellular tissue around the kidney, consisting of inflammatory thickening of, and exudation into, the tissue, frequently followed by suppuration; characterised by fever, local pain, fulness, tenderness on pressure, and in many cases ultimately by fluctuation; and resulting frequently in death, sometimes in spontaneous recovery.

Ætiology.—Perinephritis in most cases originates from pyelitis or suppurative nephritis, by perforation or by extension of the inflammatory process. It is especially related to pyelitis from urinary calculus. It may result from injuries, such as blows, wounds, or severe strains; or from extension of inflammation from neighbouring parts, as from the pelvis, the gall-bladder, or the testicle and spermatic cord. The disease appears in some cases to result from exposure to cold, especially after previous exposure to excessive heat. It arises also in the course of or as a sequel to fevers, particularly the exanthemata. It is most common in adults; and appears to affect equally the two sexes.

Anatomical Characters.—In the earlier stages the cellular tissue around the kidney is congested; and when exudation has supervened, the affected tissue becomes solid and firm. Usually suppuration speedily takes place in the centre of the mass, commencing either at one or at numerous points, and gradually extending. The pus is sometimes odourless, sometimes fœtid. It is important to remember that a fæcal odour may be present without perforation from the bowel. The perinephritic abscess may become so large as to extend from the level of the liver and spleen to the iliac fossa, and may project so far forward as to bulge the abdominal wall. The pus may burrow and make its way to the surface at the lumbar region, in the lower part of the abdomen, or even in the thigh. More commonly it makes its way into the ureter, or the colon; sometimes into the peritoneum. Occasionally the diaphragm is perforated, and the pus is discharged through the lung. Sometimes rapid gangrene is induced, and sloughy masses are found, mingled with the purulent *débris*. Either without going on to suppuration, or after discharge of the pus, cicatrisation may take place, dense fibrous tissue permanently occupying the place of the structures which had been involved.

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[1] The diagnosis of adherent pericardium is of great clinical interest. The difficulty which attends the determination of this condition, and which is always greater in stout subjects, partly depends on the circumstance that adhesions may be either partial or complete, either loose and free or firm and of a contractile character; and that the pericardium may or may not have contracted adhesions anteriorly with the different layers of the pleura, and posteriorly with the surrounding parts. In firm and extensive pleuro-pericardial adhesion the physical signs that have been most relied upon are: (1) Well-defined systolic recession in the region of the apex impulse, or within that area and in the epigastrium and lower sternal region; (2) diastolic rebound felt by the hand in the same situations; (3) non-diminution of the superficial præcordial dulness and non-depression of the impulse, but on the contrary depression of the epigastrium, in inspiration; (4) fixation of the impulse in change of cubitus; (5) superficial character of the heart-sounds; (6) presence of dulness and of impulse beyond (that is, to the left of) the seat of maximum impulse; and (7) evidence of cardiac enlargement after acute rheumatism, without evidence of valvular disease.—Editor.

Symptoms.—The constitutional symptoms in perinephritis are generally well-marked. The attack may be ushered in by rigors recurring frequently, sometimes periodically. The temperature rises to 100° or even to 105°. The pulse becomes rapid, and either bounding or feeble. The tongue is furred; there is great thirst; the appetite is lost; and there is a tendency to constipation, due in part to the fever, in part to the mechanical pressure upon the bowel. The skin is hot and dry; sometimes there are profuse sweatings, particularly during the later stages of the malady. The local symptoms are pain, usually aggravated by movement, and markedly by pressure; and the presence of a tumour. The tumour rapidly increases; and while it is at first hard throughout, it soon presents deep-seated fluctuation, which becomes gradually more distinct and superficial. The skin in the lumbar region is often œdematous, and is usually pale, excepting when perforation is about to take place. The position of the mass is important. It is situated in the region of the kidney, and is inseparable from it, while as a rule separable from the liver and spleen. The urine may be quite natural, but in many cases it is altered, in consequence of the presence of pre-existing pyelitis or nephritis; but even in cases which do not originate in renal disease, there is a tendency to diminution of the urine at first, and this is apt to continue throughout, accompanied by a dark colour of the secretion.

The onset of perinephritis is generally acute, but it may be very insidious, especially when it follows pregnancy. Probably it sometimes terminates by resolution without going on to suppuration. When suppuration is once fairly established, it extends and makes its way, either to the surface or into some internal cavity. When the pus is making its way outwards, there are the usual features of a burrowing abscess—the skin becomes red and prominent, and at last an opening is formed by ulceration. When the pus makes its way into the colon, a copious discharge of pus by the bowel occurs; and, owing to the nature of the opening, fæcal matter seldom makes its way into the abscess-cavity. If bursting occurs into the ureter, evacuation of pus from the bladder takes place. If into the lungs, a sudden discharge may happen with coughing, the layers of the diaphragmatic pleura having been first agglutinated together. With all these modes of termination there are, as a rule, fall of temperature and relief of the general and local symptoms. When the abscess makes its way into the peritoneum, fatal peritonitis is rapidly lighted up. When through the diaphragm, should the two layers of the pleura not be adherent, empyema is produced, with sometimes gangrene of the lung. In some instances of perinephritic abscess there is a fatal termination without perforation having occurred, by means of blood-poisoning, either in the form of pyæmia with secondary abscesses, or of septicæmia with affection of the spleen and other blood-glands. In a few cases suppurative pylephlebitis has been met with, accompanied by secondary abscesses in the liver.

Diagnosis.—The concurrence of fever with pain and swelling in the region of the kidney, is almost distinctive of perinephritis. The tumour is fluctuating, and is in the immediate neighbourhood of the kidney; it is usually confined to one side; its mass may be tilted forward by pressure on the renal region. It must be distinguished from new formations of the kidney, spleen, liver, or mesenteric glands; from hydronephrosis; and from extravasation of blood into the cellular tissue, due to rupture of an aneurysm. From the first group it is distinguished by the fever, and the fluctuation and exact position of the mass; from hydronephrosis by the fever, and the characters of the enlargement; from the aneurysmal extravasation by the comparatively slow growth of the tumour, and the absence of the characters of aneurysm. In most cases certainty is most readily attained by means of the aspirator. Pyonephrosis must be excluded by a careful survey of the history of the case—particularly of occasional discharges of pus in the urine, and by the details of the physical characters of the swelling.

Prognosis.—The prognosis is always grave, and becomes increasingly so as the disease advances. The duration is commonly short, the case terminating in from a fortnight to a month; sometimes, however, a case lasts several months. A favourable prognosis may be given when perforation outwards has taken place; or when the abscess has burst internally, in such a direction that the pus escapes freely, and there is improvement in the general symptoms.

Treatment.—In the earlier stages counter-irritation by blistering may be useful. The internal use of iodide of potassium, and the external application of iodine, may prevent suppuration. Supporting diet should be given, but not stimulants unless essentially necessary.

When suppuration has taken place, the abscess must be discharged by the aspirator, or by free incision. The latter is preferable, because there are often sloughs or masses of tissue which cannot be got rid of by aspiration. When operation by incision is resolved upon, the incision should be made in the lumbar region through the skin and muscular tissues; and the finger should be introduced into the abscess cavity, to tear down any adhesions which may exist. When the pus has been evacuated, a drainage-tube should be introduced, so as to keep the passage open, and give free egress to the pus. The best results are to be expected when free incision is adopted, and Lister's antiseptic method rigorously employed during the operation and afterwards. The patient's strength must be maintained by nutritious food, tonics, and stimulants when required.

T. Grainger Stewart.

PERINEURITIS (*περί*, around; and *νεῦρον*, a nerve).—Inflammation of the connective-tissue sheath of a nerve, usually more or less associated with neuritis. *See* Neuritis.

PERIOD OF INCUBATION.—The period that elapses between the entrance of an infective agent into the system and the first appearance of the symptoms of the disease which it produces. *See* Incubation.

PERIODICITY IN DISEASE.—In the older physic the periodical phenomena observed in many diseases exercised an important influence upon medical opinion and practice. In the physic of the present day these phenomena, although not disregarded by current pathology, have scarcely a place in therapeutical teachings. An increased precision of medical observation, while leading to the removal of many errors of the older writers on the subject, has begotten a general doubt as to its value in practical medicine, and has brought about a rejection of the earlier views respecting it perhaps too indiscriminate.

1. Periods of Days and of Weeks. Critical Days.—Two modern writers in this country, Dr. Thomas Laycock and Dr. Edward Smith, devoted attention to the phenomena of periodicity in disease. Laycock, from a general review of the periodical phenomena observed in menstruation, in utero-gestation, in the development of the ova of fishes, and in the metamorphoses of insects, came to the conclusion that physiological changes occur in animals every three and a half, seven, fourteen, twenty-one, or twenty-eight days, or at some definite number of weeks. In other words, he came to the conclusion that there are certain 'critical days' in health, days in which there are marked changes in the vital movements, whether that change be for the better or the worse; and that those days may be stated generally as the fourth, seventh, fourteenth, twentieth (or twenty-first), and the twenty-eighth. Further, from a review of the periodical phenomena observed in disease, particularly in the groups of eruptive, intermittent, and continued fevers, and in gout, he endeavoured to show that the changes observed in them followed a similar rule of periodicity to that manifested in health. He saw reason, moreover, having regard to the three-and-a-half day period noticed, or seven half-days, to revert to the ancient division of the whole day (*νυχθήμερον*) into two parts, here following Graves, who had said: 'We should not count three days and a half, but seven half-days; we should not say seven days, but fourteen half-days. If this method were adopted, many of the apparently critical terminations in continued fevers would, I have no doubt, be found strictly conformable to some regular law of periodicity.' Laycock also saw reason to revert to the ancient doctrine of *critical days in fever*, and he thus elucidates it: 'In the essay on the judicatory or critical days, found among the writings of Hippocrates, a critical day is shown to be that day on which certain symptoms will appear, enabling us to ascertain—first, the probable duration or termination of the disease, and, secondly, the symptoms likely to appear on certain future days. The acts of mind which deduced these inferences were termed judications (*judicationes—κρίσεις*); and the day on which those acts were to be made was termed judicatory (*κρίσιμος*). So a day might be judicatory—first, of the disease, its course and termination; secondly, of the symptoms to happen on another day. Thus jaundice and hiccup, appearing on the fifth day of fever, indicated a fatal disease; jaundice, on or after the seventh, indicated diaphoresis; on the seventh, ninth, eleventh, and fourteenth (if unaccompanied by hardness in the præcordia), a favourable termination. In pleurisy, if the fever abates on the seventh day, the patient will recover; if it do not, the disease will be prolonged to the fourteenth, on which day it is sometimes fatal. This is the first and plainest exposition of the doctrine of critical days, and, I believe, it is correct.' Laycock then proceeds to make a comparison of the critical days of febrile diseases, and the order of sequence observed by intermittents; and, further, to compare both these forms of fever with the periodicity observed in the exanthemata, and make the facts bearing upon that part of their pathology harmonise with each other. 'The critical days, according to Hippocrates [doubtless here writing, without knowing he did so, of what we now call continued fevers], are: 1, 4, 7, 9, 11, 14, 17, 20, or 21. The paroxysms of a tertian will take place on the $\frac{1}{1}$p. $\frac{3}{2}$p. $\frac{5}{3}$p. $\frac{7}{4}$p. $\frac{9}{5}$p. $\frac{11}{6}$p. $\frac{13}{7}$p. $\frac{15}{8}$p. $\frac{17}{9}$p. $\frac{19}{10}$p. $\frac{21}{11}$p. The paroxysms of a quartan will take place on the $\frac{1}{1}$p. $\frac{4}{2}$p. $\frac{7}{3}$p. $\frac{10}{4}$p. $\frac{13}{5}$p. $\frac{16}{6}$p. $\frac{19}{7}$p. And if a continued fever existed with tertian or quartan exacerbations, the more violent symptoms might be expected to appear on the days indicated. On comparing the order of days, discrepancies between the three are sufficiently obvious on a superficial consideration, but many of them disappear on more particular inquiry. . . . With regard to the exanthematous fevers, it will be seen at once that the "critical days" they exhibit occur in quartan order. . . . Exanthematous typhus exhibits the tertian type, and, as might be inferred, the critical days in this fever are the fifth, seventh, ninth, eleventh, and twenty-first. Scarlatina is sometimes tertian, sometimes quartan.'

Since the discrimination of the several varieties of continued fevers, and after the date when Laycock wrote, medical observation has not tended generally to support the doctrine of critical days, as it relates to this group of febrile disorders, or to confirm the evidence upon which that doctrine appeared to be founded. Murchison's observations (*Treatise on the Continued Fevers of Great Britain*, 2nd ed., p. 187) did not support the applicability to *typhus*; but in this respect, as he notes, they were not in accord with the observations of Gairdner, Russell, and Traube of Berlin. The last-named, indeed, as also Wunderlich, revived the doctrine. *Relapsing fever* may, perhaps, be said to illustrate the doctrine, the paroxysm intermitting on the third, fifth, or seventh day. According to Murchison, the doctrine fails with respect to *enteric fever*, but he adds that he had 'often noticed' that the disease terminated about the 21st or 28th day. E. Seguin (*Medical Thermometry*, 1876) reproduces the views of Hippocrates on critical days, and Wunderlich's seeming confirmation of them derived from thermometry, himself accepting the 'similitude,' indeed the 'quasi-identity of the results' obtained, in this regard, by the father of Physic and the modern professor. According to Wunderlich's observations, the majority of cases of typhoid fever run a regular course, divided into periods corresponding in time with the division into weeks and half-weeks. The ordinary course is about twenty-one days, and Seguin describes an 'effervescence of seven days, a fastigium of seven days, and a defervescence of seven days;' but he adds, with reference to the irregularities which so often mark the disease, 'simple as it looks, how difficult it is to make it out.' In typhus—simple uncomplicated cases—the thermometer marks the fourth day as the height, the sixth to the seventh as the turning point, and a *perturbatio critica* at the end of the second week. 'The doctrine of crises,' says Wunderlich, 'was for the ancients a dogma . . . for us it must become a law.' Robert Lyons remarks (*Treatise on Fever*, p. 74, 1861): 'We are far from denying that at certain periods febrile disease presents an unmistakable tendency to terminate on critical days; but we think that it is consistent with observation to state that a critical issue of fever . . . is far less common in our day than it once was.' And this, indeed, would appear to be a legitimate conclusion from the observations made in this country bearing on the subject. It would almost seem, in fact, on comparing the critical days set forth by the older writers with the order of sequence followed by the paroxysms of intermittent fever, as if the indications of the former, in the progress of the continued fevers of Great Britain at least, had declined with the diminution of sources of paludal malaria.

Laycock, as the general result of his investigation of the *minor* periods—that is, the daily, weekly, monthly, and seasonal recurrences of vital movements—as contra-distinguished from the *major* periods, that is, periods measured by a year, or by a series of years (which he also discussed, but which will be referred to in this article in another connexion), laid down the following propositions: (1) There is a general law of periodicity which regulates *all* the vital movements of *all* animals. (2) The periods within which these movements take place admit of calculations approximatively exact. (3) The fundamental unit—the unit upon which these calculations should be based—must for the present be considered as one day of twelve hours. (4) The lesser periods are simple and compound multiples of this unit, in a numerical ratio analogous to that observed in chemical compounds. (5) The fundamental unit of the greater periods is one week of seven days, each day being twelve hours; and simple and compound multiples of this unit determine the length of these periods by the same ratio as multiples of the unit of twelve hours determine the lesser periods.

Inquiring into the causes of the periodical changes in the vital movements of animals, Laycock saw reason to believe that they were in part dependent upon cyclical processes inherent in the system (*esoteric*), partly upon periodic agencies acting from without (*exoteric*), or that they resulted from a combination of the two (*endexoteric*). Prosecuting the inquiry further with special reference to the exoteric agencies, Laycock showed how closely the periodical changes observed in vital movements were linked to the periodical phenomena observed in nature at large, and this not merely with reference to such obvious phenomena as the alternation of sleeping and waking, in connexion with the diurnal rotation of the earth, and the succession of day and night, but also in respect to the more recondite periodical changes in the vital processes. He set forth data which suggested that those changes, as well as the periodical changes observed in disease, had definite relations to the position of the earth with reference to the sun, and to the position of the sun among the spheres: also to the periodical fluctuations occurring in atmospherical temperature, pressure, and magnetism; and in the magnetism of the earth, whether diurnal, seasonal, or secular. And of the periodicity observed in pathological processes, he endeavoured to show that (whatever the intimate nature of the pathological process might be) neither the beginning, the continuance, the fluctuations, the ending, nor the recurrence could be rightly understood apart from its relations to the phenomena of physiological periodicity on the one hand, and the periodicity of physical phenomena on the other hand. He held that there were not wanting indications in pathological phenomena of a lunar period, and particularly of a lunar cycle (eighteen years, Howard's seasonal cycle); the indications of solar periods were more obvious; and it was to be inferred that in time we should have evidence of greater pathological cycles corresponding with the greater astronomical cycles. Laycock, indeed, saw clearly that, so far as exoteric agencies were active in bringing about the periodical phenomena observed in physiological and pathological processes in man, the changes of least period were linked inextricably to the changes of greatest period, and that the study of the greater periods must be approached, if success were to be hoped for, through the study of the lesser.

Laycock was of opinion that as our knowledge of the periodical phenomena observed in vital changes becomes more exact and extensive, it will be possible to establish a science of *vital proleptics*, having for its object 'to foretell social and individual suffering'—in other words, a science of *pathological forecasting.*

Edward Smith examined the question of periodical changes in living beings, in health and disease, from a standpoint different from that taken by Laycock. He limited his observations to the human system, and prosecuted a series of researches on the daily, weekly, and seasonal changes it underwent, probably unique in their duration and extent. He adopted as criteria of these changes the rates of pulsation and inspiration, the quantities of carbonic acid expired, of air inspired, and of urea and urinary water evolved. The data as to these several changes were determined by a series of observations made upon himself and others, some phthisical, at hourly intervals, without intermission, throughout the twenty-four hours, during several days in succession, for the daily period, and at daily intervals for the longer periods of time. The fluctuations observed in the different phenomena of health being taken as indications of changes in the activity of the vital processes, it became possible to determine the progression and retrogression of that activity within the several periods to which the inquiry was directed. These may be briefly stated as follows:—

Daily period (*cycle*).—Vital activity is at the lowest between the hours of 1 and 3 o'clock A.M. After 3 o'clock A.M. the activity increases, at first slowly, then more quickly, until a maximum is reached between the hours of noon and 2 P.M. A progressive decline follows, rapid at first, slower as the evening draws on and falls into night, until the minimum is reached between 1 and 3 A.M. The day, in fact, as concerns the changes undergone in the human system may be divided into two periods, one of minimum change (approximately from 8 P.M. to 8 A.M.); and one of maximum change (approximately from 8 A.M. to 8 P.M.) Within this daily cycle, smaller cycles are observable, according to the time and quality of the meals.

Weekly period (*cycle*).—A weekly period is not shown by a clear line of progression of vital change throughout the week, but by the indications of a higher degree of change which follow upon the first-day rest than are manifested at the close of the sixth day of labour. The evidence of a seven-days period of change in the healthy system, on the line of investigation pursued by Smith, and apart from the social habit of periodical rest, is obscure; but the social habit is probably the expression of a physiological want of the system.

Seasonal (*annual*) *period* (*cycle*). — A seasonal cycle is very definitely marked by the intimate vital changes observed in the human system. Towards the close of summer vital change has reached its lowest point. With the commencement of autumn a progressive increase commences, which continues through the autumn and the winter, and reaches its highest degree in spring. Towards the close of spring vital change begins to decline progressively. This decline proceeds throughout June and July, at an increasing rate in the latter month, and attains its lowest degree early in September. The *summer* changes in the system exhibit the following minimum and maximum conditions: a *minimum* of carbonic acid and vapour exhaled, of air inspired, of the rate and force of inspiration, of alimentation and assimilation, of animal heat generated, of muscular tone and endurance of fatigue, and, in general, of resistance to adverse influence. A *maximum* of the rate of pulsation, of the action of the skin and the elimination of vapour, of the dispersion of heat, of the supply of heat from without, and of excess of heat, of the elimination of urea and urinary water, of the distribution of blood to the surface, of the imbibition of fluids, of relaxation of the tissues, and of poverty and carbonisation of blood. In the *winter season* the above conditions are, for the most part, reversed. The *autumn season* is marked by the conditions peculiar to the summer or the winter, as the character of the season resembles the one or the other; it is essentially a period of change from the minimum to the maximum. The *spring season* is characterised in its early and middle parts by the highest degree of efficiency of every function of the human system, but as the season advances to the close, these conditions merge into those peculiar to summer.

The effect of season, Edward Smith observes, is more than the physical phenomena of temperature and atmospheric pressure explain, and is so universal that even the same amount of exertion, made at two different seasons, produced different degrees of effect upon the vital changes—less carbonic acid being evolved from it in summer than in winter, in proportion to the relative amounts when at rest at these two periods.

The periodical changes here set forth have important bearings both upon the liability to, and the treatment of disease. Smith endeavoured to formulate these bearings, and thus to furnish a rational statement of many facts which the experienced practitioner learns at the bedside, and which he applies empirically.

But the interest of the seasonal period is more conspicuously marked as it influences the liability to and recurrence of disease and particular kinds of disease. And here it should be noted that Edward Smith discusses a question which, perhaps, has been too little considered, namely, the viability of children born in the different seasons of the year. This question he believed to have an important bearing upon the great loss of infant life which occurs in the summer season. Smith concludes that the viability of those children is greatest who are born in the winter and spring months.

Later and more reliable observations show that the periodical fluctuations observed in the progress of certain current diseases in the course of the year, appear to be largely determined by the influence of seasonal changes on the individual. This subject has been examined by Dr. Alexander Buchan and Sir Arthur Mitchell (*Journal of the Scottish Meteorological Society*, Nos. xliii.-xlvi.), with reference to the variations of mortality in relation to the weather for different diseases, at different ages, in London, for a period of thirty years. The results obtained by these authorities are of exceptional value, from the length of period over which it has been practicable to extend their examination. More recently Longstaff has added considerably to our knowledge of this subject. A series of researches made by Dr. Edward Ballard, on the prevalence of certain sorts of sickness, in a particular district of London, with reference to meteorological conditions, corresponds closely with the results shown for the mortality in similar kinds of sickness by Buchan and Mitchell, the minima and maxima of the sicknesses necessarily preceding by a longer or shorter period the minima and maxima of the mortality arising from them. The general results obtained from the London mortality may be taken as representing the influence of seasonal changes on disease; but the Registrar-General has shown that in measles, to take one instance only, a second and greater maximum which is so conspicuous in the London curve assumes only small dimensions in several English towns, the spring maximum being the more constant. In New York the scarlet-fever curve is practically reversed, the maximum being in spring and the minimum in autumn. The accompanying diagrams (figs. 111–116), published by the Registrar-General in the Annual Summary for 1890, show the seasonal mortality of some of the more important diseases current in London.

2. **Periods of Seasons or of Years.—Epidemics.**—A series of periodical phenomena have now to be considered which have been a source of the most eager speculation from the earliest times of medicine to the present day. So far as medicine is concerned, these periods have been marked by epidemic morbid phenomena—epidemics in man, epizootics in animals, epiphytics in plants. The recurrence of these phenomena at intervals shows that over and above the periodical morbid changes which have hitherto been noted, and which are completed within the day, the week, or a series of weeks, and the seasons within a year, there are periods of change which require for their completion a series of years of longer or shorter duration, and which for their elucidation (as Laycock showed) require to be considered in connexion with the previously mentioned periods. These periodical morbid phenomena are of two sorts, the one relating to particular localities, districts, or countries (*epidemics*); the other to groups of several countries or to the world generally (*pandemics*). There are, in fact, circumscribed (local) and general epidemics, the small and the great epidemics of some writers; the former, local evolutions of disease having relation chiefly to the physical and moral states of communities; the latter, secular evolutions (to use Charles Anglada's phrase: *Maladies Éteintes et les Maladies Nouvelles*, 1869), which appear to be governed by as yet undetermined laws. To these secular evolutions of disease some epidemiologists would restrict the term 'epidemic.' *See* EPIDEMIC.

The law of periodicity of the several diseases current in a country, and which are apt to become epidemic, being as yet undetermined, each disease has to be considered apart; and in those which are communicable from the sick to the healthy, the influence of an accumulation of susceptible persons in the intervals between epidemic prevalence, which formerly was considered an important factor in epidemicity of one and another disease, is coming to be regarded as subordinate to conditions appertaining intrinsically to this and the other virus.

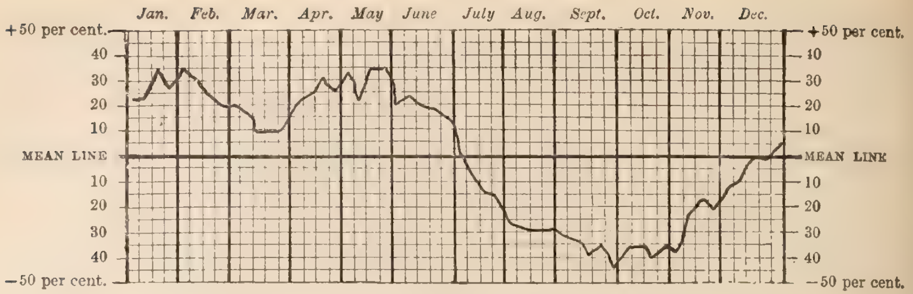

Fig. 111.—Small-pox (50 years, 1841–90). The mean line represents an average weekly number of 17 deaths.

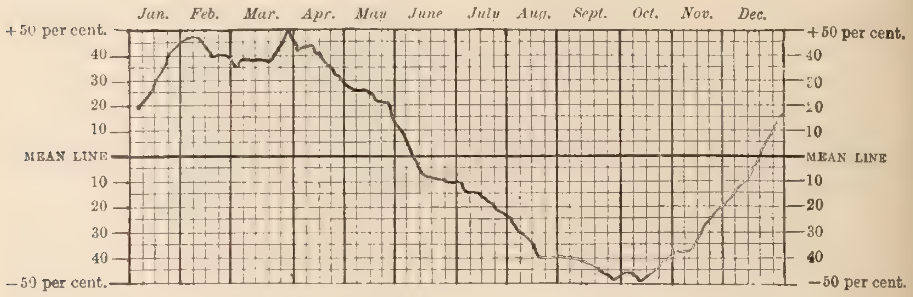

Fig. 112.—Whooping-Cough (50 years, 1841–90). The mean line represents an average weekly number of 47 deaths.

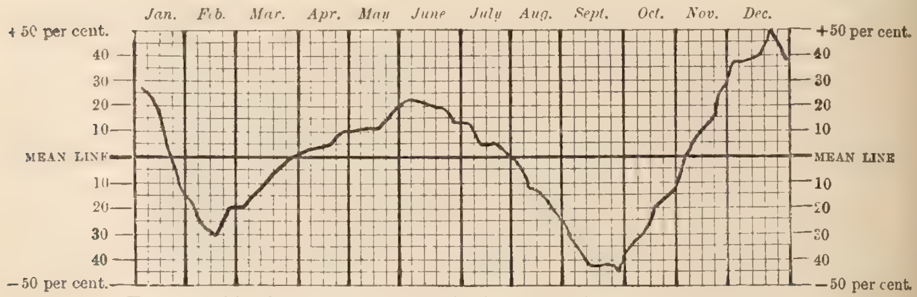

Fig. 113.—Measles (50 years, 1841–90). The mean line represents an average weekly number of 34 deaths.

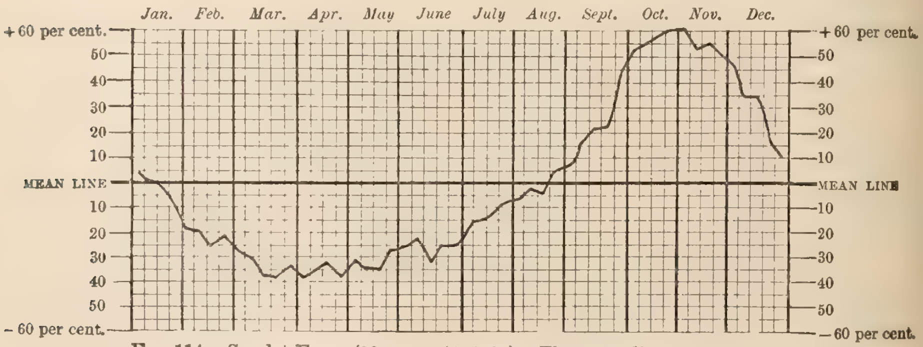

Fig. 114.—Scarlet Fever (30 years, 1861–90). The mean line represents an average weekly number of 44 deaths.

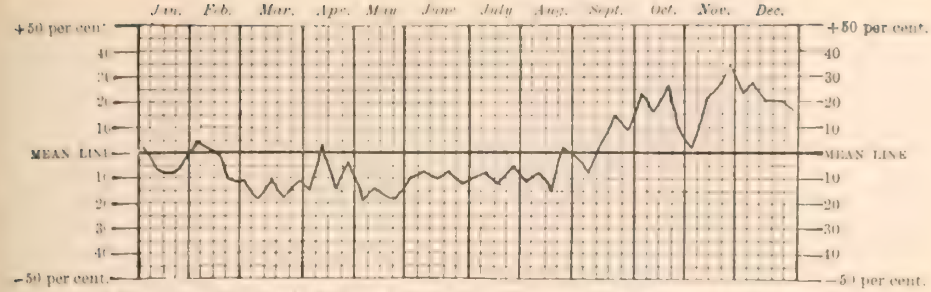

FIG. 115.—Diphtheria (30 years, 1861–90). The mean line represents an average weekly number of 13 deaths.

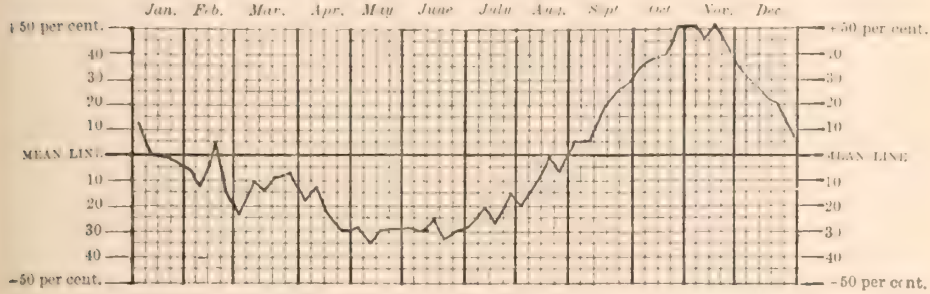

FIG. 116.—Enteric Fever (22 years, 1869–90). The mean line represents an average weekly number of 16 deaths.

Dr. Longstaff (*Studies in Statistics*) has brought out some new and important points in regard to the broader cycles which extend over periods of years. He found that from 1855 to 1880, not only in London, but also in England generally, scarlet-fever mortality rose and fell with considerable regularity at intervals of five or six years, the actual maxima having occurred in 1858, 1863-64, 1869-70, and 1874. This curve was also followed (more or less closely) by a group of diseases which in their seasonal distribution are most like scarlet fever. As regards erysipelas, puerperal fever, and rheumatism of the heart, the parallelism is almost complete, and there are plain indications of affinity in those of laryngitis, diphtheria, croup, and quinsy. During the last decade, however, with declining mortality the rhythmic recurrence of scarlet fever has ceased to be perceptible in mortality returns. Meanwhile small-pox has become epidemic about every four or five years, in London at all events; measles at intervals, which as Munro (*Trans. Epidem. Soc.*, vol. x. p. 104) and others have shown, average about two years in most towns, but may be longer or shorter; and whooping-cough at still less regular intervals of two or three years. These three diseases, as already stated, have no similarity to the scarlet-fever group in their seasonal curve. Another group, of which diarrhœa is the most prominent representative in this country, reach their annual maximum shortly after the highest temperature of the year is attained; their true relation, according to recent observations, being with the temperature of the soil at a greater or less depth from the surface. Diarrhœa often shows a curious tendency to biennial sequence of alternately high and low mortality; but on investigation, this, when it occurs, is usually sufficiently explained by alternation of hot and cold summers. Dr. B. A. Whitelegge has shown that, whatever their causes may prove to be, these cycles, like the seasonal changes characteristic of each disease, are too definite to be regarded as due to accident. Nor are they likely to be purely mechanical in origin, for they vary not only with each disease, and to some extent with locality, but also from decade to decade. There is reason to believe that they are connected primarily with variations in the quality of the contagium itself. As a general proposition, it may be stated that the years of greatest mortality are those in which both the prevalence and virulence are greatest. As regards scarlet fever, the case-mortality (that is, the percentage of fatal cases), if traced year after year, seems to yield a curve which is almost parallel with that of the scarlet-fever death rate. Statistics are wanting in respect of the case-mortality in measles, but occasionally, as at Sunderland in 1885 and Hanley in 1889, an exceptional virulence and severity of type are observed; and in these and other instances it has been found that for some ten years previously the usual biennial waves have gradually increased in destructiveness, as shown by the records of mortality. Upon similar evidence it may be suspected that small-pox declined in average virulence, as it certainly did in average mortality, from about 1838 to about 1855, increasing again to a maximum in 1871, and thenceforward declining again until 1888 or 1889. Here, however, the question is further complicated by the dominant influence of vaccination, in addition to the social and climatic conditions which are obviously concerned in promoting or retarding epidemic extension.

Again, with regard to cholera and 'fevers,' it must here be noted that Dr. Robert Lawson holds, from a widely extended range of observation, that a series of fluctuations may be distinguished in the prevalence of cholera and 'fevers' following in regular sequence at intervals of two years. These fluctuations are common to both hemispheres; and as they appear to move from east to west, he has designated them '*pandemic waves.*' These waves have a definite relation, he believes, to the magnetic isoclinal lines, and he has laid down rules for determining their position at any time (*Trans. Epidem. Soc. of Lond.* vol. iii. p. 216).

The facts relating to the secular evolutions of diseases are amongst the most interesting, if the most lugubrious, in the history of the human race. Although their too frequent obscurity and their extreme complexity have hitherto interposed an insuperable barrier to the construction of a general doctrine regarding their occurrence, it is not the less necessary that they should receive attention. Here it is possible only to note some of the more salient indications of secular periods of morbid evolution. The following illustrations (chiefly according to Anglada) may be mentioned :—

(*a*) The great *pestilence* of the fifth century before Christ, of which the so-called 'plague of Athens,' as described by Thucydides, was an incident.

(*b*) The pestilences of the second and third centuries of the Christian era, which are believed to have been of the same nature as the pestilence of the fifth century B.C. After the third century this form of pestilence disappeared from history.

(*c*) The explosion of *bubonic* (*inguinal*) *plague* in the sixth century after Christ, when, for the first time in history, this formidable disease assumed the epidemic character which it maintained to the early part of the present century. Breaking out in the reign of Justinian (A.D. 542), the disease quickly occupied the whole of the then known earth, and began a tragic course which has continued even to our own time. For twelve hundred years it had held a pre-eminence among pestilential maladies, sometimes more, sometimes less prevalent, but at all times deadly. In the sixteenth century, when quarantine was established (*see* QUARANTINE), 69 outbreaks of the disease were recorded in Europe. of which five happened in England; in the seventeenth century, 56, six in England; in the eighteenth century 28, none in England; and in the first half of the nineteenth century, 15. In the seventeenth century, the area of prevalence of the disease began to decrease. This decrease went on progressively throughout the eighteenth and the commencement of the nineteenth centuries, the latest outbreaks of the malady, however, being not less fatal than the earliest; and in 1844 it apparently became extinct. But about ten years afterwards the disease again showed itself in the Levant, and from that time to the present scattered circumscribed outbreaks have occurred in Western Arabia (1853, 1874, and 1879), North Africa (1855–59 and 1874), Mesopotamia (1867 and 1873–77), Persia (1863, 1870–71, and 1876–77), and, after an absence of thirty-six years from Europe, in the province of Astrakhan, Russia (1878–79).

The sixth century most probably also gave birth to or determined a new phase of activity in small-pox, measles, and even scarlatina, as great epidemics.

(*d*) The *gangrenous pestilence* of the middle ages (tenth, eleventh and twelfth centuries), a disease long extinct.

(*e*) The *black death* of the fourteenth century, a disease held by the most competent writers to differ essentially in nature from bubonic plague, and long extinct—unless, indeed, according to some writers, the Pali plague of India is to be regarded as the dregs of the *black death* of the fourteenth century. *See* PLAGUE.

(*f*) The *sweating sickness* of the fifteenth and sixteenth centuries, which, born towards the close of the former century, after five visitations (1485–86, 1507, 1518, 1529, and 1551) disappeared, about the middle of the latter century.

Also, the great epidemic of *syphilis* of the fifteenth century.

(*g*) The *choleraic pestilence* of the present (nineteenth) century.

(*h*) The exceptional development of fatal *diarrhœa*, especially of *infantile diarrhœa*, in this century.

(*i*) The occasional extension of the *yellow fever* of the tropics into Europe, notably at the beginning of the present century.

(*j*) The great development of *diphtheria*, a disease that had been well-nigh forgotten, within the past thirty years

(*k*) The appearance within recent years of *cerebro-spinal fever*.

In these phenomena we have evidence of secular pathological changes, to which a clue has been sought in studying their relation with secular meteorological and telluric changes. In the epidemics of short recurring periods—the lesser epidemics, so to speak—it is possible to construct a theory of recurrence, founded on the relationship of man to his physical and social surroundings, and the periodical changes which he and they undergo, in common with and in subordination to the periodical changes observed in Nature at large. In the epidemics of long recurring periods—the greater epidemics—the same conditions obtain; but it would appear as if there were in addition some slowly developed cumulative influences at work, which manifest themselves only after long intervals of time. So far as these influences may be linked with meteorological changes we look principally to India, where these changes are more uniform in their occurrence, for the earliest clear light on the subject. There, for example, cholera is constantly present—now as a disease endemic to a particular region, now as a widespread epidemic within the limits of the peninsula, but ever and anon breaking its bounds and spreading pandemically throughout the world. Dr. James L. Bryden has shown that the different developments of cholera within the boundaries of India have definite relations to particular meteorological phenomena; and it seems not unreasonable to suppose that, following the line of research inaugurated by him, in progress of time it will become possible to discriminate between the meteorological changes which influence or concur with epidemic prevalence of the disease within India, and those which influence or concur with wider extensions of the malady—such as affected Europe in 1829-37, 1847-50, 1852-56, 1865-67, and 1869-73. Blandford's meteorological researches may be thought of as promising help in this direction, inasmuch as they are tending to show a relation between the greater cycles of meteorological change in India and cycles of meteorological change in the sun's atmosphere, particularly as observed in the sun-spot period.

It might here be added that the well-known observations on the appearance and disappearance of the spirillum in relapsing fever, seem to suggest a direct connexion between the periodical character of this disease and the life-cycle of the organism.

J. Netten Radcliffe. Shirley Murphy.

PERIOSTEUM, Diseases of.—*See* Bone, Diseases of.

PERIPHERAL (περί, around; and φέρω, I carry).—Of or belonging to the periphery or circumference, as opposed to the centre. The term is now applied chiefly to morbid conditions connected with nerves or their terminations, as distinguished from those situated in the nerve-centres, for example, *peripheral paralysis*, *peripheral pains*. Peripheral may also be associated with the vessels, as distinguished from the heart, for example, *peripheral resistance*; and with the outer zone of the lobules of glandular organs, as, for instance, of the liver.

PERIPHERAL NEURITIS.—*See* Neuritis, Multiple.

PERIPNEUMONIA NOTHA (περί, around; πνεύμων, the lungs; and νόθος, false). An obsolete term, which was formerly vaguely applied to a variety of forms of acute inflammation of the bronchi and lungs.

PERIPROCTITIS (περί, around; and πρωκτός, the anus).—Definition.—Inflammation of the tissues surrounding the rectum.

The lumen of the rectum is normally, except in the act of defæcation, obliterated by the mucous membrane being thrown into folds from contraction of the muscular coat of the bowel; so that a transverse section of it in this state would present the appearance of a solid oval, with the long diameter transverse. During defæcation the bowel is distended by the passage of fæces, and in persons subject to constipation or flatulence this distension is often found considerably increased by accumulations of fæces or of flatus. The rectum is, in order to admit of this mobility, surrounded by a considerable quantity of loose cellular tissue, which below passes by direct continuity into the masses of adipose tissue which fill the ischio-rectal spaces.

In consequence of the dependent position, the comparatively great exposure to injury, the vascularity and the liability to congestion from the junction of the portal and systemic venous systems, this cellular tissue is very liable to inflammation, which usually goes on to suppuration.

Periproctitis may be either *acute* or *chronic*.

Ætiology.—*Acute* inflammation around the rectum may be of traumatic origin. Unskilful catheterisation in the male subject, by which the point of the catheter is forced through the urethra into the space between the bladder and rectum; penetrating wounds of the bowel, caused by instruments, such as injection-tubes, stricture-dilators, &c., or by foreign bodies introduced by patients themselves, or by sharp substances, such as fishbones, which have been accidentally swallowed; gunshot wounds of the part; penetrating wounds, caused by falls on sharp substances; or even contusions, the result of falls or kicks, may set up such inflammation. Or it may be the result of extension of inflammation from surrounding parts. Thus prostatitis, cystitis, pericystitis, ulceration in the membranous portion of the urethra, sloughing ulceration of the vagina, and the various kinds of ulcers in the rectum, may be the exciting cause. If perforating ulcers be the cause, so as to lead to extravasation of urine or fæces, the inflammatory process is very severe. In some rare cases no exciting cause can be traced, and such cases are known by the misleading name of 'spontaneous periproctitis.'

Chronic periproctitis always results from the extension of inflammatory processes from neighbouring parts. Disease of the sacrum, coccyx, or lower lumbar vertebræ, or chronic disease of the pelvic viscera, often leads to it. It is characterised by considerable infiltration and thickening of the cellular tissue, as well as by suppuration. Pyæmia resulting from ligature of hæmorrhoids may be attended by abscesses in this tissue; which also, though very rarely, have been found in pyæmia from other causes.

SYMPTOMS.—In acute cases the patient complains of a feeling of weight in the part, and of pain, which is much greater during defæcation. As the thickness of the integument in this region, and the fasciæ of the part, retard the pointing towards the surface, extensive mischief may exist with little external sign. Hence the importance in all suspected cases of careful digital exploration of the rectum, by which local tenderness, increased temperature, and either hardness or fluctuation, according to the stage of inflammation, may be detected. In chronic cases the symptoms are usually masked by those of the exciting cause.

TREATMENT.—In all such cases accumulation of fæces in the rectum must be prevented by the use of simple enemata; whilst in acute cases early surgical interference is imperatively required. In other cases, the exciting cause must be discovered and treated according to circumstances.

JEREMIAH MCCARTHY.

PERITONEUM, Diseases of.—The peritoneum is by far the most extensive serous membrane in the body, while it has numerous folds and attachments, and is in relation with several organs and other structures, so that the consideration of its diseases, though similar in their nature, is a much less simple matter than in the case of the other membranes of this class. It must also be remembered that in the female the peritoneal cavity is in direct communication with the uterus, through the Fallopian tubes. The morbid conditions of the peritoneum may be discussed according to the following arrangement:—

(1) Peritoneum, Acute Inflammation of; (2) Peritoneum, Chronic Inflammation of; (3) Peritoneum, Gas in; (4) Peritoneum, Dropsy of; (5) Peritoneum, Hæmorrhage into; (6) Peritoneum, Injuries to; (7) Peritoneum, Morbid Formations and New-Growths in; (8) Peritoneum, Malformations of.

1. Peritoneum, Acute Inflammation of.—SYNON.: Acute Peritonitis; Fr. *Péritonite Aiguë*; Gr. *Acute Bauchfellentzündung*.

ÆTIOLOGY AND PATHOLOGY.—Acute peritonitis may arise under several conditions, which can be conveniently included under certain heads.

(*a*) *Traumatic*.—It was formerly believed that any kind of injury to the peritoneum was highly dangerous, and would lead almost inevitably to inflammation. Not only, however, may it be punctured with an aspirator or trocar without any harm resulting, but it may even be freely opened and manipulated, under proper aseptic or antiseptic conditions, without any injurious effects, as is constantly exemplified in various operative procedures at the present day. At the same time, a very slight operation affecting the peritoneum may lead to serious or even fatal peritonitis, if septic matters are introduced into its cavity. Penetrating wounds of the abdomen are very likely to be followed by peritonitis, but not necessarily. The rupture by violence of an abdominal organ, should the patient survive long enough, will also lead to this result, from the escape either of blood or of the contents of a hollow viscus. Peritonitis has been attributed to a mere contusion over the abdomen. When it arises from a wound, it is not the simple injury to the peritoneum that causes the lesion, but its exposure to impure air, the direct introduction of septic matters, or hæmorrhage into the peritoneal sac.

(*b*) *Perforations and Ruptures.*—In addition to lesions due to injury, there are several other kinds of perforation and rupture which are liable to give rise to peritonitis. These have been discussed at length in a special article (*see* PERFORATIONS AND RUPTURES), and it will suffice to mention here, that acute peritonitis may follow either of the following forms of perforation or rupture: (i.) of hollow viscera, with escape of their contents, especially the stomach, intestines, appendix vermiformis, gall-bladder, or urinary bladder; (ii.) of solid organs which have become so softened as to give way; (iii.) of cystic or other localised accumulations of serous or other fluids; (iv.) of collections of pus in connexion with any structure within the abdomen, even with the peritoneum itself, or in the abdominal wall; (v.) of an aneurysm; (vi.) of a dilated receptaculum chyli; (vii.) of fluid accumulations within the chest, which have opened through the diaphragm into the abdomen, such as empyema, pulmonary abscess, or a hydatid cyst. The degree and characters of the peritonitis depend mainly on the materials which thus gain access into the peritoneal sac, whether gaseous, liquid, or solid, and which irritate it more or less according to their nature. Urine is one of the most virulent of such materials; and unhealthy pus or gangrenous fragments are also highly injurious.

(*c*) *Direct irritation of the peritoneum.*—This is a common source of peritonitis, and the irritation may be *general*, affecting more or less the whole peritoneum; or *local*. Thus it is probable that *general* irritation may result from distension of the peritoneal sac in extreme cases of ascites; and certainly from extensive morbid deposits, such as cancer or tubercle. *Local* irritation may be excited by many different conditions, including mere mechanical pressure or friction, as from a malignant or other tumour, an enlarged cancerous organ, or an accumulation in the bowels; as well as localised inflammation, suppuration, ulceration, or gangrene. A very severe form of peritonitis is liable to be set up by a strangulated hernia or certain forms of acute intestinal obstruction. Even chronic obstruction, or impaction of fæces, may cause peritonitis, but then this is preceded by ulceration and perforation of the bowel above the difficulty. This complication may also result from the spreading of putrid inflammation in typhoid fever, without any perforation; and it has occurred in this disease in connexion with an ulcerated gall-bladder, or a suppurating embolus in the spleen. It is occasionally associated with dysentery. Other causes to be mentioned in this connexion are a sloughing embolus in the spleen, due to ulcerative endocarditis, suppurative inflammation of the kidney, tubercular glands, typhlitis and perityphlitis, associated with lesions of the appendix vermiformis. In some instances a minute and careful search has to be made for the source of irritation before it can be discovered; for instance, it may be merely a suppurating absorbent gland, deeply situated. Peritonitis thus originating may be limited, or may spread universally, this depending very much on the nature of the irritant.

(*d*) *Extension.*—Besides the extension of peritoneal inflammation from a local irritation, it now and then happens that pleurisy or pericarditis, especially if of a septic nature, spreads through the diaphragm to the peritoneum, probably by means of the system of lymph-canals existing between the serous membranes and the diaphragm. Inflammation may also pass along the Fallopian tubes directly from the uterus to the peritoneum. In this connexion it may further be mentioned that infectious emboli in branches of the abdominal aorta have given rise to peritonitis; and this disease has also been attributed to phlebitis and periphlebitis, extending from the umbilical and spermatic veins.

(*e*) *Secondary.*—This term refers to cases of peritonitis originating as a complication or local manifestation of some general condition. Under such circumstances the disease usually results from a morbid state of the blood—especially when it contains products of excessive or abnormal tissue-change—as in low fevers, certain irritants, or infective agents. Other causes may, however, assist in its development. The most important diseases in which secondary peritonitis occurs are Bright's disease, usually tubal nephritis, occasionally the granular kidney; septicæmia and pyæmia, though here there is generally some local cause to account for it; erysipelas, small-pox, glanders, anthrax, and other diseases of this class; and possibly acute rheumatism and gout. Erysipelas has caused peritonitis by extending through the abdominal wall. It has also been said to follow scurvy; but in a large number of cases of scurvy which came under the observation of the writer peritonitis never occurred. Under this head may be mentioned cases of peritonitis due to the effects of sewer-gas, of which there are some well-authenticated cases.

(*f*) *Idiopathic.*—Occasionally cases of peritonitis occur which cannot be referred to any of the recognised causes. These have been called *idiopathic*, and have been attributed to exposure to cold, excessive eating or drinking, and various other causes in individual instances. Their reality, however, is exceedingly doubtful.

(*g*) *Contagion.*—Peritonitis may be originated by contagion, especially when of the puerperal variety, and it may thus become epidemic.

It may be noted here that different micro-organisms have been found in the morbid products of peritonitis; and some believe that there are essential differences between the various forms of this disease. The chief organisms which have been met with are streptococcus pyogenes, staphylococcus pyogenes aureus or albus, bacterium coli commune, diplococcus pneumoniæ, and the amœba coli associated with dysentery.

Peritonitis in Females.—A few special remarks are called for on this point. Peritonitis is much more common in females than males, on account of the relation of the peritoneum to the uterus, and the various conditions connected with the genital organs and functions which are liable to affect this structure. The following are the principal causes coming under this head to which peritonitis has been referred: (1) the uterine congestion attending menstruation, aided by the effects of cold, especially if this should give rise to inflammation of the womb; (2) the puerperal state and its accidents, puerperal peritonitis being a most important form of the disease, which is discussed separately; (3) premature delivery, and especially the use of instruments in procuring abortion; (4) extra-uterine fœtation; (5) local diseases, such as inflammation of the womb or its lining membrane, or in the vicinity of the organ; ovaritis or sloughing of an ovary; uterine or ovarian tumours; peri-uterine hæmatocele; and inflammation, suppuration, or ulceration of the Fallopian tubes;

(6) gonorrhœal inflammation spreading upwards; and (7) injections into the cavity of the uterus. *See* Pelvic Peritonitis; and Puerperal Diseases.

Predisposing Causes.—In addition to sex, age has to be regarded as a predisposing cause of peritonitis. It is very rare in children, except in new-born infants, in whom it occurs comparatively frequently, either from inflammation or gangrene of the umbilicus, or from umbilical hernia; or as the result of infection from the mother. The affection is said to be not uncommon in the fœtus, causing its death. In children peritonitis is usually associated with the acute exanthemata or with pyæmia, even sometimes following vaccination; but it may also be due to tubercular disease or to intussusception, and in very rare instances has been traced to an undescended testis, or to injury in administering an enema. Peritonitis is predisposed to by previous attacks; and, it is said, by accumulation of fæces, and habitual excessive use of strong purgatives. Chronic Bright's disease may be regarded as a powerful predisposing as well as an exciting cause of the complaint, a very slight irritation readily setting it up when this affection is present.

Anatomical Characters. — The pathological changes in peritonitis present much variety under different circumstances, as regards their nature, progress, and extent; and although they resemble in a general way those observed in other serous inflammations, they exhibit in most cases distinguishing peculiarities of a striking kind.

In the early stage increased vascularisation is always noticed, but this may subside at a later period, or be obscured by the inflammatory products. There is capillary injection more or less diffused, the vessels being enlarged and elongated. This is often very marked, giving rise to intense redness, frequently not uniformly distributed, but being especially observed where coils of intestine touch each other, and at the starting-point of the inflammation in certain cases. The injection is also said to be in many cases especially marked along two longitudinal lines, which run over the bowel, at a little distance from one another, parallel with the attachment of the mesentery. Small extravasations of blood are not uncommon, and they may be numerous.

The products of the inflammatory process are very variable, as regards both their nature and amount. In certain cases they consist almost entirely of a fibrinous exudation or of organisable lymph, with a very little serum, often more or less tinged with the colouring matter of the blood, and containing flakes of lymph—*adhesive peritonitis*. The lymph is of a yellowish-grey colour, and at first very soft and easily separable, but afterwards it tends to become firmer and more adherent. It is deposited as a film, which is added to until by degrees it may attain considerable thickness. Usually the exudation forms a continuous layer, though of unequal thickness, but occasionally it occurs in separate patches. It mats together loosely, or more or less firmly, the coils of intestines; and covers the solid viscera, where it tends to attain a greater thickness. The subsequent progress of this form of peritonitis in cases of recovery is towards organisation of the lymph, and the formation of thickenings, bands of adhesion, and agglutinations, which may lead to grave consequences.

In a small proportion of cases of acute peritonitis a fluid effusion constitutes the principal morbid product, varying in quantity, and it may become so abundant as to distend the peritoneum to an extreme degree. There is a slight deposit of fibrinous exudation. The effusion may be mere serum, difficult to distinguish from ascites; while ascites may excite peritonitis, and thus lead to an admixture of inflammatory effusion. In other cases the fluid is sero-fibrinous, being spontaneously coagulable, and greenish-yellow, or turbid or milky; while flakes or larger fragments of lymph float in it. In this condition there is often much fibrinous deposit. If the fluid is absorbed, adhesions will subsequently form.

In the majority of cases of acute peritonitis the products tend to be of a lower type than those thus far described. The exudation is frequently soft and non-organisable, or sometimes greasy in appearance and to the touch; not uncommonly it is greenish-yellow, and infiltrated with pus-cells. The fluid is also more or less sero-purulent or actually purulent. It may be thick, laudable pus; or more liquid and unhealthy-looking; or discoloured, and more or less offensive and foul-smelling; or mixed with blood in various proportions, especially in scurvy and low fevers. Peritonitis associated with Bright's disease is generally suppurative. The pus accumulates mainly in the pelvis as a rule; but collections of it are also found between the coils of intestine, and in other parts, pent up by lymph or adhesions, which look like abscesses, and may be of some size. These collections sometimes give way, and thus set up general peritonitis. In exceptional cases purulent peritonitis becomes chronic, and accumulations of pus burst externally or into the intestines. In rare instances a gelatinous or colloid material constitutes the effusion in peritonitis.

With regard to obvious changes presented by the peritoneum and sub-peritoneal tissue, there may be none when the lymph is separated, the peritoneal surface being normal. In other cases it is dull, lustreless, swollen, and softened, while there is sub-serous œdema, so that the serous covering can be easily torn off from the organs. When the inflammation tends towards suppuration, the membrane is more lustrous than normal. Occasionally the structures are infiltrated with actual pus; and under certain circumstances localised gangrene occurs at one or more spots.

The microscopic changes and appearances differ in the several conditions indicated, but it must suffice to state that they are similar to those observed in other forms of serous inflammation, namely, transudation from the vessels; migration of corpuscles; separation of, changes in, and proliferation of the endothelial cells; proliferation of the connective-tissue corpuscles; and the formation of vascular granulations. The proportion of cells, and their vitality, differ very much in the several kinds of exudation. The changes which take place in the formation of adhesions and allied conditions are also like those noticed in other serous membranes. *See* SEROUS MEMBRANES, Diseases of.

In certain forms of acute peritonitis foreign materials of different kinds are found in the peritoneal sac. Fœtid gas may be present, either from decomposition of inflammatory products, from transudation through the intestinal walls, or from perforation. The last-mentioned cause also accounts for the presence of foreign bodies, the contents of the stomach or intestine, worms, bile, gall-stones, urine, and other materials which may have set up the peritonitis.

The muscles of the abdominal wall are often found more or less softened, pale, and degenerated in severe cases of peritonitis. The intestines are almost always distended with gas, in some cases to an extreme degree, so that they protrude when the abdomen is opened. Their walls are infiltrated, œdematous, and softened; and the mucous layer can be readily separated. The stomach is usually small and more or less contracted, being covered by the intestines. The liver and spleen are often pale, or discoloured to a slight depth.

The morbid appearances in acute peritonitis may be more or less *general* or *diffuse*, the whole extent of the membrane, however, being rarely involved; or *local* or *circumscribed*, the latter variety being due to some local irritation, and not spreading, either owing to the nature of the inflammation, or because it is prevented by adhesions. It is believed that the omentum often checks the progress of the inflammation from below upwards. Local peritonitis may lead either to a local formation of lymph, as over the liver or some other organ; or to a circumscribed collection of pus, which becomes practically an abscess, and may burst in various directions according to its seat. Abscesses may thus form in the pelvis, iliac fossa, sac of the lesser omentum, either of the hypochondriac regions, the subphrenic region, or in other parts. Gas is sometimes mixed with pus in these cases. Certain local varieties of peritonitis have received special names, such as *pelvic*, *parietal*, *omental*, *hepatic*, *nephritic*, and *vesical*. Most cases of *perityphlitis* are also now looked upon as a form of local peritonitis. *See* PELVIC PERITONITIS; and PERITYPHLITIS.

It must be remarked that special care is required in making a *post-mortem* examination in cases of acute peritonitis, as in many forms of the disease the products are extremely virulent, and cause dangerous or fatal septicæmia if introduced into the system even in the smallest quantity. Moreover, in some forms infection is very liable to be conveyed to other persons, and extreme precautions, even to the extent of avoiding all communication, are demanded in this matter in dealing with women in the puerperal state.

SYMPTOMS.—The fact must be clearly recognised at the outset that the clinical history of acute peritonitis varies considerably in different cases, according to its immediate cause, the condition with which it is associated, its seat and extent, the course which the inflammation takes, the products which it originates, and other circumstances. So far as the peritonitis is concerned, the phenomena to be anticipated are *local* and *general*. The *local* phenomena are due to the inflammatory process itself; to its products; and to its direct effects upon abdominal organs and structures, especially upon muscular tissues, which it first irritates and then paralyses. They may be further subdivided into *abdominal* and *thoracic*. The *general* symptoms are either of a febrile character; or depend upon the absorption of septic matters formed in the peritoneum; or are indicative of collapse. It will be expedient, in further discussing this subject, to indicate first the usual clinical course and phenomena of acute peritonitis; and then to point out the more important clinical varieties of the disease.

The *invasion* is usually distinct, being indicated by shivering or actual rigors, which may be repeated several times. If the peritonitis is due to perforation, however, the phenomena attending this lesion constitute the initial symptoms, but even here rigors not uncommonly occur subsequently. The local and general symptoms characteristic of peritonitis speedily supervene.

Local symptoms.—Pain is one of the most constant and striking symptoms of acute peritonitis, and it comes on very speedily, or in certain cases may even precede the rigors. It depends directly on the inflamed condition of the peritoneum. As a rule, it commences locally, especially in the lower part of the abdomen, but it rapidly spreads more or less extensively, being often felt over the whole abdomen, though not uncommonly more marked in one or more spots, such as those from which the inflammation started, and also in the umbilical region. The pain is usually exceedingly severe and intense, and may be excruciating or agonising, as evidenced in the expression of the patient's face. In character it is variously described as hot, burning, cutting, boring, shooting, darting, and so on. From time to time exacerbations are liable to occur, owing to spasmodic movements of the intestines disturbing the inflamed structures. Any movement of the body increases the suffering, so that the patient instinctively keeps the trunk at rest, and assumes a characteristic posture, in order to relieve all abdominal tension, namely, lying on the back, with the thighs and knees flexed and the legs drawn well up. Moreover, abdominal respiration is restrained or entirely checked, as the necessary movements increase the pain; which is also aggravated by any such disturbance as the act of coughing, vomiting, or defæcation produces. At the same time there is the most exquisite tenderness, so that the patient dreads any objective examination, and cannot bear the least touch, though deeper pressure is still more unendurable. In some cases even the weight of the bed-clothes cannot be tolerated.

Prominent symptoms occur in connexion with the alimentary canal. The appetite is completely lost, but there is intense thirst. The tongue is furred, and often presents a peculiar appearance, being very small, red, and irritable-looking, while it soon tends towards dryness. The taste is affected, and becomes bitter or otherwise disagreeable, or even disgusting. The breath is also offensive. Nausea and vomiting are usually urgent symptoms, and, as a rule, set in very early. Vomiting occurs when anything whatever is taken, or even spontaneously; while there is often a constant feeling of sickness. At first the vomited matters consist of mucus and altered food; subsequently they present a grass-green appearance; or under certain circumstances may become fæculent, quite apart from intestinal obstruction. Gaseous eructations are also common. Constipation is the rule in acute peritonitis, though it can be overcome by medicines or enemata; but exceptionally diarrhœa occurs, and Dr. Fordyce Barker affirmed that this symptom is more frequent in puerperal peritonitis. At first the intestinal walls are more or less spasmodically contracted, but they soon become paralysed, so that they are distended to a variable degree with gas, and this frequently culminates in extreme tympanites or meteorism. During the development of this symptom, irregular and inefficient peristaltic movements of the bowel often occur, or certain parts are more distended than others; and these conditions may be seen or felt, while they give rise to audible rumbling or gurgling sounds or borborygmi, and aggravate the pain. The rapidity of the distension of the abdomen will depend much upon the previous condition of the abdominal walls, as to whether they are firm or lax and yielding; and upon the rapidity with which their muscles become paralysed.

The only other notable local symptoms in the abdomen are referable to the urinary organs. The urine not only presents febrile characters, but is usually markedly diminished in quantity, and may even be suppressed. What is passed is often hot and scalding. Micturition may at first be very frequent, on account of irritation of the bladder; subsequently retention is liable to occur, owing to paralysis of this organ. The urine is not uncommonly albuminous.

Jaundice is now and then observed in cases of acute peritonitis, and is probably due to some obstruction of the bile-duct.

The *thoracic* symptoms which may result from the local effects of acute peritonitis are hiccough, which is in many instances very distressing; the form of dyspnœa in which the respirations are very hurried—reaching 40, 50, 60, or more, and at the same time shallow, superficial, and upper costal; sometimes cough, although the patient makes every effort to suppress it; and cardiac disturbance, the action of the heart becoming very rapid. The disorder of the respiratory and circulating functions is partly due to the general condition, but they are also locally influenced by the pain accompanying peritonitis; by its direct effects upon the diaphragm; and by the mechanical consequences of gaseous or fluid accumulations upon the diaphragm and thoracic contents. Moreover, morbid conditions within the chest may be associated with peritonitis, such as pleurisy, pneumonia, or pericarditis.

Physical Signs.—The conditions resulting from peritonitis give rise to certain physical signs, which need to be briefly indicated. It must be remembered that in this disease physical examination ought invariably to be practised most gently and cautiously. The causes of the abnormal physical signs are the pain; the distension and disordered movements of the intestines; and the presence of inflammatory products or of other materials in the peritoneal cavity. They may be thus summarised: (1) The abdomen at an early period of the case may be slightly depressed, owing to tension of the muscles; but it speedily becomes more or less enlarged, and often attains a great size, the skin being stretched, and the lower part of the chest also distended. Generally the enlargement is quite symmetrical, but not always. A transverse groove is sometimes visible, passing across the epigastrium. In very muscular individuals the abdomen may be but little enlarged in peritonitis. (2) There is marked absence of diaphragmatic respiratory movements, and these movements as a whole are restricted. The lower intercostal spaces do not fall in during inspiration. Very rarely a friction-fremitus may be felt over some part of the abdomen if a full breath can be taken. (3) Intestinal movements are often seen or felt for a time. (4) Palpation reveals that the abdomen is smooth and regular; at first the recti and other muscles are felt to become instinctively contracted and rigid when palpation is practised, and the semilunar and transverse markings may even be plainly visible; subsequently the sensation is usually that of more or less tympanitic or drum-like tension. There are exceptional cases in which it is that of a fluid accumulation. (5) Percussion usually yields chiefly a more or less tympanitic sound, though not necessarily uniform in tone and pitch over the entire abdomen. If the tympanites is extreme the sound becomes muffled and toneless. The hepatic dulness and splenic dulness are diminished or completely annulled, even though there be no gas in the peritoneum itself. A small quantity of fluid cannot be detected, or only by careful examination in certain postures (*see* Ascites), and it is usually hardly worth while in cases of peritonitis to disturb the patient for this purpose. Generally the dulness due to fluid can be elicited in dependent parts of the abdominal cavity, being as a rule distinctly movable with change of posture. It is said that the line of demarcation between the dulness and tympanitic sound is found to be zigzag when carefully percussed out, owing to the fluid getting in between the loops of intestine. In exceptional cases of acute peritonitis the dulness of fluid is the main percussion-sound noticed, or there may be limited areas of dulness, due to local collections. Fluctuation will be present where there is fluid, but it is not a very reliable sign in acute peritonitis. (6) Auscultation, as a rule, merely reveals, if anything, sounds of the movements of flatus in the stomach and intestine; or succussion-sounds, due to the shaking up of fluid and gas in these organs. Friction-sound is for several reasons a rare phenomenon, but may occasionally be heard over some spot if the patient can be made to breathe sufficiently deeply, mainly over a solid organ, and especially the liver. (7) Examination of the chest often reveals more or less compression of the lower parts of the lungs; and displacement of the heart upwards and towards the left.

General symptoms. — Pyrexia usually sets in speedily in acute peritonitis, but in certain cases there is no rise of temperature throughout. While presenting considerable differences, as a rule the temperature rises markedly at an early period—it may be to 104° or 105°—and continues high for a time, though generally with remissions, having, however, no regular course. There are the usual accompaniments of fever; and the urine is markedly febrile, being concentrated, high-coloured, and depositing urates abundantly. The pulse becomes very frequent, reaching 120, 140, or even 160; it is also small, sharp, and often peculiarly hard, wiry, or thready. The increased rapidity of breathing is partly due to pyrexia. It must be noted that elevation of temperature is not always present, even in suppurative peritonitis. The patient soon presents an aspect of serious constitutional disturbance; the expression of the face is one of pain and grave anxiety, and the features appear sunken, pinched, and withered. There is much debility or actual prostration, while at the same time the patient is generally uneasy and restless, tossing the arms about, but keeping the trunk motionless. A more or less cyanotic appearance may be evident. There are usually no prominent nervous symptoms at first, except, perhaps, headache and sleeplessness. The intellect generally remains clear to the last, and it occasionally happens that the supervention of peritonitis rouses a patient whose consciousness has been previously more or less blunted. In exceptional cases delirium and a tendency to stupor are early symptoms. The further progress of the general symptoms will be indicated under the following heading.

Course and Terminations.—The large majority of cases of acute peritonitis terminate fatally, and usually within a few days, the progress being rapid. It is important to notice that the patient may feel better, and that the pain often diminishes or even subsides, sometimes suddenly, while the general condition is becoming progressively worse. The tympanites may also become less, or disappear. Sometimes before the close an abundance of dark, blood-stained fluid is discharged from the stomach and bowels, without any effort. Death may occur while the pyrexia is still high; but usually the phenomena observed become those of collapse, combined with signs of impaired respiration and stagnant circulation. The patient is greatly prostrated. The countenance assumes more and more the aspect of collapse, the eyeballs appearing sunken and surrounded with dark areolæ, the cheeks hollow, and the features markedly pinched, with blueness of the lips; the expression is that of extreme watchfulness and anxiety. The temperature falls, and often becomes subnormal; the extremities are cold, and the skin is covered with clammy sweats, while the prominent parts are peculiarly cold and blue. The pulse becomes extremely rapid; feeble, sometimes to complete extinction; and irregular. The respirations are very hurried and shallow; and the voice is weak or lost. As already stated, the mind generally remains clear to the last; but in certain cases the mental faculties are somewhat obscured towards the close, and delirium of a low type occurs; occasionally a comatose condition supervenes. In some instances the symptoms become those of the 'typhoid state.'

Acute peritonitis occasionally subsides into a chronic condition, in which localised accumulations of fluid remain, and the patient lingers on, the temperature continuing elevated, but presenting irregularities. Different events may then occur, such as bursting of fluid-collections in various directions, the supervention of septicæmia or pyæmia, or general wasting and anæmia, death ultimately taking place after a variable interval.

Recovery ensues in a certain proportion of cases, where the inflammation has not been extensive, and where its products are either fibrinous or sero-fibrinous. Improvement is indicated by a concomitant diminution of the abdominal symptoms; restoration of the action of the bowels; sometimes an increase in the quantity of urine; a change for the better in the aspect and expression of the patient; increased fulness and force of the pulse, and diminution of its frequency; a gradual fall of temperature; restoration of sleep; and sometimes the occurrence of perspiration. It is said that occasionally a *crisis*, with critical discharges, occurs, but this is quite exceptional, the decline of temperature being usually by *lysis*. After immediate recovery from acute peritonitis the effects of adhesions may prove serious.

CLINICAL VARIETIES.—It will only be practicable to indicate here some of the most striking of the clinical variations presented by cases of acute peritonitis. Two special forms are described in separate articles. *See* PUERPERAL DISEASES; and PELVIC PERITONITIS.

(*a*) **Peritonitis from Intestinal Obstruction.**—Here the symptoms of the obstruction are the most prominent, and the peritonitis only modifies them, while it helps to hasten the fatal issue, which is mainly due to the intestinal condition. It is in these cases that the movements of the bowels are most evident, and the meteorism is extreme. The temperature may continue normal or even subnormal throughout. The course is usually very rapid.

(*b*) **Perforative.**—When general, this is an intense and very fatal form of peritonitis, which usually runs its course very speedily, especially if highly irritating materials gain access into the peritoneum. Usually it is distinctly preceded by the characteristic symptoms of the perforation; or some condition is present in which a perforation may be anticipated. Therefore, if rigors occur, they in most cases follow a sudden local pain, which spreads rapidly over the abdomen. The local symptoms are extremely marked, and the vomiting is likely to be most violent, except, it is said, in those cases where the stomach itself is the seat of a large perforation. Moreover, there may be signs of gas in the peritoneal cavity (*see* 3. Peritoneum, Gas in). The symptoms of collapse are evident from the first, and, as a rule, quickly increase. The temperature is often below the normal, but there may be more or less febrile reaction. Should the perforation take place into a limited portion of the peritoneum, the symptoms are correspondingly limited and less severe.

(*c*) **Adynamic** or **Typhoid.**—Cases of peritonitis may be thus grouped which exhibit a disposition to the rapid development of adynamic or typhoid symptoms. These may depend upon the condition with which the peritonitis is associated; or upon septicæmia or pyæmia, arising from the absorption of inflammatory products from the peritoneum. In some of these cases the local symptoms are not so evident, and may be quite latent.

(*d*) **Latent.**—This term implies that the characteristic symptoms of peritonitis are either altogether absent, or so indefinite as to be practically valueless for diagnostic purposes. Such an event may happen in cases belonging to the adynamic group, where the patient's consciousness is so impaired that he cannot feel pain; but even then pressure over the abdomen may bring out indications of tenderness, if carefully watched for. In latent peritonitis the fluid is generally pure pus. For some latent cases of acute peritonitis, of which the writer has seen a striking instance, no explanation can be given. They appear to be frequent in Bright's disease.

(*e*) **Infantile.**—This has been described as a variety of peritonitis. In young infants pain and tenderness in this disease are indicated by the expression, and by a short cry or whine. They do not cry loudly, on account of the pain thus caused. The abdomen is greatly distended with flatus. Vomiting is less common in children than in adults. Pyrexia is usually considerable at an early period; and the pulse becomes extremely frequent, even uncountable. Occasionally convulsions occur. The course is very rapid in young children as a rule.

(*f*) **Local** or **Circumscribed.**—Cases of localised peritonitis belong practically to two groups. The first includes those in which there is a limited fibrinous exudation —a dry peritonitis—set up by some local irritation, especially in connexion with one of the solid organs, such as a cancerous liver, or with a tumour. Such a condition is only indicated by a correspondingly localised pain and tenderness; with perhaps friction-fremitus and sound, elicited during the respiratory movements. The other local as well as the general symptoms of peritonitis are absent, and the constitution frequently does not appear to suffer in the least. In the second group a limited effusion occurs, which becomes purulent; or there may be several such effusions. Here the symptoms are more severe, but the pain and tenderness are still circumscribed, and in time external objective signs often appear in the corresponding region of the abdomen, such as limited fulness, a feeling of firmness followed by elasticity or fluctuation, redness of the skin, and dulness on percussion. The more characteristic abdominal symptoms of acute peritonitis are either absent, or much less prominent than usual. The general symptoms, however, are frequently very marked, but they are merely of a febrile character, preceded in many cases by rigors. The subsequent progress of the symptoms will depend upon the course of events. Thus, general peritonitis may be set up; the accumulation may burst externally; a communication may be formed with some internal hollow organ, especially the intestine, when gas finds its way into the space, giving rise to a limited tympanitic sound on percussion, and the fluid is evacuated by the bowel; pyæmia may occur; or the condition may become more or less chronic, and the fluid is ultimately evacuated in some direction or other, or undergoes a caseous change, or is absorbed, a cure resulting, with the formation of fibrous thickening and adhesions. Any organ in the vicinity of localised peritonitis is likely to be disturbed in its functions; and the accumulation of inflammatory products may physically interfere with neighbouring structures. Inflammation of the great omentum is attended with very marked superficial pain and tenderness.

(*g*) **Complicated.**—Clinical varieties of peritonitis not uncommonly result from its associated conditions. Thus it may be modified by some disease to which it is secondary, such as typhoid fever or pyæmia; or it is accompanied by some other affection, such as muco-enteritis, pleurisy, or pericarditis; or the peritonitis gives rise to secondary lesions, which modify the clinical history of particular cases.

Diagnosis.—In well-marked cases the diagnosis of acute peritonitis is sufficiently obvious, as evidenced by the cause of the disease; its mode of onset; the severity and character of the local symptoms; the physical signs; the nature and gravity of the general symptoms; and the rapid progress of the case. More or less difficulty may be experienced when the peritonitis is associated with certain other conditions in the abdomen, modifying its symptoms; when it is obscured by the general state of the patient; when its symptoms are quite latent; or when the disease is local. In some instances it is impossible to distinguish positively between mere ascites and inflammatory effusion. It is very important to bear in mind the conditions in which latent peritonitis is liable to occur, especially Bright's disease. It may happen that the diagnosis of peritonitis is clear enough, but that its cause cannot be discovered, or only after very thorough investigation.

There are certain affections which must be remembered as being liable to simulate, and to be mistaken for, acute peritonitis. (1) The writer has seen cases of extreme tympanites, accompanied with pain, in typhoid fever, and in low febrile diseases, such as erysipelas, very much resembling some forms of peritonitis. (2) Painful conditions of the abdominal wall may prove troublesome, namely, muscular rheumatism, localised inflammation, and cutaneous hyperæsthesia. Here, however, although there is superficial and usually diffused pain, with marked tenderness, which may be extreme, there are none of the grave abdominal and general symptoms observed in peritonitis, with the peculiar pulse and other characteristic phenomena. In connexion with hysteria intense hyperæsthesia of the abdomen is occasionally met with, with more or less distension, sickness, and constipation, and even apparently severe constitutional disturbance, a combination of symptoms which may closely simulate peritonitis. Due care should, however, prevent any mistake in diagnosis, for the patient is generally obviously hysterical; no cause of peritonitis can be discovered; the hyperæsthesia is very superficial, and pressure can be borne if the patient's attention is taken off; while the general symptoms are not really those of peritonitis, and there is little or no pyrexia. (3) Painful affections within the abdomen have to be distinguished from peritonitis. These comprise cramp in the stomach; intestinal colic, including that due to lead; the passage of hepatic or renal calculi; painful affections connected with the female generative organs; and perhaps neuralgia implicating certain abdominal viscera. In many of these cases the pain is accompanied with vomiting, frequent pulse, and considerable general disturbance, tending more or less towards collapse. The history of the case, and the investigation of its causes; with the mode of onset and progress of the symptoms, as well as their precise character, ought as a rule to render the diagnosis at once evident. Moreover, the colicky and neuralgic pains are usually relieved by pressure. Doubtful cases must be watched, when any difficulty will probably soon be cleared up. It must be remembered, however, that some of the conditions mentioned may set up local inflammation, and even peritonitis, and thus the diagnosis will be rendered more obscure. (4) Certain objective morbid conditions within the abdomen must also be alluded to in relation to the diagnosis of peritonitis. It may be impossible to distinguish between this complaint and the graver forms of enteritis, especially that resulting from intestinal obstruction, but the diagnosis is not of practical moment, and the two diseases are usually combined sooner or later. The positive diagnosis of peritonitis in some cases of perforation may also be impracticable. In certain local forms of inflammation involving the cellular tissue, such as perinephritis and perityphlitis, it cannot be certainly known whether the peritoneum is involved or not; but it may be assumed that the neighbouring portion of the membrane is very soon implicated, and the peritonitis may become general. Possibly circumstances might arise under which accumulations of fluid, such as an ovarian cyst, a hydatid tumour, or a distended bladder, might simulate peritonitis with effusion, but there rarely ought to be any real difficulty in these cases. These conditions, as well as other tumours, may, however, set up peritonitis. A sudden severe pain due to the rupture of an obscure aneurysm in the subperitoneal tissue may be mistaken for perforation and subsequent peritonitis. (5) It must be mentioned that at first acute pleurisy or pneumonia may simulate peritonitis, the pain present in these diseases being referred to the upper part of the abdomen, or even to a more extensive area, and being accompanied with tenderness. In some of these cases, however, the peritoneum itself may be locally inflamed.

Prognosis.—Acute peritonitis must always be regarded as a serious disease, and in many cases the prognosis is extremely grave, or even hopeless. Moreover, its progress, when general, is usually very rapid, so that the patient may die within thirty-six or forty-eight hours, and generally succumbs within a week. Death may occur, however, in three or four weeks, or even at a later period. In some of the cases of very short duration, death is due rather to the cause of the peritonitis, such as intestinal obstruction or perforation, than to the disease itself. The indications affording hope of recovery have already been pointed out, but the practitioner must guard against being misled into giving a hopeful prognosis from mere improvement in the subjective feelings of the patient, without any corresponding amelioration in the objective local symptoms, and in the general condition. Even in cases where recovery takes place, the effects of adhesions and other remaining morbid conditions must be borne in mind, as these may subsequently become troublesome or even dangerous.

The prognosis of acute peritonitis will be materially influenced by the following considerations: (1) *Its ætiology.*—The most grave forms are those due to perforation; and those of septic origin, especially puerperal peritonitis. That associated with Bright's disease and other forms of blood-poisoning is also very serious. When the disease arises from direct injury, or from some local irritation, the prognosis is much more hopeful. (2) *The patient.*—In young infants peritonitis is absolutely fatal, and it is extremely grave in children generally. A weak or low condition of the patient, from bad living, intemperance, previous illness, or other causes, renders the prognosis more serious. (3) *The extent, rapidity, and precise nature of the disease.*—Peritonitis is more serious in proportion to its extent; and when it is local the result is much more hopeful, especially if the products of the inflammation seem to be merely lymph or sero-fibrinous fluid, when no particular danger need be anticipated. If the course of the disease is very rapid, the prognosis is exceedingly grave, partly because the inflammatory products are then probably of a low type. When peritonitis shows any tendency to become chronic, there is more hope; but even then a fatal issue may ultimately occur from various causes. (4) *The symptoms.*—It may be stated generally that the more severe the symptoms of peritonitis are as a whole, the more dangerous is the case. Among the chief indications of special danger may be mentioned extreme tympanites; urgent vomiting; the passage of bloody fluid from the stomach or bowels; great dyspnœa; incessant hiccough; very high fever; rapid development of signs of collapse; typhoid symptoms, with low nervous phenomena; and an extremely rapid, feeble, and irregular pulse. (5) *Complications.*—These may increase the gravity of a case of peritonitis, such as pleurisy, pneumonia, or pericarditis.

Treatment.—It will be evident that no uniform plan of treatment can be applicable to all cases of peritonitis, and much judgment and consideration on the part of the practitioner are often needed in the management of this serious disease. There are, however, certain definite indications to be recognised, which will now be pointed out, as well as the principal means by which they should be carried out.

(*a*) Attention must, in the first place, be directed to the cause of the peritonitis, which in obscure cases should be carefully sought for, and, if possible, got rid of or mitigated. This may be illustrated by an accumulation of fæces, hernia, and other forms of intestinal obstruction. In most cases, however, this indication cannot be fulfilled; but even then attention must be directed to the cause.

(*b*) The next indication is to endeavour to combat the inflammation itself, so as to arrest or subdue it, to influence its products, and to obviate its injurious effects upon the abdominal organs. Rest for the affected structures is essential, so far as it can be obtained. It will rarely be necessary to enjoin rest for the abdomen as a whole, as the patient usually instinctively attends to this point, and will assume the position already described. It must be understood, however, that he is to be absolutely confined to bed, and not to be allowed to get up for any purpose whatever. It may be desirable to raise the bed-clothes from the body, by means of a cradle or other suitable apparatus, so as to prevent all disturbance from this source. A pillow may be placed under the knees. If not otherwise indicated, it is extremely important in early cases of peritonitis to give as little as possible in the way of food. Of course, in cases of perforation of the stomach or intestines, nothing whatever must be given by the mouth. In other instances only fragments of ice, or small quantities of iced drinks, should be allowed, or iced milk, beef-tea, or meat-juice, if they can be retained. Not uncommonly the stomach rejects everything, and then recourse may be had to small nutrient enemata or suppositories of artificially digested materials.

Abstraction of blood, either by venesection or by the application of leeches to the abdomen, is a common practice in acute peritonitis. If this measure be thought desirable, it is certainly preferable to remove the blood locally; from ten to thirty leeches may be applied in different cases, but not more. Removal of blood can only be of service in the early stage of the disease, and is decidedly injurious when the inflammatory process has progressed considerably, and especially if it has advanced rapidly. Moreover, it must not be practised in low forms of peritonitis, or if the patient is badly nourished and weak from any cause. Healthy, strong, and plethoric subjects are most likely to be benefited by abstraction of blood. This measure is also useful in some forms of local peritonitis.

The chief medicines which are employed for their immediate effects upon peritonitis are calomel and opium, and they are usually given in combination, in the form of pill, every two to four hours. The calomel is administered until the system is brought under the influence of mercury; or, in the case of infants, this is sometimes effected by inunction with the mercurial ointment. In the writer's opinion, mercurialisation as a routine plan of treatment in peritonitis is to be strongly deprecated, and he has never seen any good result from its employment. Opium, however, is a remedy of extreme value, and is often our sheet-anchor. Amongst other beneficial effects, it acts upon the stomach and bowels, being generally supposed to arrest peristaltic action in the latter, though some are of opinion that it excites peristaltic action but diminishes reflex irritation. In whatever way this drug acts, its beneficial effects upon these organs are very manifest. Opium is usually given in doses of gr. ½ to ij. in the form of pill, and repeated every two to four hours. It is remarkably tolerated in acute peritonitis, unless there be renal disease, when it must be given very cautiously, or not at all. In children it must also be administered with due care. If the stomach is extremely irritable, tincture of opium may be administered in the form of enema; or, which is preferable, morphine may be substituted, especially by subcutaneous injection; and this agent may be also employed as an adjunct to the internal exhibition of opium, if the pain should be very intense. Tincture of aconite, veratrum viride, and digitalis have been employed for their supposed effects in checking inflammation in the early stages of acute peritonitis, but in the writer's opinion they cannot be recommended.

The question of local applications to the abdomen, as regards their immediate effects upon peritonitis, is important, but by no means settled. The common practice is in favour of employing hot applications, in the form of light poultices or fomentations, to which anodynes may be added; or turpentine stupes or sinapisms. The use of cold has, however, been strongly advocated by many authorities in the early stage of peritonitis. It may be employed either by means of cold compresses, frequently changed; a bladder containing pounded ice, not too heavy; or flannels dipped in iced water. The effects claimed for this treatment are that it contracts the vessels; allays nervous irritability, and consequently intestinal disturbance; and alleviates pain. The sensations of the patient must be some guide as to its continuance. At a later period hot applications are decidedly to be preferred, as the cold applications can be of no service, and will probably prove injurious.

(*c*) The general condition of the patient in cases of acute peritonitis always demands constant attention, and in many instances it is the chief matter for consideration. Whenever any tendency to collapse or adynamia sets in, alcoholic stimulants are called for, in variable quantity according to circumstances, brandy and champagne being the most suitable. Their administration must not be left until too late a period. They are best given at frequent intervals in small quantities. If stimulants cannot be borne by the stomach, brandy should be given in enemata. Liquid nourishing food is also often required in large quantities, and may be administered in the same way. Quinine in full doses, ether, musk, camphor, ammonia, bark, and turpentine, are the chief medicines which may be called for in bad cases, to combat the general symptoms. Subcutaneous injection of ether or camphor may be of service in extreme conditions.

(*d*) Symptoms often call for special attention in acute peritonitis, although most of them tend to be alleviated by the measures already considered. It will only be necessary to allude further to the following points. Nausea and vomiting may call for small doses of iced effervescents, with diluted hydrocyanic acid and morphine; soda-water and milk; or minim doses of creasote. Constipation in most cases ought on no account to be disturbed; if any treatment is indicated, calomel at first, followed by enemata, will answer the purpose. The treatment of certain forms of peritonitis by saline aperients has been advocated, but in the writer's opinion such treatment is most dangerous. Excessive diarrhœa in certain cases may require to be checked by enemata containing laudanum. Meteorism is sometimes relieved by the application of a turpentine stupe, or the administration of calomel in suitable cases; if very troublesome, the use of enemata containing turpentine, the passage of a long tube *per rectum*, or, in extreme cases, the puncture of the distended intestines in several places with a fine trocar, are the measures indicated. Punctures are, however, more dangerous than in tympanites from simple obstruction, as the intestinal coats have lost their elasticity, so that the apertures are inclined to gape, and to allow the escape of fæces into the peritoneum. The relief of this symptom has often a marked effect upon dyspnœa. Hiccough calls for sedatives, ether, the application of sinapisms or blisters to the epigastrium, and, if dangerous, inhalation of chloroform.

(*e*) The question of operative interference in relation to acute peritonitis has now come to occupy a prominent position. In cases of large effusion paracentesis may be decidedly indicated, and in one case under the writer's care this procedure was followed by complete recovery. The more grave operation of opening the abdomen, washing out the peritoneal cavity, and inserting a drainage-tube is also not uncommonly practised at the present day in cases of general peritonitis, especially when it is septic and purulent, and not due to perforation. Accumulations of pus must also be let out, in accordance with the usual surgical principles and methods. For details on these points, the reader must refer to surgical works.

In cases of peritonitis where recovery ensues, much care is required during convalescence, as regards diet and general management; and the removal of unabsorbed morbid products may be aided by applying blisters or iodine to the abdomen, the administration of iodide of potassium, and the employment of baths and other suitable measures.

2. **Peritoneum, Chronic Inflammation of.**—Synon.: Chronic Peritonitis.—This affection, like the acute form, may involve the peritoneum more or less generally; or only over a localised and limited area. The conditions included under the term are somewhat indefinite, but not uncommonly they are well-marked pathologically, as well as of considerable clinical importance.

Ætiology and Pathology. — Without entering into details, it must suffice to point out the circumstances under which chronic peritonitis may occur: (1) There is no doubt as to its being, though rarely, a sequel of one or more attacks of acute or subacute peritonitis, either general or local, but especially the latter; and after a circumscribed acute peritonitis chronic changes may gradually spread more or less widely. Moreover, the conditions remaining after an attack of peritonitis are liable to set up further mischief of a chronic nature. (2) Chronic peritonitis may become associated with ascites, but more particularly when repeated paracentesis has been performed for the relief or cure of this condition. In some of these cases probably the ascites is the result of a simple chronic peritonitis. (3) Localised chronic peritonitis is common as the result of continued irritation, set up by some diseased organ, such as a cirrhotic or cancerous liver, cancer or chronic ulcer of the stomach, old hernias, tumours, and various other obvious conditions. There are, however, cases occasionally observed in which the cause is not so evident, and these have been attributed to irritation by accumulation of fæces, or to repeated pressure or other mechanical causes acting from without. Extensive chronic peritonitis also starts occasionally from a local centre, and especially perihepatitis probably. (4) Morbid formations in the peritoneum itself are very liable to set up chronic inflammation. Of these the principal are tubercle and cancer; and tubercular and cancerous peritonitis constitute important forms of this disease. (5) In rare instances a chronic inflammatory effusion collects in the peritoneal cavity without any obvious cause. The fluid may be actually purulent under these circumstances, but is generally serous, and cannot be distinguished from that of mere ascites. This chronic effusion has been noticed during convalescence from fevers; and has occasionally been attributed to cold and wet. Distinct chronic peritonitis also sometimes occurs as an independent disease, and has then been referred to chronic Bright's disease, alcoholism, gout, rheumatism, lead-poisoning, cardiac disease, and other causes. A case is recorded by Drs. Fagge and Pye-Smith in which the peritoneum, pleuræ, and pericardium were all involved, with the tunica vaginalis, there being chronic effusion, with enormous thickening, but no tubercle or visceral disease.

Anatomical Characters. — The precise conditions present in an individual case of chronic peritonitis are subject to great variety, as regards their nature, extent, and site; but their general characters can be readily indicated.

Adhesions or fibrous thickenings connected with the serous membrane are almost constantly present in different degrees, and not infrequently they constitute the sole anatomical evidences of chronic peritonitis. They result from the development of the inflammatory products, and the formation of connective or fibrous tissue, with new vessels. The thickening varies much in degree, ranging from what is scarcely perceptible, to the production of a dense fibrous mass an inch or more in thickness, as the writer has seen. It may be evident in the parietal peritoneum; around organs, forming more or less thick and firm capsules; or in the peritoneal folds, especially the omentum and mesentery. Adhesions or agglutinations also form between different parts, thus uniting organs to each other, to the abdominal walls, or to the mesentery or omentum; or sometimes matting the whole together into an inseparable and indistinguishable mass. They present great variety, and by the movements which take place within the abdomen they may be stretched or made looser, or even be got rid of altogether in some instances, when they have formed after an acute attack. On the other hand, in many cases the adhesions and thickenings tend to become gradually stronger and denser, and at the same time to undergo contraction, so that they produce serious effects.

In many cases of chronic peritonitis effusion of some kind is observed. It may be merely a clear straw-coloured serum, or with fibrinous flakes, sero-purulent, or actually purulent. Blood may also be present in it. Occasionally this is the prominent or only anatomical change; and the fluid may range in quantity from a small to an enormous amount. Usually it is associated with the other conditions already described, so that the fluid is not free to move about, and may be actually circumscribed, or even lie in the substance of fibrous masses. Purulent accumulations are likely to make their way in various directions, either outwards or into internal viscera.

When chronic peritonitis depends upon the presence of tubercle, cancer, or other morbid formations, these will be evident on *post-mortem* examination. Moreover, the inflammatory products may undergo degenerative processes, and hence caseous or cretaceous particles or masses be found. Pigment is also often present in abundance.

It is important to notice the obvious effects liable to be produced upon the abdominal organs and other structures by chronic peritonitis. They are more or less fixed by the adhesions and thickenings, and may be displaced at the same time. Compression or constriction is often produced, especially important in the case of hollow viscera, as well as distortion, twisting or torsion, and incarceration. Some of these effects may occur acutely in connexion with bands of adhesion, thus giving rise to grave consequences; and fixation of the bowel may also lead to intussusception. The omentum may be greatly distorted, or contracted and gathered up in some abnormal situation; while the mesentery has been found extremely shortened, so as to contract the small intestine to half its length, its serous covering and longitudinal muscular layer being shrivelled, and its mucous lining thrown into transverse folds. It is said, however, that the small intestines are usually not compressed by adventitious membrane, or even adherent among themselves, though they are contracted in diameter. The deeper tissues of some of the abdominal viscera are likely to be affected by long-continued chronic peritonitis; and atrophy from compression may ensue. The muscular coat of the bowel is generally wasted, but that of the stomach is sometimes much thickened. As one good result of local chronic peritonitis, mention must be made of the fact that it is not uncommonly the means of preventing or modifying the injurious consequences resulting from some forms of perforation of abdominal viscera, by giving rise to previous adhesions and thickenings, and thus obviating the escape of their contents, or limiting their dissemination.

Symptoms.—The clinical history of chronic peritonitis necessarily presents much diversity. The phenomena observed result from the presence of the inflammatory products; the effects produced upon the organs within the abdomen by these products, whether in the way of mere functional disorder, or other more obvious derangements; the consequences of direct pressure upon tubes, vessels, or other structures; and the general or constitutional disturbance often present.

According to its mode of origin, chronic peritonitis either remains after an acute illness, or after a succession of more or less acute or subacute attacks; or its onset is gradual and chronic from the first, and may be very insidious. Of slight adhesions left after acute peritonitis, or originating from chronic causes, there are often no clinical signs; or there may be uneasiness and discomfort, or even painful sensations at times in some part of the abdomen, especially the iliac region, with a tendency to intestinal disorder, in the way of spasmodic movements and constipation. Even when there are no symptoms whatever, adhesions may at any time cause serious consequences. In well-marked cases of chronic peritonitis the symptoms to be expected are of the following nature: Abnormal subjective sensations are usually experienced in the abdomen, such as tightness, fulness, dragging, or actual pain. The pain, when present, is of a dull character, not severe, and liable to come and go, or to present exacerbations from time to time; it is often localised, and especially if the peritonitis be circumscribed; sometimes there is a feeling of local soreness or heat. The painful sensations tend to be increased by movement, and by shaking the body. They are sometimes aggravated by posture, in some cases by bending forwards, in others by the erect posture; and they may be increased by going up stairs, especially if the abdomen is distended. More or less tenderness on pressure is very common, even when there is no spontaneous pain, but not invariable; it is frequently more evident at certain spots, where it may be considerable. Colicky pains are not uncommon in chronic peritonitis, and may occur in severe paroxysms, especially after food, being due to the disturbed action of the bowels, associated with the production and movements of flatus, which may be abundant, even amounting to tympanites. Appetite is often impaired or variable; and dyspeptic symptoms are frequent. Constipation is the rule, and may be very obstinate, even amounting to obstruction under certain conditions. Sometimes diarrhœa is present, or it may supervene at intervals, and occasionally assumes a dysenteric character. This symptom is very common in tubercular peritonitis, in consequence of the bowel being the seat of ulceration. In some cases vomiting occurs from time to time. When there is considerable effusion in the peritoneum, the secretion of urine is diminished. Respiration may be mechanically interfered with from the same cause. As the result of pressure by fibrous thickenings and other conditions upon different structures, jaundice, ascites, œdema of the legs, thrombosis, albuminuria, or neuralgic pains may supervene. When the organs are all matted together, their entire functions must necessarily be more or less interfered with.

General symptoms are usually present in various degrees in cases of chronic peritonitis, but in many instances they depend mainly upon the condition with which this disease is associated, especially tuberculosis and cancer. These symptoms include pyrexia, not high, and having no regular course, but presenting exacerbations, either persistent or occurring at intervals, and in some cases assuming a hectic character; increased frequency of the pulse; a sense of languor or weakness; and more or less general wasting and anæmia, with dryness and harshness of the skin.

It must be noted that in some cases of chronic peritonitis, even where there is considerable effusion, the local and general symptoms are very slight and indefinite, and the patient only suffers from the discomfort due to the accumulation of fluid. On the other hand, the progress is not uncommonly from bad to worse, ending in extreme emaciation and exhaustion, with the formation of bed-sores; or there may be a succession of improvements and relapses; while various phenomena result from the opening of collections of pus in different directions. Thus death may gradually or rapidly terminate a case; or pyæmia may supervene. Even in bad cases, however, comparative recovery may ensue, only the effects of the inflammation remaining, and being more or less troublesome.

Physical Signs.—These require separate notice, and they may be the only clinical indications of chronic peritonitis. They necessarily differ in detail according to the nature of the abnormal physical conditions present in the abdomen, and are also liable to alter during the progress of a case; but their general characters are sufficiently definite. (1) In general chronic peritonitis enlargement of the abdomen is observed, mainly in proportion to the amount of fluid present; but it depends partly on gas in the intestines, or in certain cases on solid exudation. As a rule, it is not very considerable; but the abdomen may attain an enormous size, with stretching of the skin and other accompanying phenomena. While regular in shape on the whole, it may present more or less want of symmetry, especially after a time. On the other hand, in some cases the abdomen becomes locally or generally retracted, and may then exhibit marked irregularities. (2) The sensations on palpation are very variable, but often highly characteristic. It may happen that there is a uniform feeling of fluid. More commonly the sensations are not uniform, but differ in different parts of the abdomen, including indistinct fluctuation in localised areas, sometimes very limited and in unusual situations; with firmness or resistance around these areas or in other parts, ill-defined, occasionally nodulated; and even distinct tumours may be felt, more or less irregular. These in some instances are due to morbid growths, such as cancer, but they may also originate in organised inflammatory products. Under certain conditions the abdomen yields a peculiar feeling of being movable as a whole. Abnormal movements of the bowels are sometimes recognised. When there are localised adhesions between the visceral and parietal peritoneum, if pressure is made at a little distance from the seat of an adhesion, the skin will rise in a fold where this adhesion exists. Possibly general adhesions might be made out by palpation. (3) Percussion occasionally reveals freely movable fluid. As a rule, however, it shows that the fluid is not freely movable, or that it is actually loculated irregularly, this condition being associated with more or less solid material. Hence there is extensive and diffused dulness, which may be noticed mainly in front, and not in dependent parts. Not uncommonly patches of dulness and tympanitic resonance are found contiguous to each other, and irregularly distributed, unaffected by posture. Over the fluid fluctuation may, perhaps, be elicited, but indistinctly; and where there is much solid, the sensation on percussion is that of undue resistance. (4) Friction-fremitus and friction-sound are sometimes present. (5) Changes of posture, as a rule, produce comparatively little or no effect upon the shape of the abdomen, the sensations on palpation, or the percussion-sounds.

When chronic peritonitis is localised, it may be practicable to detect the condition by palpation and percussion. Moreover, when certain organs become fixed by peritoneal adhesions, especially if they are diseased at the same time, this state of things may often be recognised by noticing that the affected organ does not present its normal mobility in relation to manipulation and respiratory movements.

Diagnosis.—In most instances chronic peritonitis, if of any extent, can be recognised without much difficulty, by attending to the history of the case, the symptoms, and the physical signs. It may be very difficult, or even impracticable, to distinguish positively between mere ascites and chronic inflammatory effusion. All the circumstances of the case must be taken into consideration; and in doubtful cases the removal of some of the fluid, by means of a small trocar, will aid the diagnosis. It is important to determine the cause of chronic peritonitis, when present, and especially whether it is simple, tubercular, or malignant. Here, again, the whole case must be considered, not forgetting the age of the patient, the family history, and the presence or absence of tubercle or cancer in other parts. It has been said that a hæmorrhagic character of any fluid removed is significant of tubercular peritonitis, but this certainly cannot be relied upon.

It is quite impossible to diagnose with certainty obscure cases of localised chronic peritonitis, though the condition might be suspected; and it may become very difficult, even in evident cases, to determine the precise changes within the abdomen.

Prognosis.—The prognosis of each case of chronic peritonitis must be considered on its own merits, as regards the cause of the disease; its extent and products; the progress of the morbid changes; the effects produced on the abdominal structures; and the general symptoms. Some cases are of little or no consequence; others are very serious; but even in apparently severe cases great improvement, or even practical recovery, may take place. The dangers to be feared from the opening of purulent collections in various directions must be borne in mind; and also those liable to arise from the presence of bands of adhesion within the abdominal cavity. Tubercular and carcinomatous peritonitis are necessarily very grave forms of the disease, but the former may certainly be recovered from.

Treatment.—With regard to the *local* conditions in chronic peritonitis, it is often desirable to endeavour to promote the removal of morbid products within the abdomen. For this purpose it may be important to keep the patient entirely at rest in bed for a time. The internal administration of iodide of potassium or syrup of iodide of iron may be tried; and in some instances diuretics might be of use. Possibly the judicious administration of some mercurial preparation would be serviceable in appropriate cases. Violent purgation is to be deprecated; but where there is much fluid, advantage might be derived from repeated diaphoresis, induced by means of the hot-air, vapour, or Turkish bath, or by the use of jaborandi or pilocarpine. Local measures are in some instances of essential service, namely, counter-irritation, especially by the application of iodine; friction with some oil or ointment; the application of mercury liniment on flannel; and pressure. The writer has found pressure decidedly valuable in aiding absorption in certain cases, as well as in giving support, the abdomen being covered with cotton-wool, and a suitable bandage applied more or less firmly. A flannel bandage answers best. In cases of large effusion, where absorption cannot be effected, the writer has no hesitation in recommending paracentesis, even repeated when required, having seen signal benefit follow this treatment. A localised purulent accumulation must be treated on ordinary surgical principles.

General treatment is often of essential value in cases of chronic peritonitis. It is directed to the condition upon which the disease depends, such as tuberculosis, or to its effects, but the measures are similar in the main, consisting of good nutritious diet, suitable sanitary conditions, change of air, and the administration of cod-liver oil, quinine, preparations of iron, and other tonics and nutrients. Wine may often be given with advantage.

Symptoms will probably need attention from time to time, such as pain, flatulence, dyspeptic disorders, constipation, diarrhœa, and various other disturbances. The organs in general must be looked to, and their functions promoted. A free flow of urine often follows absorption of fluid, or its removal by operation.

There are many cases of chronic peritonitis which need no special treatment, particularly when it has merely caused local changes. For further remarks on the treatment of the tubercular variety, *see* 7. Peritoneum, Morbid Formations and New-Growths in.

3. **Peritoneum, Gas in.**—Synon.: Pneumoperitoneum; *Tympanites Peritonei.*

Gas may be present in the peritoneal

cavity from three causes, namely: (1) Its escape from the alimentary canal through some rupture or perforation; (2) Transudation of gas through the intestinal wall; (3) Decomposition of morbid materials in the peritoneal sac. The gas may be generally diffused; limited by adhesions; or associated with a collection of pus. The condition cannot be said to give rise to any definite symptoms, except abdominal distension and discomfort. When general it might be recognised by the following *physical signs*: (1) There is extreme and uniform distension of the abdomen, with a specially prominent epigastrium as the patient lies on his back. Sometimes doughy fluctuation is felt in the epigastric region, with a peculiar pitting on pressure. (2) The percussion-sound is markedly tympanitic or even metallic, full and deep in tone; and this sound is very extensive, completely annulling the anterior hepatic and splenic dulness. (3) Succussion splash and sound may be produced, owing to the presence of gas and fluid in the peritoneal sac. These are more uniformly and widely diffused than when such phenomena arise from similar conditions in the stomach or intestines. The aortic sound may also have a metallic quality, and be extensibly audible over the abdomen. A local collection of gas might cause a corresponding fulness of the abdomen, and yield a localised tympanitic or metallic percussion-sound, as well as succussion phenomena if associated with pus.

Prognosis and Treatment. — The *prognosis* and *treatment* of pneumoperitoneum have to be considered in connexion with the several diseases of which it is a part.

4. **Peritoneum, Dropsy of.** — *See* Ascites.

5. **Peritoneum, Hæmorrhage into.**—Blood may escape in quantity into the peritoneal cavity as the result of external injury; or from the rupture or perforation of different structures within the abdomen. An important form of hæmorrhage is that which results from the rupture of an aneurysm. More or less blood may be present in inflammatory or dropsical effusion; or it may originate in the opening of vessels by morbid growths, or the spontaneous rupture of new vessels. Peritoneal hæmorrhage is not uncommon in connexion with tubercular and malignant peritonitis. It may also occur from scurvy or purpura. Fatal hæmorrhage has taken place into the peritoneum owing to the rupture of enlarged veins, due to portal obstruction.

Symptoms.—It might possibly happen that peritoneal hæmorrhage could be recognised during life, if there were some evident cause for this condition; followed by the physical signs of the presence of the blood in the peritoneal cavity; and general indications of loss of blood. As a rule, however, the condition cannot be detected clinically. The hæmorrhagic nature of an effusion can only be recognised by withdrawing a portion of it.

Treatment.—This merely consists in the local and general treatment for loss of blood, if anything can be done or is required.

6. **Peritoneum, Injuries to.**—The peritoneum is liable to be injured from without by contusions and wounds of various kinds; and from within by perforations and ruptures, the injury being aggravated in many cases of this kind by the introduction of matters into the peritoneal cavity, causing mechanical or chemical irritation, or carrying with them septic agents, such as gases, food, fæces, calculi, bile, urine, pus, or worms. The mere injury to the serous membrane itself cannot be said to produce any evident phenomena, unless it be extensive; but it leads usually to serious effects, which have already been considered—namely, hæmorrhage, which may be on a large or fatal scale; and acute inflammation of an aggravated type. Of course, it must be remembered that, along with the injury to the peritoneum, there is usually associated some more or less severe injury to an abdominal organ or other structure, and the phenomena resulting therefrom will be present.

7. **Peritoneum, Morbid Formations and New-Growths in.**—These require brief notice, and may be considered in the following order:—

(*a*) *Fat.*—It is necessary to call attention to the fact that the sub-peritoneal tissue, especially that of the peritoneal folds, becomes in obese persons the seat of a large *deposit of fat*, an overgrowth of that normally present, and this is particularly noticed in the omentum. As a consequence, the functions of the alimentary canal are unquestionably liable to be interfered with, and various dyspeptic symptoms, flatulence, and constipation may arise. Moreover, this condition assists in producing enlargement of the abdomen; and in muffling the natural tympanitic sound. It can be recognised at once by the appearance of the patient; but it is important to remember that it may conceal some other morbid condition within the abdomen. The treatment is that for obesity generally (*see* Obesity). In very exceptional instances distinct *fatty tumours* have occurred in connexion with the peritoneum; and these may become separated by constriction of their attachments.

(*b*) *Tubercle.*—Tubercle is the most common and important new-growth in connexion with the peritoneum. It occurs in three classes of cases, namely—(1) As a part of general acute tuberculosis, the tubercle appearing in the peritoneum as a diffuse miliary deposit, presenting the usual characters; (2) As a localised formation, in connexion with tubercular ulcers in the intestines, granulations forming on the corresponding surface of the peritoneum; (3) As a definite local disease, usually assuming a more or less chronic or subacute course, and accompanied with peritonitic changes. The last form is a well-recognised disease of early life, and is then often a part of the condition termed *tabes mesenterica*, being associated with tubercular ulceration of the intestines, and tuberculosis of the mesenteric glands (*see* MESENTERIC GLANDS, Diseases of). Most cases occur under thirty years of age, but the complaint may be met with over fifty. It appears to be much more frequent in males than in females. In the latter it is in the large majority of fatal cases found to be accompanied with tubercular disease of the Fallopian tubes, which is probably set up by extension from the serous surface. In men the epididymis or testis is sometimes affected on one or both sides. The pleuræ are not uncommonly involved, and occasionally the pericardium. Pulmonary tuberculosis is usually present, to which the peritoneal mischief may be secondary, but this is not always so pronounced as to be diagnosed during life, at any rate without careful examination. Tubercular ulceration of the intestines is frequently associated with the peritoneal lesion.

ANATOMICAL CHARACTERS.—The morbid conditions found on *post-mortem* examination in pronounced cases of tubercular disease of the peritoneum consist of a combination of disseminated tubercles in different stages, with signs of chronic peritonitis. The tubercles are not uniformly scattered, and are said to be especially numerous on the under surface of the diaphragm and in the flanks, while the surface of the intestines may be comparatively free. They have usually undergone more or less caseation or a fibrous change in different parts. As the result of the peritonitis, great thickening and extensive adhesions are usually present, with much contraction. The omentum is in many cases drawn up into a firm flattened mass across the upper part of the abdomen, below the stomach, and often contains much caseous matter, or recent tubercle. The mesentery is also contracted, drawing the intestines together, and distorting them. The bowels may be completely matted together, and perforated by tubercular ulcers at different points. More or less effusion is almost always present, consisting of turbid serum or pus; and it often contains altered blood in variable quantity. Sometimes abundant hæmorrhage takes place into the peritoneum. The effusion is frequently localised by adhesions at different points; or it may be ultimately removed altogether, and only adhesions left.

SYMPTOMS.—The clinical phenomena present considerable variety in different cases, as regards their nature and progress. In some instances tubercular disease of the peritoneum begins acutely, or in a succession of acute attacks, usually circumscribed, with symptoms like those of peritonitis, then subsiding into a chronic condition. Far more commonly the progress is subacute or chronic and insidious, or even latent for a time. In other cases there are marked remissions of the symptoms during their progress, both local and general. The phenomena may be summarised as those of the peritoneal inflammation already described, and the presence of firm lumps in the abdomen, mainly revealed by physical examination; with general symptoms of tuberculosis, usually in a pronounced degree; and often signs of implication of other important organs and structures in the tubercular process. The detection of the great omentum, which is felt as a rounded mass, extending more or less obliquely across the upper part of the abdomen, is highly significant in the diagnosis of tubercular disease of the peritoneum. In some cases there is firm thickening, with redness and soreness, around the umbilicus, which is usually due to extension of inflammation from the peritoneum along the obliterated umbilical vessels to the surface. Occasionally the umbilicus has given way, and a discharge of pus has taken place from the peritoneal cavity. Tubercular peritonitis is usually chronic in its progress. It is a serious disease, but is not so fatal as was formerly supposed, especially in young subjects, and when treated in accordance with modern views.

TREATMENT.—The general measures suitable for tubercular disease must be carried out, as well as those already indicated for chronic peritonitis. Dr. Wilks recommends the administration of iodide of potassium, with or without quinine, and inunction over the abdomen with liniment of mercury, followed by the application of tincture of iodine. Operative treatment is now fully recognised as a means of cure in suitable cases of tubercular peritonitis. The writer has seen recovery follow paracentesis for a large effusion in a case undoubtedly tubercular. The method usually practised, however, is to open the abdomen, wash out the peritoneal cavity, and drain it. For details, reference must be made to surgical works.

(*c*) *Cancer*.—Cancer is comparatively rare in the peritoneum. It is by far most commonly secondary, originating from extension, or as a distinct secondary formation; and chiefly following malignant disease of the alimentary canal, especially the stomach, liver, pancreas, retro-peritoneal glands, and female generative organs, particularly the ovary. It can extend from one serous surface to another without the formation of adhesions. Rarely this disease is primary, and has then been referred to injury in some instances. The writer has recently met with a case in which peritoneal cancer seemed to be primary. It is very rare under thirty, but has been observed even in childhood. Most cases occur between fifty and sixty. The disease is much more common in females than in males.

Peritoneal cancer is generally of the scirrhous type, but is occasionally encephaloid, melanotic, or colloid, the last being comparatively frequently found here, and it may form an enormous mass. Virchow believes that the growths are often sarcomatous. Rarely the disease assumes an acute character, the cancer being in diffused nodules. Usually chronic, it either takes the form of separate nodules, which are often umbilicated; or of an infiltration, sometimes of great thickness. Probably this appearance is due to an aggregation of nodules. Each nodule may send out processes, which tend to pucker and drag the neighbouring part of the peritoneum to it as a centre. The distribution of the nodules is very variable. They are usually far more abundant in the flanks and over the diaphragm than elsewhere. The omentum may be drawn up into a solid mass, as in tubercular disease. Generally there are associated signs of chronic peritonitis, with more or less effusion, which is often hæmorrhagic; extensive hæmorrhages sometimes take place. Abdominal organs are usually found implicated; or the cancerous process may lead to their destruction or perforation. In some instances there is a large dropsical effusion in the peritoneal cavity.

Symptoms and Diagnosis.—The clinical phenomena in different cases of peritoneal cancer are very variable in their exact nature, but their general characters may be readily understood. At first the disease will probably be obscure, and the symptoms indefinite. Abdominal pain is commonly complained of, and is often increased paroxysmally from intestinal disorder; tenderness here and there is also generally marked. There may be signs of more or less disturbance of abdominal organs, or one or other of these is in most instances also the seat of disease. Cancerous growths in the peritoneum tend to interfere considerably with the alimentary canal, and by their contraction and puckering may cause marked narrowing of the intestinal tract, or even give rise to ileus. They may produce other symptoms by pressure on various structures. Ascites is a very frequent symptom; and jaundice sometimes occurs. Physical examination will reveal signs of the growth itself; of chronic peritonitis; and of ascites. Cancerous nodules may originate friction-sounds. In some instances a hard thickening or mass is evident in the tissues around the umbilicus, which may also look red and inflamed, as in a case recently under the care of the writer. If fluid is withdrawn from the peritoneal cavity, it is usually more or less mixed with blood; and marked anæmia or fainting may result from hæmorrhage. The general symptoms and cachexia of cancer become pronounced during the progress of the disease. Its course is occasionally somewhat acute, with pyrexia; as a rule, it is more or less chronic, with little or no fever, or this only occurs at intervals. The termination is necessarily invariably fatal.

It is necessary to offer a few separate remarks about *colloid* involving the peritoneum. This condition is attributed to a colloid degeneration of a carcinoma. All the abdominal viscera may be enveloped in thick layers, consisting of round gelatinous masses. Many of these are attached only by the most delicate threads, or even seem to be free. It is a very rare disease, but when present in a marked form is, according to the writer's limited experience of it, easily recognised clinically by the following physical signs: (1) The abdomen is greatly and may be enormously enlarged, but is not quite uniform or symmetrical; the umbilicus is only stretched, not everted. (2) Palpation generally reveals a feeling of resistance, with rather firm, irregular masses. Fluctuation is either absent or very indistinct. (3) There is extensive dulness, with resistance, over the abdomen, the anterior regions being markedly dull, and there being no indications of accumulation of fluid specially in the flanks. (4) Usually a change of posture produces little or no effect upon the physical signs. (5) A slimy gelatinous fluid may possibly be removed by the exploratory needle or aspirator; and occasionally a similar fluid is said to be discharged *per rectum*, or from the stomach.

Treatment.—Nothing can be done in cases of malignant disease of the peritoneum, except to treat symptoms.

(*d*) *Rare formations.*—Among rare formations found in the peritoneum may be mentioned hydatids, associated or not with a similar disease in one or more organs; serous, dermoid, and colloid cysts; fibromata; myxomata; and remains of blood-clots.

8. **Peritoneum, Malformations of.**—It will suffice to mention under this head that the folds of the peritoneum, such as the mesentery, may be abnormal in length or formation; that unusual bands or openings may be present; and that prolongations of the peritoneum, which naturally become obliterated or shut out from the general cavity, sometimes do not undergo these changes, as may be illustrated by the occasional patency of the process of the serous membrane which descends with the testis into the scrotum. As the result of these abnormalities, displacements of organs may occur; or their movements are restricted or too free; or constriction of the intestine may take place. These conditions can only be recognised

clinically by their effects; and not uncommonly they cannot be made out. Treatment may sometimes be directed to their cure, as is exemplified in the radical cure of a congenital hernia.

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PERITYPHLITIS (*περί*, around; and *τυφλόν*, the cæcum).—SYNON.: Fr. *Pérityphlite*; *Phlegmon iliaque*; Ger. *Perityphlitis*.

DEFINITION.—By perityphlitis is understood a peritonitis localised to the region of the cæcum. The clinical phenomena represented by this form of peritonitis have been included under such terms as *typhlitis*, *paratyphlitis*, and *inflammation of the vermiform appendix*. Typhlitis was formerly considered to indicate especially an inflammation of the cæcum itself, and paratyphlitis to be applicable to an inflammation of the connective tissue which was at one time erroneously supposed to invest the cæcum behind. The term 'perityphlitis' does not concern itself with the seat of origin of the trouble, but indicates with sufficient clearness the predominant pathological feature of an affection which may arise in many ways, and which has no precise clinical individuality until the peritoneum in the cæcal region has become inflamed.

NORMAL ANATOMY.—The cæcum is that part of the large intestine which lies below the level of the ileo-cæcal valve, that is to say, below the point of entrance of the ileum. The average breadth of the adult cæcum is three inches, and the average length two and a quarter inches. The cæcum is always entirely covered by peritoneum, and is never attached by areolar tissue to the iliac fascia. It is usually found lying upon the psoas muscle, and so placed that its apex just projects beyond the inner border of that muscle, and corresponds with a point a little to the inner side of the middle of Poupart's ligament. In exceptional instances the cæcum may be found within the pelvic cavity, or even to have passed to the left of the median line. In examples of imperfect descent of the caput coli this part of the bowel may be met with close beneath the liver or high up in the right loin. The average length of the vermiform appendix is three inches, and in the majority of instances the process is found twisted upon itself. This spiral disposition depends mainly upon the shortness of its mesentery. In the adult body the appendix will usually be found to lie behind the end of the ileum and its mesentery, and to point in the direction of the spleen. Another position which is not infrequent is a vertical position behind the cæcum. The process may occupy the pelvis, and may be found in contact with the sigmoid flexure, rectum, uterus, or bladder.

ÆTIOLOGY.—Perityphlitis has been noticed to follow an exposure to cold, and also after violent exercise, but it is very doubtful whether either of these circumstances alone could be responsible for the attack, though very possibly they are effective accessories to any of the pathological conditions to be presently mentioned. Injury to the cæcum from blows, &c., might set up the disease, and even produce a chronic inflammation with progressive ulceration of the structures in the iliac fossa. Formerly it was usual to attribute many cases of perityphlitis to rheumatism, but with an extended knowledge of its real causation there seems no good grounds now for such an idea.

The important predisposing causes, however, are to be found in sex and age. By far the larger proportion of cases—some say even three-fourths—are males, although in the milder cases associated with extreme constipation this preponderance is not, in our experience, so marked. It has been estimated that 33 per cent. of the cases occur between the ages of twenty-one and thirty, and 30 per cent. between eleven and twenty years, the remainder being distributed over younger and older ages than these; the malady therefore is mainly incidental to childhood and early adult life.

ANATOMICAL CHARACTERS AND PATHOLOGY. 1. Perityphlitis may originate in the *cæcum*. In such rare instances an ulcer of the mucous membrane has probably been produced by the mechanical and chemical irritation of impacted fæcal matter, or by the lodgment of a foreign substance. The ulcer has extended in depth until an inflammation of the peritoneum has been induced. This condition is not often met with in the *post-mortem* examination of fatal cases, but it has been demonstrated during the progress of an operation for perityphlitis. Perforation of the cæcum, and consequent perityphlitis, has been produced by a tubercular ulcer, and more rarely by a dysenteric or even typhoid lesion. Epithelioma of the cæcum which has perforated has also been known to cause the symptoms of perityphlitis.

2. The disease may start from the *vermiform appendix*. The process may become so twisted upon itself, owing to the scantiness of its mesentery, that its lumen is occluded. Mucus may collect behind the point of blocking, and the distal part of the process, becoming distended thereby, may form a large and firm swelling. In this distended part of the appendix suppuration may occur, and perforation follow. Severe perityphlitis, regarded clinically, may be met with in cases in which the appendix has not given way, and in which no pus has been produced within its lumen. (*See* series of cases, *Brit. Med. Journ.* April 22, 1893.) On the other hand, as a result of torsion, the vessels may be compressed and the appendix may become wholly gangrenous, or it may be found in cases which have recovered to present the appear-

ance of having been cut into two or three pieces. In another series of cases a foreign body in the appendix has been the cause of an acute inflammation of the process, or of a perforative peritonitis about it. Such bodies have included seeds, grape-stones, cherry-stones, bristles, pins, shot, minute gall-stones, and the like. Foreign bodies of this class may be expected to be the cause of the perityphlitis in about one-eighth of the cases. In more than one-third of the instances of perityphlitis, as revealed by *post-mortem* records, a concretion has been discovered. The salts forming these little bodies are derived from the mucus secreted by the appendix. There is often as a nucleus a minute foreign body. It is probable that the formation of these concretions is preceded by some disturbance of the blood-supply, whereby the mucous membrane is irritated and a chronic catarrh is maintained. In 146 cases of perforation of the appendix collected by Matterstock a concretion was found in sixty-three instances, and a foreign body in nine. In the remaining examples it may be concluded that the trouble took origin in the walls of the appendix itself.

As a result of repeated attacks of inflammation, the appendix may become obliterated, and the total effacement of the process may occur without suppuration having taken place.

Among the least common causes of perityphlitis may be mentioned actinomycosis of the appendix, and tubercular ulceration of that part.

A *perityphlitic abscess* is primarily intraperitoneal, and is an encysted form of suppurative peritonitis. In the majority of instances the centre of the abscess is behind the cæcum. The contained pus is sometimes of wholesome appearance and free from offensive odour. In the larger proportion of the cases, however, it has a distinctly fæcal smell, a circumstance which attends most abscesses in connexion with the lower bowel, and which does not of necessity imply that the contents of the intestine have escaped into the abscess cavity. In the minority of the examples the abscess does contain fæcal matter, and the lumen of the intestinal canal is opened up. The fæcal material may have escaped through a rent in the appendix, or may have followed gangrene of that process, or, less often, may have made its way through an aperture in the cæcum. This perforation may have proceeded from within outwards, but more usually it is due to the bursting into the cæcum of an abscess which had commenced outside the caput coli. The direction in which the abscess tends to burst is illustrated by sixty-seven cases collected by Bull. In twenty-eight instances it burst through the anterior abdominal parietes; in fifteen it entered the cæcum; in eight the general peritoneal cavity; and in two instances each it made its way respectively into the thorax, the rectum, and the bladder. The abscess often shows a tendency to extend upwards behind or along the ascending colon, and it is by this route that the thorax has been reached and an empyema produced. The abscess, when it extends to the pelvis, may pursue the course of any other pelvic abscess, and may thus make its way out into the buttock and perinæum, and may even extend down the thigh. The comparative frequency with which a suppurative collection started by disease in the appendix may make its way into the cæcum has given rise to an exaggerated and erroneous idea of the frequency with which the cæcum is primarily involved in these cases. Suppurative pylephlebitis may be met with in association with perityphlitis. *See* APPENDIX.

SYMPTOMS AND COURSE.—The signs and symptoms which are associated with the structural changes just described, and determined by the causes just indicated, exhibit a marked variety in mode of onset, course, severity, and duration; so much so that descriptions of extreme cases are scarcely recognisable at first as pertaining to what we regard as the same disease. It is also probable that the clinical application of the term 'perityphlitis' is of somewhat wider range than its pathological significance as here defined; there are many cases, for instance, commonly so designated, in which an actual peritonitis is of doubtful existence. The exact relation of the clinical conditions observed to the existing anatomical changes is sometimes uncertain, more especially in the milder cases which end in complete recovery, and cannot be investigated *post mortem.*

Three well-marked groups may be recognised, to one or other of which most cases may be referred, though occasionally the disease runs a course which cannot be exactly included within one of these types.

(*a*) In the first group will be found those cases which, occurring in apparently healthy persons, or with but very little and unimportant previous symptoms, run an exceedingly rapid course of a few hours, death resulting at the outside within two days. Here the symptoms are mainly those of perforation of the intestine, with very little indication of the seat of the lesion. The patient is suddenly attacked with severe abdominal pain, by no means necessarily felt in the neighbourhood of the cæcum, but often about the umbilicus, followed by all the symptoms of collapse, which may be very soon fatal (*see* INTESTINES, Diseases of: 21. Intestines, Perforation and Rupture of). The necropsy reveals perforation of the vermiform appendix or very exceptionally of the cæcum, and some degree of localised peritonitis.

(*b*) The onset of the symptoms in the next group also takes place as a rule without any history of previous discomfort, constipation, or illness; and whilst less rapid than in the preceding, they are usually well marked. Often commencing with a chill or rigor, these cases are also characterised by acute pain, indifferently referred to the belly generally, or perhaps specially to the umbilical or cæcal region. The pain may cause a moderate degree of collapse, but not nearly so severe as that associated with acute perforation, which we may surmise in the cases under consideration has not yet actually taken place; or, if it have occurred, its effects are strictly confined to the immediately adjacent region. With the pain, which becomes paroxysmal and often radiating to the testis, pudendum, thigh, or bladder, there is considerable tenderness, which may be distinctly limited to the right iliac region, and thereby becomes an important factor in the diagnosis. Other signs of localised peritonitis quickly supervene: the abdomen becomes distended and tympanitic; and occasionally, if the tenderness do not prevent, a slightly increased resistance is perceptible over the cæcum, due in part to the rigidity of the abdominal muscles, and partly perhaps to retained fæces in the cæcum, or inflammatory effusion around that structure. The temperature rises two or three degrees, or even to 104° or 105° F.; the pulse is frequent and thready; respirations are quickened; and the aspect of the patient is that of severe illness. There is constipation; often severe tenesmus; and vomiting, which may be mild and only excited by food, or of a bilious character, but its occurrence is not followed by any sensation of relief. The tongue is thickly coated, or dry brown and cracked, with sordes on the teeth. Some observers have noted a very abundant flow of urine, which contains an excess of indican; and frequency of micturition. The patient may remain in much the same state for two or three days, when the pain and tenderness spread over the abdomen. The legs are drawn up and the arms raised above the head so as to relax the parietes and increase the capacity of the abdominal cavity; and with an intensification of the above symptoms there exist all the evidences of general peritonitis, from which the patient may succumb within the next few days, though recovery even at this stage is not quite unknown. Or the inflammation may assume a distinctly suppurative character, leading to the formation of a large quantity of pus encysted within the peritoneal cavity in the cæcal region, giving rise to an increasing fulness and resistance, which may be detected through the abdominal wall, or sometimes by rectal or vaginal examination. The abscess thus formed may extend, and burst in one or other of the directions already indicated. On the abdomen being opened, either by the surgeon or *post mortem*, the mischief is seen to have started from ulceration and perforation of the appendix; and these cases only differ from those in the former group in degree of severity and rapidity, their longer duration affording the opportunity for the development of additional symptoms. It may be observed that cases of this severe type do occasionally begin with mild symptoms such as characterise the following group, or the graver manifestations may be delayed in their occurrence; but it is estimated that 68 per cent. of the fatal cases die within eight days.

(*c*) The third class of cases—certainly the most numerous—include those which are much less severe in their character, more prolonged in duration, and generally recover. Contrary to what obtains in the previous groups, the patients are more frequently women, and a previous history of constipation, often excessive, is the general rule. After perhaps a more than usually obstinate confinement of the bowels, or some gross error in diet, such as eating a very large quantity of nuts, the patient complains of very definite pain over the cæcum, which is found to be tender, swollen, resistant, and dull on percussion, due to fæcal accumulation. It is the prominence of the local symptoms which specially characterises this class of cases, the seat of the trouble being obvious from the commencement. There is also a moderate and very irregular rise of temperature, rarely exceeding 103° F., with soft quick pulse, and general febrile symptoms. The constipation persists, owing to the arrested peristalsis from inflammation of the bowels; and nausea or vomiting is of frequent occurrence, though not often very severe. It is in these patients that is commonly noticed the drawing-up of the right leg, which is flexed across the other thigh, so as to relieve as far as possible the pressure of the abdominal wall on the swollen region. The pain continues of a dull aching character, now and then with sharper twinges, and often spreads across the lower part of the abdomen, and suggests an extension of the peritonitis, though it is doubtful whether this is really the case; it also shows a great tendency to pass down the inner and anterior surface of the right thigh, due to pressure on the genito-crural nerve. Sometimes there is œdema of the right leg, from thrombosis of the iliac vein induced by pressure. The duration of these cases is very uncertain, and much depends on their treatment; some last but a few days, others may continue for two or even three weeks, varying much in the severity of the symptoms, for some days the patient being gravely ill and then appearing considerably better, fluctuating from day to day. The extent of the swelling and dulness is frequently changing, as also to a less degree the pain and general symptoms. A small proportion of the cases which run the course described end in suppuration, and the formation of a circumscribed abscess, such as occurs in the former group; but the greater majority end in resolution and complete cure. How far the appendix is concerned in these cases is doubtful, and certainly it is unlikely that gross lesions of that structure occur in any but the few which suppurate; nevertheless it has been shown that very mild perityphlitis does follow disease of the appendix, and may end in perfect recovery, and also that suppuration does not always occur even when severe disease of that organ exists. It is probable that in certain of these milder cases the cæcum is more at fault, being in a state of inflammation and probable ulceration, determined by the irritation of the hardened fæces, and that it is a true typhlitis—the *stercoral typhlitis* of writers—the well-defined swelling being partly formed by the thickened wall of the inflamed bowel, with perhaps some peritonitis, and still more by the retained intestinal contents.

Relapsing perityphlitis.—A marked characteristic of the morbid state under consideration is its liability to relapse—11 per cent. of the cases are estimated to do so. A slight indiscretion in diet may be sufficient to reinduce it, and it may recur from this cause again and again; or it may be that the patient has got about before the attack has completely subsided; or in many cases relapse may occur when every care has been taken, and successive recurrences are likely to be of increasing severity. When suppuration has taken place as a result of perforation of the appendix and escape of the original irritant, concretion, or foreign body in the discharge from the abscess, recurrence is not so likely to happen; but so long as it remains it is an ever-present source of danger; nor will there be relapses if the appendix have become gangrenous and separated. The exciting causes of these relapses may be found in the condition of the appendix itself, which by becoming twisted or bent on itself, fixed by adhesion, or stenosed by a cicatrix of an old ulcer, permits an accumulation of mucus within it, and consequent distension of its distal end; this condition is sufficient to set up a localised peritonitis, which recurs until the pseudo-cyst is emptied, and the lumen of the process finally and completely occluded. The attacks which form the third group of cases above described, which are closely associated with fæcal retention, are also likely to be repeated unless the bowels are kept regularly and thoroughly opened. The liability to some accumulation taking place, even when there is a daily evacuation, is not to be forgotten.

Diagnosis.—The condition known as perityphlitis requires to be distinguished from several other intestinal affections. In ileocæcal invagination, which may give rise to many of the symptoms above described, the evidences of obstruction rather than of peritonitis predominate, the pain is more acute, and vomiting is usually more severe and persistent, whilst the stools contain bloody mucus; tenesmus also in these cases is much more marked. Other forms of acute intestinal obstruction may be mistaken for it, and often cannot be distinguished; the presence of distinct swelling, dulness, tenderness, and pain restricted to an area in the iliac fossa are of primary importance in determining the case to be perityphlitic. Occasional cases of enteric fever, where there is constipation and absence of rash, may be confused with the malady under consideration, especially as the neighbourhood of the cæcum is the situation where the most distinct signs occur in both diseases; but the history, the course of the fever, and the characteristic tongue and general appearance of the patient in typhoid fever, together with the sequence of headache and delirium and splenic enlargement, should afford grounds for discrimination. Less often may tubercular peritonitis need to be separated, but here again the history, temperature, and coincidence of other evidences of tubercle elsewhere must be considered. Suppuration in connexion with the ovary, or behind the peritoneum from caries of bone, perinephritic abscess, &c., may simulate the fæcal abscess following perityphlitis.

Prognosis.—Much difference exists in this respect among different cases. Those which may be comprised within the third of the foregoing groups should be expected to recover. The mortality among the severe cases described in the first and second groups has been estimated at 30 per cent. in adults and at even a higher rate in children. The course and termination of cases attended with constipation are less favourable.

But, beside those cases which end in death or recovery, a few may continue for months or years suffering from some of the effects of the disease, such as chronic peritonitis, chronic diarrhœa, fistulæ. The frequency of relapse has been alluded to.

Treatment.—This must obviously differ very considerably according to the severity of the case, and may conveniently be considered according as operative interference is or is not called for.

When the disease is distinctly associated with fæcal impaction, and when the symptoms are milder and somewhat more prolonged in duration, recovery is to be expected without operation, although, as said, occasionally an abscess forms, which may require to be opened. For such patients as would be included within the third of the above described groups, rest is essential, and the treatment consists in a judicious application of means to remove the contents of the cæcum, together with such an amount of sedative as will serve to keep the parts concerned as quiet as is consistent with the necessary evacuation. To meet the first indication enemas of plain water or soap and water are the most satisfactory. They should not be too large—fifteen to twenty ounces for an adult—and should be repeated, but not too frequently; it is rarely desirable for the enema to be given more than once in the day, and every other day is usually often enough. Much harm may be done by inducing a violent evacuation, though there may be a large quantity to be removed, and it is far better for this to be effected gradually. Some advise, in addition, frequent small doses—twenty grains—of sulphate of magnesium or sodium, not with a view of direct purgation, but to induce a moderate intestinal secretion, whereby the hardened fæces may be somewhat softened. Anything in the nature of a violent aperient is strongly to be deprecated, and it is better to give occasional doses of opium, gr. ⅓ to i, by the mouth, whereby pain is relieved and the risk of peritonitis appears to be diminished. For the same object, three or four leeches applied over the cæcum are most effective; or hot fomentations, either made with poppy-heads, or applied after the surface of the abdomen has been painted with extract of belladonna and glycerine. The diet should be restricted in amount as much as possible: there is usually anorexia, and abstinence from food is beneficial; occasional teaspoonfuls of meat-juices, and a few ounces of peptonised food are amply sufficient as a rule, and stimulants are very rarely needed. It cannot be too strongly insisted upon that the patient should be kept in bed, even for some days after complete cessation of all symptoms, as a very little exertion or slight excess of food may be sufficient to induce a relapse.

If the symptoms persist, if the temperature keep high, and if the local phenomena become more prominent, then an incision over the swelling will be called for. It is seldom until after the fifth day that surgical interference is demanded. In the cases dealt with by the surgeon the dulness will have increased, the local tenderness will be more marked, and possibly redness of the skin and œdema may indicate the importance of immediate treatment.

In some cases which have been allowed to progress, all the clinical evidences of abscess are present.

The treatment of cases of the first group is identical with that followed in instances of acute perforative peritonitis. A prompt abdominal section offers practically the only prospect of saving life.

In dealing with cases of the second group, the general measures already described are employed. If the local and general symptoms persist, an incision will be called for. This, as already stated, is seldom indicated before the fifth day.

In cases of relapsing typhlitis, the operation for the removal of the appendix may be called for when the attacks are severe or are increasing in severity, when the attacks are becoming very numerous, when the last attack has been of an alarming character, or when the repeated illnesses to which the patient is rendered liable are undermining his health, or interfering with the pursuit of his calling.

In any case in which this operation is undertaken, it may be assumed that the enlarged appendix can be made out after the acute symptoms have subsided. The removal of the offending appendix should be carried out during the period of quiescence, and after all the usual symptoms of perityphlitis have disappeared.

It may perhaps be said that the danger of the operation is no greater than that attending another attack. W. H. ALLCHIN.
FREDERICK TREVES.

PERI-UTERINE HÆMATOCELE. *See* PELVIC HÆMATOCELE.

PERSONAL HEALTH.—Personal hygiene is the science of individual health. As there are public acts and laws which, observed, promote the health of communities, so there are rules of living and habits of life, inculcated by competent observers, by attention to which the health of the individual may be preserved or increased. Health is a quality of body easily comprehensible, but difficult to define. It is dealt out in different measures at different periods of life, and is perhaps best described as exemption from disease. It admits, however, of being estimated, and we shall first show how this may be done.

First, the form of the individual must be examined to ascertain how far it agrees with or departs from certain mean standards, such as are laid down by anatomists and practical hygienists, and which give, in tables for each age, what the height, weight, girth of chest, and mobility of thorax ought to be every year of life. Thus above the weight of 161 lbs. avoirdupois, the circumference of the chest ought to increase 1 inch for every 10 lbs. of additional weight; and for every inch in height over 5 feet 8 inches the mobility of the thorax ought to increase in a definite ratio (*see* Parkes's *Hygiene*, p. 480). Then the girth-measurement, taken round the mamma, should be in excess of that taken lower down, at the level of the xiphoid cartilage, in every man, although not disproportionately so, as it is in women who lace tightly.

Secondly, the manner in which the various functions of the body are performed must be ascertained. The situation of the heart's apex-beat is to be determined; its impulse; its mode of action; the rhythm of its sounds; the way in which the circulation is being carried out; how temperature is maintained at the extremities; and what individual capacity exists to resist conditions calculated to lower the body temperature. The respiratory, cerebral, and spinal functions must be tested; the organs of digestion, sanguification, and excretion, as well as their performances, will have to be examined in due order; and the state of general nutrition and the condition of the skin appraised.

That state of body which enables it to perform every function which can be reasonably required of it, to accomplish each ordinary task, and be equal to some exertion of brain and muscle without painful sense of fatigue, is what we ordinarily understand as health. It would be difficult, however, if not impossible, to lay down the amount of work or exertion, short of positive fatigue, which a child, lad, woman, or man ought to be equal to without preparation or training of any kind. Erectness, firmness, good balance of body and mind, testify to a man, as they do to a racehorse or a gamecock. An experienced eye recognises at a glance the particular build of man suitable to particular taskwork; likely to excel in particular exercises, sports, or games; fitted to labour with his head, or with his hands; to run, swim, or fight well. There is, perhaps, a little less difference between man and man than between carthorses and racehorses, but it is one of degree only. *Fortes creantur fortibus*, and for perfect bodily aptitude for any trade, profession, or particular craft, the individual must be born, bred, and trained accordingly. We arrive at the following signs or evidences of health: (*a*) good construction; (*b*) accommodativeness to change, individual adaptability to widely diverse conditions of life, or of climate, without deterioration of energy; (*c*) endurance; (*d*) self-control — mental, emotional, sexual; and (*e*) resistance to morbific influences.

From birth onwards to old age, health is not uniform; it varies as the body varies, according to wear and tear, and treatment—a sufficiently obvious proposition. At different epochs of life the strain or stress is felt in different parts, falls upon different organs, and issues in proclivity to disorder of their several functions, or in wear or degeneration of the tissues of which they are built. Our object here is to demonstrate how personal health may be secured; how disease may be avoided, or diminished; and how the days of ailing, of sickness, of incapacity to follow one's work or ordinary pursuits can be diminished; how the active, energetic period of life may be extended, the ageing of the body deferred, its happiness or *bien être* promoted. To fulfil this endeavour, we divide the life of a human being into the following periods, and consider them separately in relation to their special physiology, to morbid imminences, and to probable accidents, laying down the best rules of guidance in diet, clothing, habits, exercise of body and mind; indicating whatever appears most conducive to the health of the individual at the age mentioned. It is of course of first importance to be born of a healthy, long-lived stock; but for heredity and its effects the reader is referred to the articles, DISEASE, Causes of; and HEREDITY.

LIFE PERIODS. — The following are the periods of life, as they will be here successively considered:—

1. **Intra-uterine life and Gestation.**
2. **Birth.**
3. **Infancy,** the period between birth and the completion of the first dentition.
4. **Childhood,** the period between 2 and 7 years.
5. **Adolescence,** the period between 7 and 14 years.
6. **Puberty,** the period between 14 and 20 years.
7. **Adult age,** the period between 20 and 30 years.
8. **Maturity,** the period between 30 and 45 years.
9. **Turning-time,** the period between 45 and 60 years.
10. **Advanced life,** the period between 60 and 82 years.
11. **Old age,** the period between 82 and 100 years.

1. The Intra-uterine and Gestation Period.—The health, habits, and conduct of the mother during pregnancy modify the future individual considerably. Whatever affects the blood of the mother affects that of her fœtus, and *vice versâ*. There are grounds for thinking that the mother possesses and exercises purifying and excretory powers over the blood of her fœtus, appropriating into her own eliminating organs, and in some degree removing from her offspring, taints or disease-germs derived from the father of the child, perhaps suffering from these herself vicariously. This surmise has been offered to explain a fact not infrequently observed, that previously healthy wives, born too of healthy stocks, married to consumptive husbands, after breeding one or more children, tend to die themselves of a rapid form of phthisis, although bearing children not necessarily consumptive. On the other hand, delicate women who have been impregnated by exceptionally sound sires are observed to improve in vigour and robustness with each succeeding pregnancy. It is certain that small-pox, scarlatina, and measles may be conveyed by the mother to the child *in utero*; that typhoid fever occurring to the mother is usually fatal to her fœtus; and that the poison of syphilis derived from either parent is extremely pernicious to the growth and development of the fruit.

Alcoholic abuses committed by the mother during pregnancy favour premature delivery, and appear beyond this distinctly prejudicial to the health of the children when these are born alive, the constitutional flaw not showing itself by apparent malnutrition so much as by undue proclivity in them to manifest disorders of the nervous system—chorea and epilepsy in childhood, hysteria and insanity in adult years. Experience shows the hygiene of this period to consist in temperate living. The pregnant woman should avoid excitements of all kinds, take moderate exercise, rise and go to bed early, not alter her habits of life abruptly. In the later months she must dress herself appropriately to her state, not so as to interfere with the emerging of the uterus from the pelvis, or so as to limit the movements of the babe *in utero*.

2. **Birth.**—Béclard in his work (*Hygiène de la Première Enfance*, Paris, 1852 pointed out a fact of some importance in the hygiene of birth. When the fœtus with its membranes and placenta are separated from the mother, and independent existence is commenced, a good deal of blood, properly the newborn child's, remains, and is for a short time after actual birth lodged in the cord and placenta. If time enough be allowed, and the newborn be kept properly warm the while, all this blood—some two ounces or thereabouts, and therefore no unimportant quantity when the weight of the child is considered—will find its way into the infant's body; whereas, if the cord be tied and divided too quickly, and before the umbilical vein becomes collapsed and empties itself, the child is mulcted of its natural blood-endowment. According to Pinard's observations, it is easy to distinguish the babies who thus receive their full complement of blood at birth from those who do not. The skin of the former is rose-coloured and plump, whereas the skin of the latter has an anæmic or icteric tint, and is poor; the former infants grow and develop more rapidly, and are altogether more vigorous than the latter. As a guide to the accoucheur's practice, he inculcates careful observation of the cord at birth. All pulsation ceases in the umbilical arteries directly the newborn breathes and cries; but for some while, different in different cases, the umbilical vein remains full; and the blood in it continues liquid up to the moment when its last drop is absorbed into the child's body. But the cord must not be ligatured until the umbilical vein is flat and empty. The accidents incidental to birth are multifarious, and belong to the subject of parturition. We may notice specially asphyxia from prolapse and compression of the cord; and prolonged pressure upon the infant's skull inducing epicranial cephalhæmatoma, and, rarely, apoplexy and paralysis.

If the temperature of the external air is about 60°, children may be allowed to go out when they are eight to fifteen days old, after cicatrisation of the umbilicus. Children born in February and September appear to possess the greatest vitality, those born in June the smallest. According to statistics carefully collected by Dr. E. Smith in his work on *Health and Disease*, p. 267, 'the viability of the infants born in the winter and spring months is greater than that of those who come into the world in summer or autumn.'

No artificial purgative, oil, gruel, or sugar-water, should be given in lieu of the mother's first colostrum milk.

3. **Infancy.**—The period of infancy might be subdivided into *early* and *late*: *early* comprehending the time from birth to eruption of the first teeth; *late*, that from the commencement to the completion of the first dentition. The leading anatomical features of this age are the large amount of blood relatively to the solids of the body, the laxity of all the tissues, the disproportionate quantity of component water, and the large relative amount of red blood-corpuscles and of iron, which appears far in excess of that existing in adults. *See* E. Smith's *Cycle of Ages*, p. 247.

The circumstance of chief physiological importance is that the greatest growth occurs in the first years of life. Quetelet in his essay, *Sur l'Homme*, shows that the mean average weight of male infants exceeds that of females; boys at birth weighing 3 kilogrammes 20 grammes, and girls 2 kilogrammes 9 grammes. There is no indicator so infallible as the balance to prove whether an infant is or is not being properly nourished. It appears that from birth up to the end of the second day all newborns lose weight a little; they do not increase perceptibly till after the end of the first week.[1]

M. Odier states that it is usual to find an infant increase 30 or 40 grammes (461 to 606 grains) *per diem* during the first five months of life, 20 grammes (308 grains) a day from the fifth to the eighth month, and 10 grammes (or 155 grains) daily between the eighth and the twelfth month.

Dentition is the change most characteristic of the infant's growth and development.

In infantile life all the vital functions go on rapidly. The pulse at birth ranges from 130 to 140 per minute; and to the end of the first year is from 115 to 120. The rate of respiration is from 25 to 30. While the circulation is rapid, the skin, from its softness and vascularity, disperses heat rapidly; the cooling agencies are at a maximum; and the heat-maintaining powers (that is, resistance to depressing influences) are at a minimum. 'The food taken by infants is, in proportion to the weight of the body, from three to six times greater than that taken by adults' (Dr. Smith, *op. cit.*, p. 247).

The perils from without to infant life are mainly derived from cold, those from within result chiefly from improper or defective feeding, and from the over-sensitiveness of the nerve-centres. Young brains and spinal cords are over-alért to impressions received from without, and act too impulsively upon them. Control powers become developed as they grow older. The ordinary phrase 'emotional as a young child' expresses a physiological fact. It is not easy to over-feed young infants. If proper food, that is, their own mother's milk, be given them, they get rid of excess quickly enough by vomiting it, and the part not appropriated in growth or maintenance is stored up for future use as fat. The morbid tendencies of this period are towards the intestinal and mucous tracts. Catarrhal diarrhœa and bronchitis, thrush and stomatitis, are epiphenomena of all febriculas and states of malnutrition. Delirium and convulsions attend all general disorders. Over-rapid dentition is associated often with tubercularisation, retarded dentition with rickets. The more rapid the eruption of the teeth, the greater the attendant disturbance; the more closely the evolution of the teeth follows its normal periods (*see* TEETHING), the less conscious are infant and mother of their appearance. The hygienic rules for this period have reference principally to feeding, cleanliness, clothing, open-air exercise, and the avoidance of cerebral excitement.

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[1] The infant should be weighed naked in a warm room, lying on a piece of flannel of ascertained weight, in the scale of a balance sensitive to a drachm.

DIET.—For diet the reader is referred to the article DIET, where the proper aliment for infants is fully discussed. Experience proves that nature will not be contradicted—that no aliment is so appropriate as the milk of a mother, or of a wet nurse aged between twenty-two and thirty-five. Next best to this comes the milk of a goat; and next, again, a mixture of equal parts cow's and ass's milk given by a feeding-bottle. The suckling of her own infant by the mother for nine months is good not only for the child, but for its mother. The uterus passes through its retrograde involution more rapidly, no periodic uterine congestions delay it, and ovulation is deferred. With respect to the frequency of feeding, and the quantity taken, the reader may be referred to the statements of Proust.[1] During the first day of life, what with scantiness of the colostrum, mechanical obstacles to suction, and the weakness of the infant's efforts, the child does not extract more than a drachm each time it is placed to the breast. It needs no more, however. During the first week of life it should be nursed ten times in the twenty-four hours, arranging times so that the mother gets six hours' consecutive rest at night. On the second day each suckling should furnish about 5 drachms of milk. On the third day each suckling should furnish about 1½ ounce of milk. On the fourth day each suckling should furnish about 2 ounces of milk. During the first month average-sized infants require and obtain nearly 3 ounces of breast-milk at each nursing, and should be nursed nine times in the twenty-four hours, or receive about 27 ounces of milk a day. During the second month each suckling should furnish 4½ ounces of milk, and the number of feedings may be reduced to seven *per diem*, which allows 31½ ounces each twenty-four hours. At three months old the infant sucks about 5 ounces at a meal, an equivalent of 35 ounces each twenty-four hours; and at four months it extracts as much as 6¼ ounces of milk at each meal, which may be again curtailed to six each day, giving 37½ ounces of aliment. This continues to be the quantity of milk and frequency of feeding required of a good nurse up to the end of the ninth month; but the quality of the milk during this period steadily improves, becoming enriched according as the child sucks more vigorously and at longer intervals, a provision fraught with mutual advantage to child and mother.

At the ninth month the child may be gradually weaned, although the age for weaning should be governed by the health of the mother or nurse, the forwardness of dentition, and the infant's own craving for other food. The best time to take for the purpose is the interval or pause after the four lateral incisors are cut, and before the first molars appear.

Dentition, normal order of.—For this subject, *see* DENTITION, Disorders of.

CLEANLINESS AND CARE.—The infant requires washing all over from top of head to sole of foot night and morning every day, and is best, because most quickly, immersed in a tub once daily. Infants who have had convulsions at any period of their lives are, as a rule, better washed all over with a sponge in the lap of their nurse than immersed in a bath, as immersion is apt to frighten them. The water should be the softest procurable. Rain-water is best. The temperature of the room during the bath should be between 65° and 70° F.; that of the bath itself, fixed by the thermometer, between 70° and 90°, according to the season of the year. Fixing the temperature of the bath should not be left to the possible indiscretion of a nurse; many a woman's hand will support water at a heat enough to parboil a baby.

The nurse should be required not to dawdle over bath or dressing; the former should occupy five minutes, the latter not more than twenty. Little or no soap, or only soft soap, should be employed. The drying should be accomplished with soft dry cloths; and for baby powder, to prevent excoriations, fuller's earth cannot be surpassed. Eczema and intertrigo are obviated by due attention to the frequent change of diapers and to cleanliness.

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[1] *Traité d'Hygiène* (Paris, 1877), p. 115.

Clothing.—No infant ought to be swathed like a mummy; it requires keeping warm, but should not be overweighted with clothes. Its chest must be free to expand, its limbs at liberty to move. The more lightly its head is covered, and the more quickly all caps are dispensed with, the stronger will be its hair and the less its susceptibility to catarrh. Nightcaps are dirt-traps, and in all classes alike promote scalp eruptions by provoking perspiration, with which the skin is softened, and by the decomposition of which the sebaceous follicles are irritated and clogged.

General Rules and Hygienic Advice.—Even the youngest infants require sunlight and open air. Due discretion must be employed, however, in sending them out. They are better carried in their nurse's arms, and thus assisted to maintain their own heat by that derived from their nurse's body, than placed in perambulators. As soon as they can crawl they should be encouraged to do so, either on a carpet, in a garden, or on a dry, sandy pathway protected from wind and open to sunlight. Cold and dark places are specially inimical to them; and when the weather is cold they should be encouraged to amuse themselves on a blanket or soft hearthrug, so as to learn to stretch their limbs and co-ordinate all their muscular movements. They learn first to sit up, then to stand, helped by their arms, against a chair; next to stand without support; and at some period between one year and two years of age should be able to walk about by themselves.

Sleep.—Infants require day as well as night sleep. Very young babies do little else but suck and sleep. As they grow they need and take less and less sleep, and by the time the first dentition is accomplished—three years of age—a child may usually dispense with day sleep altogether, except a short hour's nap early in the afternoon or between eleven and twelve. Sound sleep coincides in the infant, as in the adult, with short sleep hours, and the strongest children require least sleep. The infant should have its own cradle, and the child its own cot, placed close beside the bed with its mother or nurse. In extra cold weather, or hard frosts, the cot should be artificially warmed by a hot-water bottle. The sleeping nursery ought not to be kept warmer than 65°, nor colder than 50°; whilst the nearer it is maintained to 55° during the winter months, and 65° during summer, the sounder the child will sleep. The more freely the whole house and nurseries are ventilated, the less prone the infant will be to all infantile disorders.

4. **Childhood.**—In this period, between the second or third and seventh years of life, the first dentition is accomplished, the second uncommenced. The rate of pulse falls from 115 to 90 per minute, and respiration commensurately. The excretions are all absolutely increased. In the co-ordination of muscular movements and in mental operations great progress is being made. The cerebro-spinal structures, which nearly double in volume between birth and the second year, continue to develop disproportionately to the growth of the trunk and limbs between two and seven. The cellular tissues are loose and vascular still, and the cutaneous and mucous surfaces therefore extra vulnerable. A notable physiological feature of this age is the readiness to swell observable in the lymphatic glands upon the slightest irritation, and the general functional activity of all the lymphatic structures. It might be distinguished as the life period of greatest *lymphatic activity*. From these facts the morbid imminences may be inferred, namely, a tendency to eczema and to catarrh of mucous surfaces, diarrhœa, laryngeal and bronchial catarrh, general anasarca, hydrocephalus, susceptibility to contagious impressions, proclivity to tubercular meningitis, and to functional cerebral disorders like delirium and convulsions. The incontinence of urine, so frequent in early childhood, may be likewise referred to the reflex irritability of the spinal centres characteristic of this age. According to Lébert, the cerebellum attains its largest size relatively to the cerebrum between 4 and 5, to which circumstance has been referred the occasional sexual excitability and vicious practices discovered in some children at this early age. However this may be, the importance of good nurses and wise supervision cannot be too much insisted on, as also the inculcation of healthy habits and provision of proper amusements and employments.

Diet.—While bread, starch, and flesh foods are taking the place of cows' milk very greatly, they must not be allowed to wholly supplant it. Eight ounces of bread may be reckoned about equivalent in nitrogen content to one pint of milk, but the former exceeds the latter in carbon. The food must be nutritious and abundant. The error committed is far too often that of under- than of over-feeding. Young children do not require so much variety in their food as adults do, but are greatly benefited by a change in their bread and meal stuffs, and a dietary not too monotonous. They do not need meat more than once a day, and fish may be substituted for meat, if cream or butter sauce be provided with it, once or twice a week. Milk, bread, porridge, suet puddings and milky puddings should form the staple of their dietaries; fresh vegetables well cooked, watercress, cooked fruit, and oranges are most useful adjuncts; while the addition of fried bacon, clotted cream, and oil, or butter, when the drinking-water is hard, and the tendency of the child is rather towards constipation than otherwise, is now fairly generally understood.

It is usually easy and always beneficial to instruct young children to secure an alvine evacuation directly they rise of a morning, and before their bath. Four meals a day are most appropriate—a breakfast at eight, a dinner at twelve, a tea at four, and a supper at half-past six.

Cleanliness.—Washing all over once a day, and in the morning, is as necessary as ever; but after first tubbing in hot water between 98° and 100°, the child should stand up and be sponged all over from a basin of cold water, and be briskly dried with a large towel.

Sleep.—A child should sleep in a cot or bed by itself, but in the same room with its parent or nurse, since it is apt to show any disorder by night vagaries, delirious talking, restlessness, or sleep-walking.

Between 2 and 5 most children are the better for twelve hours of sleep out of the twenty-four. At 7 years of age they do not require day sleep, but should be in bed at seven or half-past seven, and up at six in summer and between six and seven in winter. The best bed for this age is an ordinary iron bedstead, with firm and level wool and hair mattresses; not spring beds, which do not adapt themselves so well to light bodies, nor keep them uniformly warm. Cotton sheets, blankets, and counterpane must be used according to season. Beyond saying that the day clothing should be warm, and merino or wool put next the skin, we can add nothing further about clothing.

Exercise.—Two things are requisite for healthy growth and development and a happy childhood—a play-room and a garden. Children need a place like an empty barn, in which they can swing and amuse themselves in wet and wintry, as well as in hot sultry weather, practising those games which are requisite for the schooling alike of their muscles and nerves.

Teaching.—Teaching such as they need should be conducted on the Kindergarten system; but the main rule for their lives is open air and exercise, the chief objects being to harden their skins, develop their muscles, and teach them self-control, love and respect for those to whom they render implicit, because well-nigh unconscious, obedience.

5. **Adolescence.**—The consideration of this, the period of second dentition, between the ages of 7 and 14, is best prefaced by the order of eruption of the second teeth.

About 7 years the 4 anterior molars (permanent teeth) are cut.

About 8 years the 4 central incisors.
,, 9 ,, 4 lateral incisors.
,, 10 ,, 4 anterior bicuspids.
,, 11 ,, 4 posterior bicuspids.
,, 12 to 12½ ,, 4 canines.
,, 12½ to 14 ,, 4 posterior molars.

The teeth of the lower jaw usually precede those of the upper. Second dentition is accomplished leisurely, and is therefore usually accompanied by no such grave disorders as mark first dentition; but in nervous children nervous tricks may manifest themselves, as well as marked lack of emotional control. Some are hypersensitive, others contradictory and difficult; and most parents admit that between 7 and 8, if not between 7 and 14, they learn what the characters of their children really are. Physiologically, absorption of the subcutaneous fat goes on rapidly, while the muscles become more developed, the skin gets tougher, its epidermis harder, and it perspires less readily. In our climate the morbid liabilities of this age are to rheumatism, chorea, epilepsy, the exanthemata, and typhoid fever.

Between 7 and 8 the appetite is apt to become capricious; the child physiologically does not require so much hydrocarbonaceous food; and, while growing fast and becoming leaner, protests against fat, often while showing a marked longing for fresh fruits, in which nature should be indulged. After 8, however, any marked defect of appetite or loss of weight is suggestive of undue cerebral excitement, attributable to over-study or some infraction of the laws of health.

Diet.—Three good meals a day are sufficient, but four are more advisable. Constipation at this age usually signifies irregular feeding and overloading with pastrycook supplies or other improper food. Breakfast at eight, dinner at one, tea at five, and supper at eight appears the best distribution. By supper is meant such a meal as growing lads and girls positively need. They require either soup and potatoes, and bread and butter, or some one hot dish of meat or fish; and the drink should be either warm milk or cocoa to about half a pint of fluid: aliment enough is needed to improve the circulation at the extremities and obviate chilblains. Boys and girls may retire to bed within an hour of their supper, which, instead of making them dream, will secure good and refreshing sleep. The greatest dangers at this age arise certainly from defective nutrition and an over-sensitiveness of the skin. Neither wine nor beer is necessary, nor should either be allowed without medical authorisation.

Clothing.—The objects of clothing are warmth, cleanliness, and convenience. Vests of cotton and wool, merino, or spun silk should lie next the skin of the chest and trunk. Merino, flannel, or other woollen materials should protect the legs and feet; cloth, woollen jerseys, furs, and skins are adapted for external coverings. But a whole chapter could be devoted to the foot alone, and its clothing during its growth and development. The desiderata appear to be length and breadth enough, low heels, impervious soles, old and flexible skins for uppers. Boots for outdoor exercise are advised for children, because their ankles need support; shoes a little later on, because they are cheaper and do not repay re-soling, and may be discarded at once when worn out. The same boots should not be worn day after day—they require time to dry properly in damp weather, and the foot at that age profits by change of pressure. During youth the adaptation of clothes to special sports and exercises is far from unimportant to health. For violent muscular exercise, flannel or merino should be worn next the skin, and an easy flannel jacket or over-jersey; both after being used should be hung up to dry and air before being worn again. It is well that youth should be informed how rheumatism is promoted by indolence, neglect of exercise, carelessness in getting overheated, standing about on damp soils, remaining in wet shoes, wearing woollen shirts or under-clothing that have been permeated and saturated over and over again with the secretions of the skin.

Rest and Exercise.—These are requisite for both body and mind at this age; the duty belongs to parents and schoolmasters to study what is appropriate. We annex, therefore, a table from Friedländer, which shows how the twenty-four hours may be wisely apportioned: —

Age	Hours for			
	Exercise	Work	Leisure	Sleep
7	8	2	4	9 or 10
8	8	2	4	9 or 10
9	8	3	4	9
10	8	4	4	8
11	7	5	4	8
12	6	6	4	8
13	5	7	4	8
14	5	8	4	7
15	4	9	4	7

6. **Puberty.**—The physiological feature of this period is the more rapid growth of the whole body, and the gradual perfectioning in their functions of its several organs. Between 14 and 20 the human plant reaches not only its full size but the completion of its organic endowments. During this period mind and body expand together, but the body develops more rapidly than the mind. Growth in man, as in plants, proceeds by fits and starts, succeeded by periods of quiescence; seasons affect it, so do supplies of food; boys do not develop so rapidly in autumn and winter as in spring and summer. Girls at this age often fall back, as it were, a little in winter, when they are much more confined indoors, to make a greater push forwards in spring.

It is even difficult for the digestive and assimilative powers to keep pace with the bodily requirements, so that the tendency is for the temperature of the body to fall somewhat, to be ill maintained at the extremities, and for the cold bath to be shunned for lack of adequate reaction in those who are manifestly growing very rapidly.

The heart in some is hardly equal to the task set it, and when it is diseased we perceive both growth and the attainment of puberty retarded. The lungs, again, as Dr. E. Smith pointed out (*op. cit.*, p. 288), more often in girls than in boys, do not expand in proportionate ratio with the rest of the body. The body runs up tall, but the thorax remains narrow and flat, and the apices of the lungs approach too closely to each other. The definition of a line—length without breadth—is too closely imitated. The morbid imminences of this age are disorders of the nervous system, chorea, epilepsy, mania, anæmia, rheumatism, pneumonia. Girls during this period of their lives suffer more illness than boys, probably in consequence of insufficient gymnastic exercises, over-study in cramped postures, and from that folly of follies, a forcing-pit education, 'all articles warranted to be turned out highly finished by eighteen years.' It is the age of all others when good or bad habits of life are formed; the time, too, when the seeds of disease are sown broadcast, to spring up in the after-age of man- and womanhood.

Diet.—Food should be abundant, varied, but unstimulating. Three or four moderate meals a day are requisite; if at any period of life fermented liquors are beneficial, now is that time. Light bitter unadulterated table-beer or claret and water should be provided at dinner, but not more than half or three-quarters of a pint of it allowed. If violent exercise has provoked thirst, this may be satisfied with plain water or toast-and-water *ad libitum*. Girls should take cocoa-nibs for breakfast, with bread and butter, meat, eggs, bacon, or fish, as much as they like. School dietaries err usually on the side of deficiency. At dinner, as well as substantial meats, fruits, vegetables, and suet- and milky puddings are required. Tea should be allowed only once in the twenty-four hours, at six o'clock, and a warm supper be provided at nine o'clock.

Clothing.—Nothing need be added to what has been already advised. Without entering into minute particulars, it should be seasonable, rather extra warm, and offer no uncomfortable restraints. When mothers complain of their daughters' neglected figures, the hygienist retorts, What gymnastic exercises did you require of them? It is the age for exercise of the body as well as of the mind. Boys' spines are straight and girls' backs crooked because the former use all their muscles and the latter do not. As the body is making its most rapid growth, so the evil of unilateral use of muscles is particularly baneful. Sitting over-long in a slouching attitude will tend to contract the chest, as carrying too heavy weights over the back will spoil the normal spinal curves; so leaning too much on one side, standing too long on one foot, even carrying constantly a pocketful of articles on one side of the dress, will suffice at this age to induce spinal curvature. The daily use of the trapeze, swinging, playing games like *la grâce*, in which both arms are used, badminton, and lawn-tennis, in which arms and legs are employed, and every muscle brought into due action, are quite essential to the proper development of the thorax and the muscles of the trunk. Girls should row and run and ride and swim and skate no less than lads do, in order to become fit mothers for a nation like ours.

The best temperature for a sitting-room is 60°; that for a sleeping-room between 50° and 55°. The hygiene of the bedroom and the bed needs a few words. The temperature of the room should not rise above 65° in summer, or fall below 45° in winter. It must be thoroughly ventilated with a constant amount of fresh air passing through it during the day. The desiderata for a bed are coolness for the spine, restfulness for the trunk muscles, and warmth without too great heat or too burdensome a weight of bedclothes: all objects are well attained by a French *sommier élastique*. A horse-hair bolster is preferable to a pillow, and a paper pillow to a feather pillow; a feather pillow enwrapping the neck and head heats the upper part of the spinal cord undesirably. Posture in bed is not unimportant. The head should be low, the feet perhaps a trifle raised, certainly not dependent. 'Sleep not on your back, as a dead man,' is a maxim attributed to Confucius; the opposite attitude, on the stomach, is restrictive of the intestinal movements, and uncomfortable. It is as well to begin the night lying upon the right side so long as food remains in the stomach, and to turn on first waking upon the left side. The best attitude is probably that crouched one habitually selected. Good advice is to stretch yourself straight whenever you wake, in order to render the circulation of the blood freer. In winter the arms should lie under the clothes, in summer above them.

The cold bath, or cold sponge, or shower bath should be taken by the robust every morning; with a warm or tepid bath once a week, for cleansing purposes, throughout summer and winter. Whilst the young of both sexes should be encouraged to swim, in seasonable weather, the length of time they stay in the water must be strictly limited according to the temperature.

We abstain purposely from any discussion of the hygiene of *mental* education.

7. **Adult Age.**—This is the prime of life, between 20 and 30. Anatomically, the body broadens, the chest deepens; for feats of muscular prowess—short, severe labours—it is at its best. The intellectual and cerebro-spinal sexual energies are at their maximum. What the French call the greatest latitude of health, and of strength, exists at this period; severe strains are supported with apparent ease. In male adults the body gains weight by small amounts for about twenty-eight days, then relapses to its normal average by a sudden crisis, attended by head-heaviness, loss of appetite, and copious discharge of urine, or seminal evacuation. It is not a time about which the hygienist has much to say. If the preceding periods of life have been wisely ruled, the individual is at his or her best. The morbid imminences directly belonging to this age should be few, and certainly are usually due to direct contravention of the laws of health: to exposure to contagious influences, to irregular living, especially drinking, to excessive strains upon the heart or its blood-vessels, to pulmonary inflammations, to contravention of proper sexual relations, to over-emotional excitement, or to mental worry and loss of sleep.

The guiding rule for this period is succinct enough: '*Sustine et abstine.*'

> *Qui studet optatam cursu contingere metam,*
> *Multa tulit fecitque puer, sudavit et alsit;*
> *Abstinuit Venere et vino.*

Hitherto excess in feeding was difficult to effect, quickly punished, and admitted of rapid and spontaneous repair; but now he who would rise above the ruck must rule with a tight rein all his appetites. The penalties are not exacted directly after the offence is committed: they are kept in store, but nature inflicts them with pitiless justice.

Total abstinence from alcoholic drinks may be recommended Not only does it favour health, but lessens all the temptations incident to these important years, in which a man carves out his own career. A question not infrequently propounded is, How shall I know when I have eaten more than is good for me? If individuals are dull or drowsy after a meal they have usually eaten too much; if they can converse, write, or transact business with ease after a meal, they have fed temperately.

Women may be advised to marry not earlier than 21—between 21 and 28—when in our climate they are best fitted to become wives and mothers. Men had better wait till between 28 and 35 before they undertake the responsibilities of being parents. For the generality of men and women we must insist once more on their not giving up out-of-door muscular exercises. An entirely sedentary trade or office-life cannot be a healthy one for either body or mind: the latter appears to suffer most from it—the sense of morality becoming blunted. When the struggle for existence is so severe that, with early rising and very limited hours of sleep, no leisure hour remains for sports or amusement, the time has arrived for emigration, war, enforced military service, or revolution.

SLEEP. Doubtless different constitutions and individuals differently employed require different amounts of sleep. As nothing dulls the intellect and weakens the recuperative faculties more than too much sleep, except over-feeding and drinking at this age, so few things are more certain than that a man may rise too early for making the best use of his twenty-four hours. He must live in the world and keep the world's pace still. John Wesley's advice in this matter is worth recording. He writes that any man can find out how much sleep he really requires to repair his nervous system by rising half an hour earlier every morning until he finds that he no longer lies awake at all on going to rest in bed, or wakes up until it is time for him to get up. Six to eight hours is usually ample for healthy adults, with nine hours every seventh day. The mistake too often made is that of endeavouring to make up for over-hard mental efforts by over-long sleep hours. Mental over-fatigue is to be repaired not by sleep, but by bodily exercise in the open air. Exercise directs the blood-flow from the head towards the muscles, and renews the appetite. As we have pointed this out as the suitable age for marriage, we may mention some things which conduce not slightly to healthful and happy marriages: parity of station, similarity of temper and tastes, and no disproportion either in age or size.

8. **Maturity**.—The body has now reached its maximum weight and solidarity, and the period is that of maximum endurance. Men reach their full weight at 40; women later, sometimes not till 50. At this age the soldier is fittest for service, the labourer for work, the artisan and professional man for their respective duties. 'High to soar and deep to dive is given to man at thirty-five.' The morbid tendency is towards anæmia and obesity, the former promoting the latter, and both alike being determined by a too sedentary town-life, and by daily occupation in close, ill-ventilated, and badly lighted chambers. Now are perceived the first attacks of gout; whilst visceral degenerations and atheroma of arteries may manifest themselves — events all of which may be delayed, if not wholly prevented, by attention to the laws of health. It is desirable that each individual should pay heed to his weight at this age, since this indicates whether or no he is living wisely. Celsus (lib. 2, cap. 1) writes: 'Corpus autem habilissimum quadratum est neque gracile neque obesum. Nam longa statura ut in juventa decora est, sic matura senectute conficitur. Gracile corpus infirmum, obesum hebes est.' When, however, men are engaged in trades or professions, there is no more difficult task than to maintain their weight at this age, the *juste milieu* referred to being a hard matter to secure. The advice given by Celsus (lib. 1, cap. 1) cannot be surpassed in force or brevity: 'Sanus homo qui et bene valet et suæ spontis est nullis obligare se legibus debet; hunc oportet varium habere vitæ genus, modo ruri esse, modo in urbe, sæpiusque in agro, navigare, venari, quiescere interdum; siquidem ignavia corpus hebetat, labor firmat.' As to diet, clothing, and habits, we need add nothing to what has been already advised for a previous age; but on exercise of body and mind there is much to be written.

A good rule is laid down by Lynch, too, in his *Guide to Health* (p. 290), that the lean should exercise *ad ruborem*, *i.e.* to glow-point, or until their bodies and spirits are heated, for that will fatten them; and the fat *ad sudorem*. The more luxuriously a man lives, the more exercise, and the more active exercise, he needs. Want of it, and the costive habit thus superinduced, may, as Kotzebec observes, extinguish the divine flame of genius and seriously impair the intellectual powers. Hypochondriasis and hysteria are the special punishments of ease and affluence and indolence. Obviously a portion of each day should be set apart for exercise for those who can take it. In the households of the wealthy a gymnasium is at least as important as a bath-room; and twenty minutes every morning before breakfast might well be devoted to breathing the muscles—that is, calling into play every muscle of the trunk and limbs. The chest should be expanded by clubs and dumb-bells; swinging on the trapeze, and hanging by the arms and legs, may be recommended. Again, before forenoon or midday meal, an hour's ride or walk must be obtained; and a third time in the day an hour and a half's exercise —fencing, or walking, or rowing—should be arranged before bedtime, in the spring and summer seasons. A great point is to vary the exercise by every means at hand: to change the set of muscles called chiefly into play upon different days, as Celsus advised: to swim, ride, fence, sail, row, shoot, fish. Lastly, we can recommend those only who are very robust to take a long walk before breakfast. Bodily exercise should not be undertaken immediately after a heavy meal; nor should those who have sweated themselves violently sit down at once to a full meal—at least an hour's rest should intervene.

Let us pass on from the exercise of the muscles to that of the brain, since here, too, the hygienist may be expected to give a few words of advice as to what is proper and profitable in mental work, and what is improper and likely to prove detrimental to the cerebral organs. Our own experience entirely confirms that of others, that most brains suffer more from rest than over-work. Exercise is as essential for the healthy nutrition of the cerebral as it is for that of the muscular tissue; and without regular employment daily up to fatigue-point no high quality of intellectual condition is ever attained. Fret, hurry, worry, and the endeavour to accomplish some task in too short a time, is what wearies and wears the thinking organ; but what damages it is always its imperfect nutrition, the insufficient repair of its waste after its active employment. It is a matter of observation that feeble brains, those constructively defective, or those damaged by accidental injury or by disease, most speedily suffer both from over-work and from actual disease: the education of the half-witted, and of the congenital idiots is a difficult problem as well as a disheartening task; that they admit of some improvement is proven, but directly their daily exercises are discontinued they fall back. Immature brains are doubtless more vulnerable and require more rest, more sleep, and more diversion than fully developed ones. Again, the mere degenerative changes in the blood-vessels and capillaries incident to disease and old age interfere with the nutritive changes requisite for the most perfect intellectual operations. Hence it is easy to point out a true pathological foundation for epileptic insanity and senile dementia, and to perceive why poorly fed children should suffer from over-pressure in schooling.

The cultivation, however, of the human mind, and the determination of what is best for its sound development and maintenance, belong to education, not hygiene. Let it suffice to say that the *mens sana in corpore sano* depends as much upon the judicious training and education of the intellectual centres, as it does upon their minute structures and sound nutrition. The best intellects are built on good foundations; the education of the cerebral centres begins with the first special sense impressions made upon them, and, we may hope, does not terminate only with this life. There is still as much to be learned in the training of the brains as there is in that of the muscles. True excellence is only to be reached after much striving, and can be attained only by gradual steps, and slowly.

9. **The Turning Period.**—This period of life, which lies between 45 and 60, is also known as *the grand climacteric*, or *middle age*. The skin wrinkles. Up to 60 years of age the skull may continue to increase in size, principally at its anterior part, by enlargement at the frontal sinus; after 60 the skull-cap loses weight, and the brain may waste, but gets tougher and firmer. The heart grows a little larger, and its walls are thicker. The lungs grow denser, a change common to every tissue of the body. The hair grows grey; the features sharpen; the sight alters; and the hearing grows dull. Pressure and wear and tear begin to tell at every part. Upon the blood-vessels their effects are more marked in males than in females, because ordinarily the former labour harder than the latter; further, the death-rate of men is greater than that of women at this age. As the sexual powers decline, which they do by a quick descent between 46 and 63, the intellectual powers increase, so that mentally there is often exhibited a marked increase of vivacity and agreeableness, more noticeable in men than in women. In the latter the cessation of the catamenia is attended usually by some rejuvenescence, attributable to their recovering a little embonpoint. It is an age, however, at which women kick rather, and become restless and uneasy, the change of life being attended in many by a renewal of their juvenile tempers, as between 7 and 14, and occasionally by a revival of their youthful ailments, such as eczema, skin eruptions, and various neuroses, insomnia, hysteria, and sometimes epilepsy. In character, whatever obstinacy exists reaches its climax.

Morbid Imminences.—The inflammatory disposition is lessened, but there is a tendency to venous plethora of the abdominal viscera, and towards vicarious hæmorrhages. Gout assails its victims with well-characterised attacks. New-growths, simple and malignant, tend to demonstrate themselves, and rheumatoid arthritis to appear. Dr. Waterhouse, in a letter to Sir T. Sinclair, published in his *Code of Health and Longevity* (vol. i. p. 33: Edinburgh, 1807), notices the three following periods as very important in every human life, as sickly or moulting times. The first he had noticed to befall males chiefly at 36 years of age, when the lean person becomes fatter and the fat kine leaner. The second sickly period happens at some time between 43 and 50, and lasts a year, or perhaps two. During it the complexion fades, the appetite fails, the tongue becomes furred at the smallest over-exertion of body or mind, the muscles are flabby, the joints are weak, sleep is unrefreshing, and the spirits droop. It is no particular organ that suffers, but a uniform deterioration that is manifested. At this time a man first experiences a reluctance to stoop, prefers a carriage to riding on horseback, and perceives each change of the weather affect him. This observation of Dr. Waterhouse has, according to the experience of many, much justice in it; as also that between 61 and 62 a similar deterioration of health takes place, but with aggravated symptoms.

Hygienic Rules.—At the menopause women should be advised to abstain, as a rule, from alcoholic drinks, and to avoid highly spiced and seasoned dishes. They may be recommended to take meat not more than once daily, and to live chiefly on farinaceous food, milk, eggs, vegetables, and fresh fruits. A tablespoonful of lime-juice taken twice daily occasionally for a week or ten days at a time has a salutary, depurating effect upon both stomach and kidneys, and clears the tongue when this is foul in the morning. Riding and walking exercise are highly appropriate, but very violent muscular efforts should be avoided. If the individual be thin, and growing thinner, the clothing should be extra warm. Flannel abdominal belts may be worn advantageously in all seasons, but especially in autumn and winter.

Both sexes should avoid emotional excitement, and the stimulation of waning sexual abilities. Prolonged exposure to wet and cold is sure to be seriously resented. Hot or Turkish baths, succeeded as they should be by the cold plunge or douches to remove the lassitude otherwise provoked, are very beneficial, and taken once a week may be safely indulged in throughout the year. It becomes extra important as the subcutaneous fat gets absorbed, and the skin wrinkles, to keep its pores clean and open and capable of perspiring.

10 and 11. **Advanced Life, and Old Age.**—The period of advanced life—60 to 82, and old age, from 82 upwards, may be advantageously considered together. When a man turns his toes out much in walking and treads upon the whole base of his foot, when he is always stopping and turning round to look back, he is already old. The sagacious 'boots' at an inn can tell a man's age by the state of his shoe-leather.

'*Senectus ipsa morbus insanabilis.*' Some degenerate earlier than others, but the decline of life is characterised in all human kind alike by an indurating condition of every tissue, diametrically opposed to the cellular softness and laxity of infancy. The capillaries thicken, the arteries harden, the nutritive metamorphoses proceed more slowly. The muscles waste; the subcutaneous fat lessens; the blood becomes poorer and paler; the skin dry, sallow, and wrinkled; further, it gets less vascular, and the mucous surfaces become relatively more so. The teeth loosen and fall out; the gums recede from them; and the digestive juices fail. The arteries become atheromatous and calcareous, lose their elasticity, and are liable to fibrinous thromboses, or to embolic pluggings; and while they tend to block up at one part, their coats may split and yield to pressure, bulge out, and form aneurysms or dilatations in other directions. Hence happen apoplexies, brain-softenings, and senile gangrenes. The heart up to an uncertain period grows progressively larger and more muscular, to meet the obstacles offered to the circulation; but finally it, too, degenerates, and its walls grow thinner and dilate. The air-cells of the lungs lose their elasticity, and progressively enlarge; then merge into each other; and become emphysematous at the edges of the lobes where least supported. Emphysema implies degeneration of capillaries and diminution of aërating surfaces; and as the pulmonary area becomes thus lessened, the right heart becomes hypertrophied and dilated.

The dryness and lessened secretion of the skin cast harder work upon the kidneys in eliminating water, and increase the disposition to catarrhal fluxes from the nasal passages, the bronchi, and the intestines. Thus, while there is a constant predisposition to skin-irritation from its dryness, and to eczema from scratching and rubbing it, the other morbid imminences towards bronchial catarrh and diarrhœa very closely follow the direction given them by the season of the year, and greater or less degree of external cold. The bladder grows thicker with age, and its capacity is less; the prostate gland enlarges. Few persons after 60 pass seven hours in bed without requiring to micturate. Dr. Rush regarded the prompting to more frequent micturition as the first symptom indicative of a man's years impairing his bodily functions. The pulse feels firmer and fuller; fills quickly after food is taken, but falls in frequency and flags in power in a marked degree after fasting. It is a far less trustworthy indicator of the gravity of any febrile disorder, or of degrees of asthenia, than it was in youth or middle age; and it fails to point to the practitioner the nearness of death, unless he have large experience of it.

There is a default of reaction manifest in advanced life, so that all acute disease is clinically less easy of recognition, and the beginning of the end is therefore apt to pass unobserved. The thermometer warns the doctor of changes which old people do not notice themselves, but which it may be of considerable importance to notice. A slight elevation of temperature means much in old age, and should be heeded accordingly. The slightest change excites a young child; nothing seems to move the old man. In extreme old age life is little more than vegetative existence; the individual eats and sleeps and dreams. The sleep the aged get by night seldom rests or satisfies them. Memory is one of the first mental faculties to become impaired, but finally every sense and every faculty fail. Up to 75 the strong of both sexes usually retain their digestive powers, and a fair amount of mental and muscular vigour. Later on, indecision, inconsequential reasoning, self-distrust, uncertainty as to facts, delusions of sight and hearing, restlessness, day-dreams, night-wandering, too often prove that the old are no longer what they once were in intellect, and testify to the brain degenerations belonging to senile dementia.

Hygienic Rules.—A prime necessity for old age is warmth: nothing kills the aged so certainly as cold. It is of first hygienic importance after 75 that the individual should be loved and cared for; old people do not, perhaps cannot, take care of themselves.

Those who live longest, and enjoy the fullest measure of activity, are those who do not over-tax their stomachs when their teeth begin to fail them, and who adapt their aliment to their enfeebled powers of mastication, by having their food properly cooked. Stews, minces, meats boiled and afterwards baked—cooked, that is, twice—are more easily digested than fresh roasts or close-fibred meats. A moderate amount of wine cheers and comforts old people; a glass or two of good Burgundy or of champagne, and an occasional glass of old port wine, or such stimulant as suits them, are most beneficial to the aged, and are better for them than overloading their stomachs with milk and farinaceous foods.

Great attention should be paid to the functions of the bowels and of the skin. Galen pointed out that old people should not suffer their bowels to remain costive beyond two days; on the third they should take some gentle purge, such as by experience they have found adequate. A hot bath once a week, and a hot foot-bath every night, may be advised. A short nap after breakfast and before dinner is the natural habit of the aged. Further, their clothing should be extra warm, and their chambers night and day be heated. They should be encouraged to go out in the open air only in seasonable weather; and, when they are equal to it, should take a little walk on a dry gravel path in some warm locality, sheltered from north-easterly winds. All change and cheerful society are good for them. If their purses admit of it, they should follow the swallows to warm winter quarters. If they must winter in England, let them shut themselves up throughout the season in a well-warmed house.

Summary.—Advice for every age may be thus briefly given: for infancy and childhood—*sustine*; for adult years—*sustine et abstine*; for old age—*sustine* again. There is less need now to enjoin *abstine.*

The hygienist, however, seeks not to lengthen out the days of age and decrepitude; his art is not to prolong life beyond its natural term, though this may come subordinately, but to render its period of activity and utility longer—'*Hic labor, hoc opus est.*' Some cynic observes that we have pointed out very few habits as worth cultivating, the truth being we believe what we have insisted on—that most bodily habits need resisting. Individual health is attained by self-denial; habits imply self-indulgence.

Reginald Southey.

PERSPIRATION, Disorders of.—*See* Sudoriparous Glands, Diseases of.

PERTUSSIS (*per*, signifying excess; and *tussis*, cough).—A synonym for whooping cough. *See* Whooping Cough.

PESTIS (Lat.).—A synonym for plague. *See* Plague.

PETECHIÆ (*petigo*, an attack, eruption; Ital. *Petecchie*, fleabites).—Synon.: *Peticulæ*; Fr. *Pétéchies*; Ger. *Petechien.*

Description.—Petechiæ are small crimson and purple spots of the skin, resembling those that result from the bite of a flea. They are circular in figure; are developed around the apertures of the follicles; have an average size of one or two lines in diameter; and are consequent on the transudation of the colouring matters of the blood, through the capillary vessels of the follicles, into the immediately adjacent tissues. They are distinguished from spots resulting from simple hyperæmia by pressure with the finger. Under pressure the hyperæmic spots disappear, but the petechiæ remain permanent. They are differentiated from flea-bites by the presence in these of the puncture, which is always perceptible and contrasts strongly with the lighter colour of the rest of the disc; although it is to be remembered that the colour of the petechial spot is always deepest in the centre, and becomes lighter towards the circumference. Petechiæ vary in tint of colour according to age and the amount of effused blood, being at first brightly crimson, then purple, next almost black, and subsequently fading away through the ordinary colours of a bruise. Hence it is usual to find them scattered over the skin of various shades of colour, ranging through all the tints already mentioned.

Petechiæ are met with on the mucous membranes, as well as on the skin, in purpura, scorbutus, malignant fevers, and in several forms of congestion of the follicles of the skin associated with constitutional diseases. Petechiæ do not call for special treatment. *See* Purpura.

The term *petechial* is applied to certain varieties of diseases, such as typhus, when petechiæ occur in their course, or the eruption becomes hæmorrhagic. *See* Extravasation; and Typhus Fever.

Erasmus Wilson.

PETIT MAL (Fr.).—A term applied to attacks of epilepsy which are of short duration and slight intensity. *See* Epilepsy.

PFAEFFERS, in Switzerland.—Simple thermal waters. *See* Mineral Waters.

PHAGEDÆNA (φάγω, I eat away).—A form of ulceration, which rapidly destroys the surrounding parts. *See* Bubo; Gangrene; Ulcer and Ulceration; and Venereal Sore.

PHAGOCYTOSIS (φάγω, I eat; and **κύτος**, a corpuscle).

Definition.—A term expressing the property possessed by certain animal cells, called 'phagocytes,' of taking into their substance solid particles, which may either be rejected, be used by the cell for its nutrition, or, when the solid mass is living, may destroy the cell.

Phagocytosis, from this wide definition, is thus a process not limited to diseased conditions of the animal body, but is a part of a general property possessed by cells in animals of every grade, invertebrates and vertebrates. The cells which act as phagocytes are not highly differentiated: they are not, like the muscle-fibre or the nerve-cell, organised to perform special functions, but they possess the characteristics inherent in undifferentiated protoplasm. Two of the chief properties of these cells are the amœboid movement or power of contractility of the protoplasm, and the power of digestion. They are, moreover, very sensitive to stimuli, both chemical and physical, which diminish or increase their movements, or which attract them to one spot. To a certain extent they show a selective power, that is, they refuse to take in some solid particles; but how far this power is generalised in the different cells which act as phagocytes it is at present impossible to say. The relation of phagocytosis to disease is in part discussed in the article on IMMUNITY. The anatomical facts which have been discovered by a study of phagocytosis will alone be discussed in the present article. For convenience, it is best to consider the subject under two headings—(1) *physiological*, and (2) *pathological phagocytosis*.

1. *Physiological Phagocytosis.*—Examples of this occur in both the most lowly and the highest animals. The amœba takes into its substance solid particles which, if suitable for the nutrition of the organism, undergo digestion, and, if unsuitable, are ejected after remaining in the substance of the protoplasm for some time. The ciliated animalculæ (of which Paramœcium may be quoted as a type) also take into their substance particles of the nature just mentioned, which undergo a similar process. This intracellular digestion is also a feature in Hydra, sponges, and other allied animals. In the higher animals there are many examples of this phagocytosis, for example, in the absorption of fat in the small intestines, in which the globules are taken up by the epithelial cells and then by the leucocytes, by which they are conveyed to the lymph-stream; in the absorption of bone during ossification, and in old age by the osteoclasts; and in the absorption of the branchiæ and tail of the tadpole during its transformation into a terrestrial animal. These processes are performed by cells, playing the part of scavengers. It is sufficient to mention these facts to bring them into line with what more nearly concerns disease, namely, pathological phagocytosis.

2. *Pathological Phagocytosis.*—This is observed when a living organism is injured mechanically or infested by a parasite, or when an inert foreign body is introduced into its substance. It is a battle between the host and the parasite, in which in some cases the host, in some the parasite, gains the upper hand. Parasitism may not inconveniently be divided into two varieties: in the one, the parasite, by the bulk of its growth, may be fatal to the host by interfering with the essential functions of the organism, or of a vital organ; in the other, the parasite acts on its host not so much by the bulk of its growth as by the poisonous products which it excretes or forms from the tissues of its host. Infective disorders in man and the higher animals, so far as we know them, belong chiefly to the second variety of parasitism; to the first variety belong some of the cases of parasitism in the lower animals; perhaps also in man (*e.g.* actinomycosis). Whatever truth there may be in this division of parasitism, it must be borne in mind that it is not yet clear that every noxious parasite is capable of secreting products which are poisonous to the host. To illustrate this question of parasitism in the animal kingdom and its relation to phagocytosis, the description given by E. Metchnikoff in his *Leçons sur la Pathologie comparée de l'Inflammation* (1892) will be adhered to.

Commencing with the lowest in the animal grade, the *unicellular organisms*, such as the amœba, it has been mentioned that the solid living particles (diatoms, bacteria, &c.) ingested by them may serve as food; but some of the living bodies absorbed, instead of being digested, may actually produce a fatal disease. Thus, as Metchnikoff has shown, the amœba may take into its substance a microsphæra (an organism composed of nucleated round-cells, multiplying by division) which multiplies to such an extent as to kill the amœba. This is an example of fatal infection of a unicellular organism by a parasite. Examples of similar parasitism in other lowly plants and animals are well-established. In some instances the living bodies, diatoms and bacteria, are ingested and digested by the organism, in other instances the ingested living body multiplies and destroys its host.

The study of phagocytosis becomes more complicated in *multicellular organisms*. Of the three layers of cells of which the majority of these organisms are composed, namely, the ectoderm, endoderm, and mesoderm, it is the last to which the property of phagocytosis is eventually limited in the process of evolution. This limitation of the phagocytosis to the mesodermic cells is attained only gradually. The sponges, animals composed chiefly of ectoderm and endoderm, with a well-developed mesoderm, protect themselves against harmful bodies by means of their contractile ectodermic cells, but also by the phagocytic power of the mesodermic and endodermic cells. In them the mesodermic cells play a large *rôle* in the normal digestion of the organism. Some of the Cœlenterata possess no mesoderm, and in these, Hydra, for example, the endodermic cells, which have the property of sending out amœboid processes and of performing the normal digestion of the organism, play the *rôle* of phagocytes; in other similar animals, the ectoderm cells are also phagocytes. Such animals are without any vascular system. This is also absent in the Medusæ, which, however, possess a mesoderm differing from that of the sponges in the fact that the mesodermic cells play no part in the normal digestion of the animal. These mesodermic cells are, however, the phagocytes. They surround and attack harmful substances introduced into the substance of the animal, and may unite together, forming *plasmodes*, an example of the formation of giant-cells low down in the animal scale. In all animals higher than the medusæ, namely, echinoderms, worms, vertebrates, &c., this formation of plasmodes, or giant-cells, by the union of mesodermic cells is very common, the plasmode in some instances completely surrounding the foreign body or parasite, as in fig. 117.

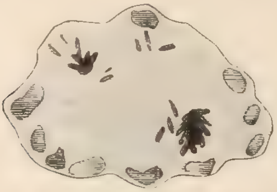

FIG. 117.—A Giant-cell enclosing the clubs of the fungus in Actinomycosis. (Verick, Oc. 1 × $\frac{1}{12}$ − 700 diam.) From a preparation and drawing by Dr. Armand Ruffer.

The classes of Mollusca and Arthropoda possess a vascular system, filled with a liquid containing colourless cells. These cells are mononuclear; their protoplasm is in one variety granular, in another hyaline. They act as the phagocytes of the animal. Numerous experiments have shown that, after a lesion of a part of the animal, these cells accumulate near the injured spot as they do in an 'inflamed' area in warm-blooded animals. A similar accumulation occurs around inert foreign bodies introduced into the animal; and the cells also take up pigment-granules injected into the tissues (Haeckel, 1862). The best example of infection in such animals has been brought forward by Metchnikoff as occurring in the water-flea, *Daphnia magna*, which in a pond was found infested with a kind of yeast-fungus, *Monospora bicuspidata*. At certain periods an epidemic of this disease will kill off nearly all the daphne in the pond. A study of the process shows that the ripe spores of the fungus are eaten by the daphne, and pass through the intestinal wall into the body cavity. Here the elongated spores become surrounded by the leucocytes, and one of two events may happen. The spores may rapidly increase in number and fill the body cavity, eventually destroying the life of the daphnia; or, becoming surrounded by leucocytes, they undergo degeneration, so that they are killed or are not fatal to the daphnia.

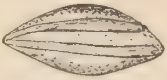

FIG. 118.—A phagocyte of the Daphnia containing two undegenerated spores of the Monospora. (Metchnikoff, Virchow's *Archiv*, vol. xcvi.)

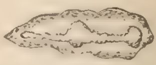

FIG. 119.—A spore of the Monospora enclosed by phagocytes, and undergoing degeneration. (Metchnikoff, *ibid.*)

In both cases there is a struggle between the leucocytes and the germinating fungus: in the first, the fungus overcomes the resistance of the leucocytes; in the second, the leucocytes surround and finally digest the spores of the fungus.

In the very young tadpoles of the lower amphibia (urodeles) phenomena similar to those occurring in mollusca have been observed by Metchnikoff and others. Thus, after a slight injury to the non-vascular fin of the tadpole, the amœboid cells collect at the injured spot, the fixed cells of the tissue taking no part in the process. In older tadpoles, when the blood-vessels are developed in the fin, there is still this accumulation of amœboid cells at the injured spot; but there are also the phenomena of inflammation such as are observed in the higher animals, namely, acceleration of the blood-stream, &c. As Metchnikoff points out, both the phenomena in the very young and those in the older tadpole must be classed as 'inflammatory,' although in one case there is no vascular change. Similarly, the phenomena following an injury or an infection which have been described as occurring in invertebrate animals possessing a mesoderm must be classed as inflammatory; not as belonging to a completely developed process of inflammation, but as forming one of the stages in the evolution of the inflammatory process in the animal kingdom.

Phagocytosis in the *higher animals* is a part of inflammatory and of infective processes. It is a question whether all primary inflammatory processes are not infective, that is, due to a living infective agent; it is probable that they are. The study of the nature of inflammation and of the process of infection are in reality to be conducted on the same lines, namely, that both are due to the introduction into the healthy organism of a harmful agency, which may either remain localised in its action, or may become generalised.

The cells which act as phagocytes are derived from the middle layer of the embryo (mesoderm), and are some varieties of leucocytes, the endothelial cells of the vessels, and the elements of the splenic pulp. The endothelial cells possess the power of contractility in many animals. In leprosy they not uncommonly contain large masses of the bacillus lepræ. In rabbits inoculated intravenously with the bacillus tuberculosis, these cells take up the bacillus; a similar phagocytosis occurs in swine-erysipelas. The endothelial cells and the elements of the splenic pulp are also macrophages, which will be described immediately.

Varieties of Leucocytes.—There are four chief varieties of leucocytes which exist in the blood and lymph of vertebrate animals.

1. *Lymphocytes*, characterised by the presence of a single round nucleus, surrounded by a thin layer of protoplasm, which is stained slightly by aniline dyes, while the nucleus is deeply coloured (fig. 120, *a*).

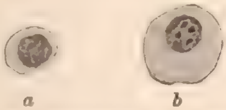

Fig. 120.—*a*. Lymphocyte. *b*. Mononuclear leucocyte.

2. *Mononuclear leucocytes — Macrophages.*—These also possess a single nucleus, but the protoplasm surrounding it is greater in quantity than in the lymphocytes; both nucleus and protoplasm are well stained by aniline dyes (fig. 120, *b*).

3. *Eosinophile leucocytes* (Ehrlich). These possess a lobed nucleus, but are characterised chiefly by the characters of the surrounding protoplasm, which contains large granules stained only by acid aniline dyes (such as eosin), and not by the alkaline ones (such as methylene blue, basic fuchsin, &c.) They are formed in the bone-marrow (fig. 121, *a*).

4. *Polynuclear* or *Neutrophile leucocytes* - *Microphages.*—These possess either a lobed nucleus or several nuclei, sometimes joined by filaments; the form of nucleus or nuclei is very varied. They have been termed neutrophile because the granules of the protoplasm are only stained by a mixture of acid and alkaline aniline dyes. The neutrophile leucocytes are found only in man; in other mammals (such as the rabbit and guinea-pig) their place is taken by the amphophile or pseudo-eosinophile leucocytes (fig. 121, *b*).

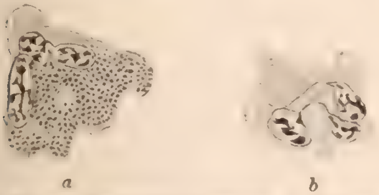

Fig. 121.—*a*. Eosinophile leucocyte. *b*. Polynuclear leucocyte. (Quain's *Anatomy*, 10th ed. by permission of Professor Schäfer.)

They are by far the most numerous of the varieties of leucocytes, forming three-fourths of the total number.

Of these varieties only the mononuclear and the neutrophile leucocytes act as phagocytes; and the former may also engulph the neutrophile leucocytes when these are dead or dying.

Leucocytes can digest suitable particles taken into their substance. Their digestive power is a property inherent in all original cells. In some cases of infective disease, the living bacteria have been observed to undergo this digestion in the phagocyte; they lose their protoplasm, leaving the investing membrane, which also finally disappears; and they also lose the property of being stained by some aniline dyes, such as vesuvine. Examples of this are found in recurrent fever in the ape, and in the streptococcus erysipelatis in man (Metchnikoff). Some of the bacteria may be digested and others not, the latter infecting the organism generally. This has been observed in tuberculosis and in swine-erysipelas.

It has been a question whether the bacteria taken in are living or not; but it has been proved by Metchnikoff that they are in many cases not only living, but virulent, since a single phagocyte of a pigeon (an animal refractory to anthrax) containing anthrax bacilli has been separated, and the bacilli cultivated in a suitable medium, proving on inoculation fatal to mice, &c.

The two varieties of leucocytes which act as phagocytes appear in some instances to be selective in their action. Thus in man it is the neutrophile leucocyte which takes in the streptococcus erysipelatis and the gonococcus; the mononuclear leucocyte remaining inactive. On the other hand, the mononuclear leucocyte is the phagocyte of the bacillus lepræ; the neutrophile variety remaining inactive.

Instead of digesting the bacterium, the phagocyte may prevent it developing. Thus the spores of anthrax injected into fowls and frogs (which are refractory to the disease) commence to germinate, but are taken up by the leucocytes. If, however, the body-temperature of the fowl be lowered by cooling the animal, or that of the frog increased by warming, the activity of the leucocytes is diminished, and the spores then germinate rapidly, the bacilli invading the whole body.

In other cases the leucocytes do not take in the infective agent, as in mice and guinea-pigs infected with anthrax, and in pigeons and rabbits infected with fowl-cholera; and according to Metchnikoff the more virulent the infection, the less phagocytosis occurs.

Why the leucocyte, possessing as it does the property of absorbing solid particles, refuses in one instance to act as a phagocyte, or why in another only one variety of leucocyte acts as a phagocyte, although both are present, is perhaps in part explained by what has been described as *chemiotaxis* (*see* IMMUNITY). Certain substances have the power of attracting leucocytes, others do not possess it—positive and negative chemiotaxis. Thus most bacteria, living or dead, papain, and leucin attract leucocytes; while the most virulent bacteria, strong solutions of sodium and potassium salts, alcohol, chloroform, glycerine, bile, quinine, and jequirity repel them. Some substances act in a neutral manner. Buchner separated what he called 'proteins' from the bodies of dead pathogenic bacteria, and found that these 'proteins' were very active positive chemiotaxic agents. These 'proteins' have at present no chemical significance.

Chronic infective processes.—The best examples of such processes are tuberculosis and leprosy. The formation of miliary tubercle has been ascribed to the proliferation of the fixed cells of the organ affected, that is, the alveolar cells of the lungs, the hepatic cells, &c.; leucocytes playing but little part in the formation. This is the view usually held. From a study of tuberculosis in the early stage, produced by the intravenous injection of the bacillus in rabbits, Metchnikoff has concluded that in the liver the tubercle is formed not by the hepatic cell, but by the phagocytes: the mononuclear leucocytes and the endothelial cells. The agglomeration of phagocytes forms the tubercle, the fusion of some of the cells forming giant-cells; the tubercle nodule is therefore purely mesodermic in origin, and is produced by the phagocytes accumulating to attack the bacilli. The polynuclear leucocytes readily absorb the bacilli, but soon die, being absorbed by the mononuclear leucocytes (the macrophages). The macrophages are more resistant to the bacilli, and may destroy them. In leprosy, also, Metchnikoff considers that the cells containing the bacilli are phagocytes struggling against their invasion; the leprous nodule would thus be ranged with the tuberculous nodule as one of purely mesodermic origin.

The facts discovered by Metchnikoff have a clear bearing on the phenomena of inflammation, and are to some extent explanatory of them. For fuller details of the relation of phagocytosis to the inflammatory process his work, already quoted, must be referred to.

The writer is much indebted to M. Metchnikoff for revising this article and for his valuable suggestions.

SIDNEY MARTIN.

PHANTOM TUMOUR. — SYNON.: Hysterical Tympanites; Spurious Pregnancy.

DEFINITION.—A peculiar enlargement of the abdomen, occurring in females belonging more or less distinctly to the hysterical class. It is supposed by the patient to be an actual tumour, or to be due to pregnancy, but it can be made at once to disappear by placing her under the influence of chloroform.

DESCRIPTION AND DIAGNOSIS.—The phantom tumour is characterised by a more or less general prominence of the abdomen forwards, varying in degree. The enlargement may attain a considerable size, but is always quite symmetrical. The projection is most marked about the middle of the abdomen, and usually a depression or constriction is observed below the chest and above the pubes. It is rounded, smooth, and quite regular, presenting a uniform soft feeling, quite distinct from that of gaseous distension, fluid accumulation, or a solid mass. The enlargement is peculiarly movable, as a whole, from side to side. There is no sense of true fluctuation. Percussion yields a resonant note, but not usually excessive, and it may be of a muffled character. On examination *per vaginam* nothing abnormal can be detected, such as would be associated with ovarian or uterine enlargements, or with pregnancy. Should there be any doubt whatever as to the nature of the supposed tumour, it may be at once cleared up by placing the patient under the influence of chloroform or other anæsthetic, when the swelling immediately disappears, the abdomen becoming quite flat; but it gradually returns, even before the patient returns to consciousness, on the removal of the anæsthetic. There is no pain or tenderness in connexion with the enlargement; nor are any symptoms due to pressure or other causes observed: while the patient usually presents distinct signs of the hysterical condition. There ought, therefore, to be no difficulty in the diagnosis of a phantom tumour. What is the actual cause of the enlargement is by no means clear, but most probably it is due to a kind of paralysis of the intestines depending upon disordered innervation.

TREATMENT.—In a patient having a phantom tumour, the general and medicinal treatment for hysteria is that principally called for. She should be constantly impressed with the fact that the enlargement is not really a tumour, and is of no consequence. The condition is by no means easy to get rid of, but for this object galvanism may be applied to the abdomen, or, in obstinate cases, the patient may be put repeatedly under chloroform. The use of pressure, by means of an abdominal bandage or elastic apparatus, might be serviceable in some cases. The bowels should be kept freely opened.

FREDERICK T. ROBERTS.

PHARYNX, Diseases of.—The pharynx is often involved in acute general diseases which affect the throat, such as scarlatina and diphtheria; or it may be implicated along with other structures in diffused inflammation of the throat, ulceration, gangrene or morbid growths; but the diseases of practical importance connected with the pharynx itself which need to be discussed here are three—namely (1) **Acute inflammation**; (2) **Chronic inflammation**; and (3) **Follicular inflammation.**

1. Acute Inflammation of the Pharynx. Synon.: Fr. *Pharyngite Aiguë*; Ger. *Acute Schlundkopfentzündung*.

Definition.—An affection of the pharyngeal mucous membrane, characterised by a non-exudative catarrhal inflammation.

Ætiology.—Some persons, though otherwise robust enough, show a particular predisposition to pharyngeal catarrh; and previous attacks seem to increase the predisposition. The young are, on the whole, more liable to the complaint than those more advanced in age; while all that brings the strength of the individual below par, whether over-work, exposure, or disease, more particularly of a specific nature, acts as a predisposing cause. Two of the most common exciting causes are cold and damp. At other times it may take origin in an extension of the catarrh from other organs, in a blood-poison, or in a direct irritant.

Symptoms.—Most frequently, though not universally, the attack is ushered in by a certain amount of fever. The patient experiences some degree of chilliness, if not actual rigor; he is restless; his temperature is raised; the skin is dry; and languor and stiffness of the body are complained of. This may precede the pharyngeal symptoms by some hours, but soon these begin to arrest attention. The patient discovers in his throat a feeling of dryness, soreness, or fulness, speedily amounting to pain. This is particularly noticed when an attempt is made to swallow. And yet this very condition of dryness of the throat provokes him to renew the effort to swallow, the unpleasantness of which he manifests to the bystanders by the wry faces thereby induced. This desire to swallow is greatly aggravated if the uvula happens to be involved in the catarrh, as from its swollen and often œdematous condition it suggests the presence of a foreign body, of which the patient endeavours to rid himself by repeated swallowing. Cough is a frequent accompaniment, especially if the inflammation have extended downwards.

The inflammation may not extend into the larynx, but more usually this part is involved; and then the voice is altered in tone, becoming husky or hoarse, and it acquires the well-known 'nasal twang,' or it may become entirely toneless. On inspecting the throat, it will be observed that the mucous membrane is considerably altered in appearance and colour, being tumefied and redder than in health. At first it is dry, often glistening, tense, and extremely irritable. But as the case progresses this condition is altered, a secretion, more or less abundant, being poured out, bathing the tonsils and posterior parts of the pharynx with a muco-purulent discharge. This gives rise to repeated hawking and attempts to expectorate. Occasionally this catarrhal inflammation extends into the Eustachian tubes, exciting considerable deafness, and pain in the ears when the middle ear is involved. At the same time the oral mucous membrane is affected, as evidenced by the usual symptoms of foul tongue, bad taste in the mouth, accumulation of saliva, and offensive breath. This acute variety, under effective treatment, usually subsides within a week.

Treatment.—Dr. Ringer urges the use of tincture of aconite, in drop doses every quarter of an hour for the first two hours, and afterwards hourly, if the angina has been seen at the very commencement. He states that the inflammation rarely fails to succumb to this treatment in twenty-four to forty-eight hours. The patient should be confined to bed; a brisk purgative administered; and bland nourishment allowed, including abundance of milk, ice *ad libitum*, and stimulants if called for. Warm fomentations or poultices may be applied externally, or a wet compress. Steam may be inhaled, and a warm spray, medicated with morphine, or concentrated solution of phenazone, thrown into the throat every two hours. The parts may be painted once daily with a solution of nitrate of silver (gr. 40 to ℥j). Cocaine pastils may be cautiously sucked to relieve pain. When the swelling and redness subside, and the parts no longer present the dry, tense appearance, but are covered with mucus or pus, then is the time to bring in the astringent gargles, or to paint the throat with glycerine of tannic acid, and to use guaiacum or krameria lozenges. And now, also, tonics will prove useful.

2. Chronic Inflammation of the Pharynx.—This is by no means an uncommon affection, and may exist without having passed through the acute form.

Symptoms.—As in the acute variety, so here, there is considerable difficulty in swallowing, amounting even to pain when irritating substances are attempted to be passed into the gullet, but of course in a much less degree. Persons suffering from this form of sore-throat are specially liable to exacerbations of the catarrh, giving to the affection more of a sub-acute character, and then their usual symptoms are all aggravated. The hawking and expectoration, which habitually go on, more or less, during the whole time of their toilet-making, are increased; and as they find some difficulty in removing the tough mucus from the back of the throat, the hawking is continued till the mucous membrane itself is strained, and some of the ramifying vessels give way, and the patient is alarmed to see blood mixed with the expectoration. In some instances, especially in the case of those who are habitual topers, this hawking in the morning is the prelude to the morning vomiting. The voice is apt to be husky, more particularly if the catarrh have at all invaded the larynx. On inspection of the throat, it will be observed that the mucous membrane is more or less reddened; it presents a roughened appearance; and is sometimes puffy-looking, with numerous veinlets running across it, and a quantity of mucus adhering to the posterior part of the throat: the last appearance is more common in the relaxed condition of the throat. This variety is not infrequently found as an accompaniment of other diseases — phthisis, syphilis, disorders of the stomach, and gout; and as an effect of intemperance. The affection is usually very obstinate.

Treatment.—If the disorder be dependent upon any other affection, such as gout, rheumatism, or lithæmia, then of course the primary disease must be treated. But in the case of simple chronic pharyngitis it will usually be found that the sufferer is considerably below par in his general health. This indication must be met, and the patient supplied with tonics; his habits of life altered, his business suspended, and much out-of-door exercise enjoined. Good nourishing diet should be ordered. Smoking must be entirely prohibited, or much reduced. Locally, the affection is best treated by sprays or swabbing. Gargles seldom reach the parts: but if they are to be used, the best are those of alum, tannin, chlorate of potassium, and bromide of ammonium. The last is especially valuable in relaxed throats, with elongated uvula and irritable cough. As sprays, the most valuable are solutions of the following in distilled water, in the proportions indicated to the ounce: Tannin, 5 to 15 grains; alum, 10 to 30 grains; sulphate of zinc, 5 to 10 grains; common salt, 10 to 30 grains; and glycerine diluted with water. In swabbing the throat, glycerine of tannin may be used, Lugol's solution, or the simple tincture of iodine. Inhalation of chloride of ammonium in the gaseous form from a suitable apparatus is occasionally beneficial. In some cases mineral waters are prescribed with success.

3. Follicular Inflammation of the Pharynx.—Synon.: Granular Pharyngitis; 'Clergyman's Sore-throat'; Fr. *Angine Glanduleuse*; Ger. *Chronische Pharyngitis.*

This is another, by no means rare, form of chronic pharyngitis. On inspecting the throat of a sufferer from this affection, the posterior wall of the pharynx will be seen to present a mammillated appearance. The mucous follicles are much more prominent than is usual in health, and seem as if distended with their proper secretion. The submucous tissue, in which they are imbedded, is also thickened and hypertrophied. Occasionally these tubercles coalesce, and then a large confluent prominence is observed, studding, here and there, the posterior wall of the pharynx. In addition to the distension of these follicles, in some cases a large secretion of mucus is poured out, which, especially at night, hardens and concretes, and presents a dry, ugly, greenish-coloured crust on the back of the pharynx.

At other times there is, on the contrary, a deficiency of mucus, and then there is observed a dry varnished-like appearance of the back of the throat.

Symptoms.—Each of these conditions gives rise to a considerable amount of coughing and hawking; more particularly is this the case when the adherent mucus is tough, tenacious, and difficult of expectoration. The voice becomes hoarse and husky, this being very observable after any continuous effort at speaking or reading. Swallowing is not attended with difficulty or pain. But the presence of these enlarged follicles in the throat suggests to the mind of the patient the necessity of swallowing, and consequently he makes frequent uncalled-for attempts to swallow. At the same time he perceives a sensation of dryness or pricking in the throat. Those who are the subjects of this disorder will generally be found to be those who strain their voice—often clergymen—and hence the erroneous name for the affection of 'clergyman's sore-throat'; or those whose bodily and nervous energy have been in any way reduced. It is a tedious disorder, often lasting for years. There seems to be small disposition for the disease to extend to the larynx or lungs; but on examination by means of the rhinoscope, the same enlarged appearance of mucous follicles may, in some cases, be seen to extend to the utmost limits of the pharynx, and the mucous membrane is itself tumefied and thickened. If this condition be neglected, it may ultimately proceed a stage further, and the character of the secretion become altered, presenting a muco-purulent appearance, while the glands themselves become indurated and, in some cases, ulcerated. Occasionally it will be found that the mucous membrane and the follicles of the larynx take on the same form of chronic inflammation, especially when the disorder is persistently ignored for years. Arrived at this stage, the general symptoms become so aggravated as to forbid the patient, or his friends, any longer to neglect the disease. The hoarseness, always present in a certain degree in speaking or singing, becomes constant and intensified; and if the larynx be considerably affected, there may be complete aphonia. And now more decided pain is complained of, and the individual no longer exhibits the same alacrity and interest in the pursuit of his avocations, but becomes indifferent to them, in consequence of the increased debility and general languor which pervade his whole system. Cough, however, is not a striking symptom, if the disease do not invade the larynx to any great extent, and its tendency is rather to progress upwards than downwards. The other structures in the neighbourhood of the pharynx become implicated, when the disease assumes the ulcerated form; and the uvula, tonsils, and soft palate become tumefied, swollen, elongated, and generally so enlarged as greatly to interfere with the inspection of the parts. The epiglottis also exhibits, in severe cases, a tendency to become crooked and ulcerated.

Treatment.—The general rules already laid down with regard to the treatment of chronic pharyngitis apply equally in this disorder, only, perhaps, with greater force. The constitutional treatment must be more decided. The constitution must be braced in every possible way, by the use of generous diet, tonics, bathing, and travelling. And to further the cure of the affection, attention must be paid to the secretions generally, these being stimulated or altered by the exhibition of small doses of blue pill, podophyllin, and aloes. Iodine in some form should be given. But the local treatment is equally, if not more, important, and to be effective must be regularly and conscientiously persevered in for months. There are various methods of carrying out this, by inhalations of medicated fluids, or the insufflation of various powders, as alum or tannin. The most certain and efficacious means, however, because at once reaching the affected parts, and producing decided and visible effects, is the destruction of the follicles which are the seat of the disease. This is best effected by the use of the galvano-cautery to each of the follicles, not more than four or five being treated at a sitting. If this be not possible, then certain remedies may be directly applied to the diseased parts by means of a large camel's-hair brush. One of the best of these applications is a strong solution of nitrate of silver, varying in strength from twenty to sixty grains to the ounce of distilled water. If the parts be much ulcerated, a still stronger solution may be employed. Other medicaments which may at a later stage be used are the glycerine of tannin, or a solution of tannin in water (equal quantities of tannin and water), bromide of ammonium, tincture of iodine, or nitrate of uranium. Of course it must be left to the discretion of the practitioner to decide how often he should repeat these strong applications, as it all depends upon the nature of the case; but as a general rule it may be laid down that once every second day will be quite sufficient for the first fortnight, and after that two or three times a week will be often enough. This is to be kept up till the nodulated appearance is got rid of. As soothing applications the glycerine of borax will be found valuable, or glycerine alone, or olive or almond oil. Gargles are useless, as they never reach the affected parts. A course of mineral waters is sometimes of the greatest value. *See* Mineral Waters.

Claud Muirhead.

PHIMOSIS (φιμόω, I confine). Synon.: Fr. and Ger. *Phimosis.*—A morbid condition of the penis, in which the glans cannot be sufficiently uncovered, on account either of congenital smallness of the orifice of the prepuce, or of disturbance of the natural relations between the latter and the glans by disease. *See* Penis, Diseases of.

PHLEBECTASIA (φλέψ, a vein; and ἔκτασις, extension).—Synon.: *Hypertrophia venarum.*

Definition.—An increase or spreading of veins, especially applicable to the minute venules of the cutaneous or mucous surfaces.

Description.—Phlebectasia is sometimes congenital, as when it gives rise to venous nævus; and at other times accidental, proceeding from relaxation of the tissues, or obstruction of the venous circulation. Phlebectasia, from want of tone of the tissues of the skin and weak contractile energy of the vessels, is most frequently met with on the cheeks and nose; whilst that which results from venous obstruction occurs generally upon the lower limbs. On the nose it is associated with small venous trunks which carry the returning blood into the deeper venous plexuses, and are very conspicuous.

Treatment.—The treatment of phlebectasia consists in improving the tone and vigour of the skin, removing palpable causes of obstruction, and applying local astringents. When torpid action is the chief cause, as happens in accidental phlebectasia of the face, daily friction with sulphur ointment is useful in exciting an improved nutritive vigour. Where large venules are present, as on the nose, they may be obliterated by a careful touch with potassa fusa, which forces the blood to seek a deeper channel. In phlebectasia of a nævous character a good method of treatment consists in painting the surface night and morning with solution of subacetate of lead. But the capillary venous hypertrophy of varicose or obstructed veins could only be benefited by the removal of the cause.

Erasmus Wilson.

PHLEBITIS (φλέψ, a vein).—Inflammation of a vein. *See* Phlegmasia Dolens; and Veins, Diseases of.

PHLEBOLITH (φλέψ, a vein; and λίθος, a stone). A concretion formed in a vein. *See* Veins, Diseases of.

PHLEBOTOMY (φλέψ, a vein; and τέμνω, I cut). A synonym for venesection. *See* Blood, Abstraction of.

PHLEGM (φλέγω, I burn; I am inflamed).—A popular name for sputum or expectoration. *See* EXPECTORATION; and SPUTUM, Examination of.

PHLEGMASIA DOLENS (*phlegmasia*, inflammation; and *dolens*, painful).—SYNON.: *Phlegmasia Alba Dolens*; Pop. White leg; Fr. *Phlegmasia Alba Dolens*; Ger. *Phlegmasia Dolens.*

This is a disease having very distinct characters and easily identified. It has, therefore, been long familiarly known both to the profession and the public. Except in lying-in women, it is uncommon, few medical men seeing well-marked or characteristic cases of it under any other circumstances; and it is for the most part as a disease of the puerperal state that it has been the subject of study and investigation.

ÆTIOLOGY.—Phlegmasia dolens affects both sexes, and no age is exempt from it. It may attack any part of the body, but one or other of the lower limbs is the ordinary seat of the disease. Occasionally it seizes one lower limb first and then the other, or may extend from the one to the other. The well-characterised disease, as it affects lying-in women, is an affection of one or other of the lower limbs, very rarely of both. The left leg is far more frequently affected in the puerperal state than the right; and the left leg is supposed to be more frequently affected than the other under whatever circumstances the disease occurs. In lying-in women the comparative frequency of this affection, and of several other morbid conditions on the left side, is believed to depend on the circumstance that the parts on that side of the pelvis are more frequently subjected to pressure and bruising than the parts on the other side. This probably arises from the comparative frequency of the right lateral obliquity of the uterus throwing the direction of the uterine power of labour across the mesial line to the left side of the pelvis. The disease affects multiparæ more than primiparæ. It is prone to recur in successive confinements.

From the variety of circumstances under which phlegmasia dolens may occur, it will be easily apprehended that it may arise in any period of pregnancy or of the puerperal state, but the usual time of its appearance in lying-in women is the second week after delivery. It rarely commences in the first week, less rarely in the third; seldom subsequently, in the puerperal state.

The special proneness of lying-in women to this disease probably depends on the hydræmia which prevails during pregnancy, and on the natural formation of thromboses in the uterine sinuses at its termination.

Besides the puerperal state, other conditions render the body liable to phlegmasia dolens. Among these are convalescence from fever—especially typhoid, dysentery, disease of the rectum, malignant disease of the uterus, uterine fibroids, arrestment of menses, and malignant and tubercular disease generally. The complaint has been frequently observed to affect the leg of the side corresponding with a previously commenced pleurisy. Occurring in connexion with any of these conditions, the disease may vary greatly in severity, from being scarcely recognisable to its utmost degree of intensity. But its liability to severity is not the same in all circumstances. For example, in connexion with malignant diseases of the womb it is often very slight and chronic.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances referable to phlegmasia dolens vary, especially in the presence or absence of thrombosis of the veins. Phlebitis and thrombosis are, however, generally found, with more or less associated inflammation of connective tissue and of the lymphatics. The intravenous blood-clots vary in extent, sometimes occurring as high as the vena cava inferior. They vary in appearance, being more or less decolorised, more or less softened, or even in parts diffluent. They may be adherent to the veins, partially organised, or separable from them. They may entirely block the veins, or may allow the passage of blood between them and the wall of the vein or through their substance as by a tunnel. In recent cases the clot adheres to the internal coat of the vein, which is blood-stained. The coats are thickened and inflamed, and the surrounding cellular tissue is also sometimes specially hardened. In cases complicated with pyæmia there may be found suppuration of the clots, and other appearances observed in that condition.

PATHOLOGY.—Various theories, which reflect the pathology of the times at which they appeared, have been held concerning the nature of phlegmasia dolens. The disease was ascribed to a metastasis of lochia by many pathologists, and by others to a metastasis of milk. These views had no basis of facts, or very little; they rested almost entirely on authority, and disappeared as pathology improved. The discovery of the lymphatics in the last century led to the first attempts of a truly scientific kind to solve the mystery of the nature of this affection, the suggestion being that it arose from their injury and obstruction. But considering how imperfect is our acquaintance even now with the origin and distribution of these vessels, with the circulation through them, and with the effects of their injury or obstruction, we must still seek for information. The next attempt to account for this disease was based on the important discovery of the thrombosis of the veins of the affected limb. This was erroneously assumed to be an invariable or essential condition of the disease, which was accordingly now regarded as phlebitic. But the occurrence of the lesions regarded as essential, the phlebitis and thrombosis, without the development of the characteristic appearances of the affected limb; and, on the other hand, the occurrence of the characteristic appearances without the simultaneous presence of the phlebitis and thrombosis, demonstrated the insufficiency of the phlebitic theory. The next theory to be mentioned is a sort of retrogression to humoral pathology. It alleged that a morbid condition of the blood, of undefined nature, is, along with phlebitis and thrombosis, necessary for the production of the disease. This theory is nearly as deficient in basis as the lochia or milk theory. The confirmatory experiments on the lower animals, by injecting lactic acid into the circulation, are in the highest degree insufficient; and this theory leaves unexplained important points, such as the seat of the affection. The last theory to be mentioned is now very widely held to be the true one. It is that the disease, as it is seen in lying in women, is essentially a parametritis, probably of septic origin—that is, an affection of the cellular tissue, commencing, indeed, in the close neighbourhood of the womb, but extending to remote parts, and, it may be, prevailing in them, while the original inflammatory affection of the womb and its immediate neighbourhood has diminished, or even disappeared. Parametric inflammation extends in a similar manner occasionally as far as the cellular tissue around the kidney. When it extends to a limb, it is believed to be the cause of the phlegmasia dolens, and to have the phlebitis and lymphangeitis with their secondary thromboses as its consequences. This theory is to a certain extent an old one in modern habiliments.

The great barrier to progress in our knowledge of the nature of phlegmasia dolens is the rarity of necropsic investigations, and the sometimes doubtful character of the evidence they afford. Very few unexceptionable *post-mortem* investigations have ever been made in this disease. Such a *post-mortem* inspection must be made in an early stage, and in a patient dying accidentally from some cause unconnected with the disease of the limb. Now, the disease is not only not fatal in an early stage, but it might be asserted that by itself it is not fatal at all—that death, apparently from it, occurs only in complicated cases—in such as run an extraordinary and rare course. In the meantime, then, no theory of the disease can perhaps be regarded as yet absolutely established.

Symptoms.—As a rule, phlegmasia dolens is preceded by a slight access of feverish phenomena, seldom by a distinct rigor. There is also sometimes an indefinite malaise for a day or two, before the pain in the limb is complained of. Another premonitory symptom is described, but it is certainly not always present—namely, pain and tenderness in the region of the womb, especially affecting that side of it corresponding to the limb about to be swollen.

The first definite announcement of the disease is generally acute pain along the course of the femoral vein, or in the calf, or above the ankle. In these situations the thrombosed vein can frequently be felt, but not invariably, for sometimes the tenderness, sometimes the swelling, prevents its being made out; and sometimes this thrombosis is absent, at least in parts where it can be felt through the skin. Soon the pain and tenderness extend over the whole affected parts, which may be the whole limb, and often a feeling as of aching in the bones is complained of. The pain is sometimes along the internal saphena vein, which may be traced by the finger till it dips to join the femoral.

Simultaneously with the complaint of pain, or within a day or two after it, swelling appears, which gradually spreads and increases in hardness. This swelling is not like ordinary œdematous or anasarcous swelling in the sensation it communicates to the hand of the physician, or in the history of its commencement and progress. When it commences, and again as it disappears, it may be, comparatively to its perfect state, soft, and it may pit on pressure; but when, a few days after its appearance, it is fully developed, it is very tense, and nearly as hard as a solid india-rubber ball, and does not pit on pressure. The swelling may appear at once all over the limb, but frequently it commences above and spreads downwards. Sometimes the inverse course is followed. It not rarely affects only the lower parts of a limb, very rarely the upper parts only. It does not affect the posterior more than the anterior surface of the limb. It rounds off the figure of the limb, but does not distend the skin or destroy the form so entirely as anasarca. If the skin is pricked the exudation is a coagulable lymph. Occasionally there is an erythematous blush over parts of the limb; but this is not common, and it may be confined to a narrow surface along the course of a subcutaneous vein or lymphatic.

In a characteristic and fully developed case, such as is frequently observed in the puerperal state, the limb presents a remarkable appearance. The swelling affects the labium and hip and the whole limb, only rarely rising higher. The form of the limb is partly retained, but its features are all rounded and nearly lost in the swelling. Its colour is white, and hence the name occasionally used of 'white leg,' and formerly of 'milk leg,' when it was supposed to be due to a metastasis of milk. But besides being pale, it is glossy; or its surface resembles that of polished marble, and the disease is sometimes called 'marble leg.' In the milder cases the swelling is less, and softer, and may be confined to a part of the limb.

The limb may be kept in an extended attitude, or it may be slightly flexed at the joints. Movement of it causes much suffering, and the power of voluntary motion is almost completely lost while the disease continues.

After the disease has lasted nine days or thereabouts, it generally makes no further progress, but recedes, the pain and swelling diminishing. The rate of this recession varies very much, being probably more or less directly in proportion to the restored permeability of the vessels. In a favourable case several weeks may elapse before the disease disappears, whilst in other cases the cure may be further or even indefinitely delayed. The temperature throughout rarely exceeds 102°, and is often less.

Complications.—The disease is sometimes complicated by other affections, or by aggravations of some of its conditions. Among such occurrences are inflammation and suppuration of the intrinsic joints of the pelvis, erysipelas, limited abscesses of periphlebitic origin, diffuse suppuration of cellular tissue, gangrene of any part or of a varying amount of the entire lower portions of the affected limb. These complications or aggravations cause much danger to life, and in this respect their influence varies according to circumstances. But there are other complications or aggravations which are more often fatal. They may be summed up in the terms 'embolism' and 'pyæmia,' and are the consequences, on the one hand, of detachment of a thrombus in the femoral, or in still larger veins, or, on the other hand, of a more slow breaking up of blood-clots into *débris*, more or less puriform, which enters the circulatory current, and induces a general toxæmia, septic or non-septic, according to the conditions under which the clots suppurate.

Sequelæ.—The most frequent sequela of phlegmasia dolens is persistent aching of the limb. This is liable to be increased by cold and damp weather, and by derangement of the general health, as well as by exercise. Another is a tendency to œdema of the ankles, more or less persistent. Sometimes the limb remains deficient in muscular power. Rarely, the limb is not only powerless but wasted. And in some very uncommon cases it is the subject of a great hypertrophy of the cellular tissue, simultaneous with muscular wasting; and this cellular hypertrophy may be complicated with more or less extensive and intractable ulceration. Such cases probably result from permanent destruction of large vascular areas.

Diagnosis.—The diagnosis of phlegmasia dolens requires no discussion. The disease can scarcely be confounded with any other if its history is taken into consideration: only it is necessary to remember that œdema with phlebitis or accompanying varicose veins may somewhat resemble it.

Treatment.—The treatment of phlegmasia dolens should be both constitutional and local. The former will vary according to the circumstances of the case, and the views of the practitioner. In the early stage ammonia in effervescence, with quinine, according to the amount of pyrexia present and the general condition of the patient, and in the later stage iron, are generally useful, with as much sedative as may be indicated by the severity of the pain. Local treatment is very important. The limb is to be kept at rest, either in an extended or flexed position, as may prove most comfortable, and supported on a pillow raised at the foot, with the pressure of the bedclothes kept off by a cradle. Sometimes hot fomentations are most comfortable to the patient's feelings, but more frequently wrapping the limb in cotton wool sprinkled with equal parts of belladonna and chloroform liniments, with oil-silk outside, gives the greater relief. When the swelling is subsiding gentle bandaging with a light flannel bandage is very serviceable. Leeches are sometimes applied along the course of an inflamed vein, but their utility is, to say the least, doubtful. If the phlegmasia be associated with septicæmia, its general treatment will of course vary with the general treatment of the toxæmia.

After the acute stage of the disease is past, the sequelæ have to be dealt with. Of these the most frequent are aches, swelling, œdema, and muscular weakness; and for these the most efficient, but by no means invariably successful, remedies are frictions, bandaging, and faradisation. After all active disease has disappeared, and after danger of dislodging thrombi has passed, the patient may resume the use of the leg. No exact statement can be made of the time at which the danger of embolism is passed. It may prove suddenly fatal as late as thirty-seven days after delivery.

Persistent local hardness and tenderness, probably periphlebitic, may be treated locally by gentle frictions with a mixture of mercurial and belladonna ointments, but in using frictions of all kinds the danger of dislodging a thrombus is not to be overlooked. Internally, small doses of potassium iodide with quinine or iron are useful adjuvants.

J. Matthews Duncan. Henry Gervis.

PHLEGMATIC TEMPERAMENT.

See Temperament.

PHLEGMON (φλέγω, I burn—as a medical term, glow, am inflamed).—Synon.: Fr. *Phlegmon*; Ger. *Entzündungsgeschwulst.* The term 'phlegmon' is almost disused now in English medical literature. It is still employed by the French. Abernethy defines phlegmon as the 'most violent kind of inflammation,' 'attended with heat, redness, throbbing, pain, and swelling,' such as 'generally takes place in a good constitution.' Older writers describe it as a 'tumour or apostume against nature, engendered of defluxion of blood, and of colour red and hard.'

Nélaton describes simple or circumscribed phlegmon and diffuse phlegmon. He says: 'Phlegmon is generally defined as inflammation of the cellular tissue; but surgeons have restricted the sense of the word, and only apply it to inflammation of the free cellular tissue, that is to say, of that which is placed immediately beneath the integuments or which surrounds the different organs.' The diffuse phlegmon of the French writers is the phlegmonous erysipelas of the English. *See* ERYSIPELAS.

MARCUS BECK.

PHLEGMONOUS.—A term applied to extremely acute inflammation of the cellular tissue, spreading widely, and accompanied by great exudation, with brawny hardness, intense redness, heat, and pain. If unrelieved by treatment, phlegmonous inflammation tends to terminate in gangrene. *See* ERYSIPELAS.

PHLYCTÆNA (φλύζειν, to be hot).—A small vesicle, containing an aqueous or serous fluid, and not exceeding in bulk the diameter of a pea, as in sudamina, miliaria, and herpes. The term is sometimes also used in connexion with ophthalmia. *See* EYE, AND ITS APPENDAGES, Diseases of.

PHLYCTIS (φλύζειν, to be hot).—A vesicle or blister, averaging in size the hemisphere of a hazel-nut or walnut, and filled with serous fluid. Phlyctis is the Greek synonym of bulla, and is applicable to the large vesicles or blisters familiar to us in pemphigus or pompholyx. *See* PEMPHIGUS.

PHLYZACIUM (φλύζειν, to be hot).—A hot or inflammatory pustule. The term 'phlyzacia' is applied to acute pustules with an inflamed base, such as those of ecthyma and small-pox.

PHOSPHATIC CALCULUS.—DESCRIPTION.—Phosphate of lime calculi are sometimes formed in the kidney, but much more frequently phosphatic stones are a secondary deposit on some pre-existing nucleus. They form dense or porous white layers, frequently showing the glistening crystals of the triple phosphate on the surface. Such masses are soluble in acids, insoluble in alkalis or water, friable, and fusible. They develop rapidly, and may reach an enormous size.

TREATMENT.—When of moderate dimensions, phosphatic calculi may be easily removed by lithotrity; but, as it is often difficult to ensure the removal of every minute particle, and as they are often accompanied by chronic cystitis and deficient expelling power of the bladder, recurrence is not infrequent, and the ultimate result unfavourable.

WILLIAM CADGE.

PHOSPHATURIA.—SYNON.: Phosphatic Diathesis.

ÆTIOLOGY.—Phosphoric acid in the urine is derived directly from the food, and also from oxidation of the waste albuminoid tissues of the body. The daily excretion by the kidneys amounts to about 50 grains, being greatest after the ingestion of food, and especially observed after indulgence in vegetable food.

CHARACTERS AND COMPOSITION.—Phosphoric acid in the urine is always found combined with potassium, sodium, calcium, magnesium, and ammonium. These salts, variously associated, are held in solution by the acidity of healthy urine, and this acidity is probably chiefly due to the acid phosphate of sodium. Where this acidity, from any cause, is greatly diminished or destroyed, then a deposit of the phosphates takes place; but this deposit by no means shows that any excess is present. Careful quantitative analysis, under strict precautions as to diet, can alone detect excess or deficiency; but, clinically, this is of less consequence in that no constant symptoms are produced by excess or deficiency, and the real importance to the practitioner lies only in the fact of feebly acid or alkaline urine leading to deposit of phosphates.

The two most common forms of phosphatic sediment are—(1) the *triple phosphate of ammonium and magnesium*; and (2) the *amorphous phosphate of lime*.

1. The *triple phosphate* crystallises in the form of transparent triangular prisms with bevelled ends. The deposit has a white appearance, but more frequently it shows as a slight flocculent cloud in the urine, resembling mucus, or as an iridescent pellicle on the surface. The urine is either faintly acid or alkaline; and boiling gives rise to an opaque cloud, which is instantly dissolved by a drop of nitric acid. It not infrequently co-exists with deposits of uric acid, urates, or oxalate of calcium; and also in dense urine with an excess of urea.

2. *Amorphous phosphate of lime* is only found as a deposit in alkaline urine. Microscopically it shows as pale granules or spheroids, sometimes resembling the dumb-bells of oxalate of calcium, sometimes the pale urates.

A third form of phosphatic deposit, the *stellar phosphate of lime*, is but rarely met with. It was first noticed by Dr. Hassall, who considered it to be a biphosphate; it crystallises in minute rods, which are gathered into sheaf-like bundles, or grouped in stars and fans. The clinical importance of this deposit is not well understood. Sir William Roberts has met with it in cases of diabetes, phthisis, and chronic rheumatism; and the writer has recently found it in a diabetic patient, and also in one convalescing after ovariotomy.

Symptoms.—Deposit of phosphates takes place in many diseases—diseases often of an opposite character, and having no pathological resemblance—for example, in acute cerebritis; towards the close of cases of pleurisy, pneumonia, and rheumatic fever; in certain periods of typhoid fever; and in acute mania. But it may be taken as proved that there is no morbid condition, characterised by definite and constantly occurring symptoms, and accompanied by the deposit of phosphates in the urine, which can be entitled to the designation of a 'diathesis.' Prout's description of phosphatic diathesis is merely that of ammoniacal urine. Golding Bird associated the deposit with symptoms of irritative dyspepsia, hypochondriasis, and temporary exhaustion of the nervous power; symptoms which are not unlike those said to be characteristic of the so-called oxalic acid diathesis. Remembering, however, that phosphatic deposit does not necessarily or frequently mean excess, but depends on diminished acidity or on alkalinity of the urine, it will be more profitable to notice this condition.

The urine becomes neutral or alkaline from the presence of either fixed alkali—potash and soda, or of the volatile alkali—ammonia. The continued or frequent presence of alkaline urine from *fixed alkali* denotes grave disorder, generally characterised by debility, anæmia, and nervous dyspepsia; it may and does occur in the course of many, even acute, diseases; it represents an altered condition of blood and nutrition; but it is not typical of any one malady or diathesis, nor, so far as analytical investigations have yet gone, is there any clear evidence of the truth of the theory that excess or deposit of phosphates and alkaline urine are the result of increased cerebral action or of brain-disease.

Urine rendered alkaline from *carbonate of ammonium* is always accompanied by deposit of both forms of the phosphates. The alkalinity is the result of decomposition of the urea; there is the peculiar ammoniacal odour, reaching sometimes to intense putrid fœtor. This decomposition is believed to be due to the presence and action of a specific micro-organism (*bacterium ureæ*) which acts as a ferment, and causes the urea to split up into carbonate of ammonium and water. This bacterium is probably introduced through the catheter, but the change may occur in those for whom a catheter has never been used, and in them it is supposed that the bacteria may find their way along the mucous membrane of the urethra, or through the medium of the circulation. Ammoniacal urine is always indicative of lowered vitality, either from age or disease, or spinal injury; it points to no altered condition of blood or constitution, but is the result of local disease. The phosphates which are so freely thrown down are the triple phosphate and the amorphous phosphate of lime; they are readily deposited on any pre-existing nucleus, whether it be a stone, a clot of blood, a roughened ulcerated portion of bladder, or any foreign body; but without this pre-existing nucleus it but rarely, if ever, happens that concretions form.

Treatment.—As there is no real phosphatic diathesis requiring special management, it follows that the treatment should consist in removing the cause of the alkalinity of the urine from *fixed* alkali. The two most common causes are dyspepsia and nervous and general debility. In those cases of chronic vomiting and irritable dyspepsia in which the urine loses and recovers its acidity several times daily, no special remedies addressed to the state of the urine can be of any avail. The mineral acids have long been relied on for restoring the natural acidity of alkaline urine; it seems certain, however, that they have no special or direct influence, but simply act beneficially by their indirect tonic effect on the system. Phosphoric and benzoic acids may slightly add to the acidity of the urine, and opium and belladonna in certain conditions of nervous irritability are known to have the same effect; but, speaking generally, the mineral, vegetable, and acid tonics are required in almost all cases, and with them the usual adjuncts, namely, good air and exercise; the cold sea-water bath; a well-selected generous diet, largely composed of animal food; and relief from anxiety or over-work.

For alkalinity and phosphatic deposit depending on *volatile* alkali, it must be remembered that in this state the urine is almost always secreted acid. The local disease which causes it must, if possible, be remedied: a stone should be removed; an atonic bladder emptied at stated intervals by the catheter, and washed out with antiseptics, if necessary. But the strength is always to be upheld by rest, good diet, and tonics.

William Cadge.

PHOSPHORUS, Poisoning by.—

Synon.: Fr. *Intoxication Phosphorée*; Ger. *Phosphorvergiftung*.

Phosphorus acts as a poison only when in the form of yellow, common, or soluble phosphorus; in the allotropic form of red or insoluble phosphorus it is generally thought to be inert, but this is doubtful. Poisoning by phosphorus may be (1) *acute* or (2) *chronic*.

Acute poisoning by phosphorus has recently become not uncommon in this country. On the Continent phosphorus, in the form of the tips of lucifer matches, is frequently used for suicidal purposes. In England phosphorus is most commonly taken in the form of 'rat paste' or 'phosphorus paste,' a vermin-destroyer composed of butter or other fats and phosphorus, coloured with Prussian blue. Chronic phosphorus-poisoning from the inhalation of phosphorus vapours has long been recognised.

ANATOMICAL CHARACTERS.—These are well-marked, and consist of extreme fatty degeneration of the liver, and frequently also of the gastric mucous membrane, kidneys, and cardiac muscular fibre. The liver is also greatly enlarged and white; and the organ frequently takes fire on the mere application of a spirit-lamp flame. On microscopical examination the organs affected are seen to be infiltrated with granular fatty matter, soluble in ether; the gastric tubuli are also filled with granular fat; and the striated muscular fibre has more or less completely lost its normal appearance, and been converted into a similar granular material.

SYMPTOMS.—1. *Acute Phosphorus Poisoning.*—When a phosphorus mixture is swallowed a disagreeable taste is perceived, which is occasionally followed by a burning sensation in the throat, gullet, and stomach, and speedy vomiting. But these signs of the local action of the poison may be either absent or altogether inconsiderable. At any rate, as a rule, these and the diarrhœa and colicky pains described by some writers, soon pass off, leaving the patient apparently nearly well; though a careful examination may reveal a small, feeble pulse, and when the patient is questioned, the existence of obscure wandering pains may be admitted. In the course of a few days—usually two, three, four, or five—the patient becomes listless, dull, and slightly jaundiced. There is much headache and sleeplessness, together with a general febrile condition, gradually passing into a 'typhoid' state; increasing jaundice; scanty, high-coloured, biliary urine; and a quick and very feeble pulse. Muttering delirium supervenes; there may be violent vomiting of yellow, biliary mucus; and the patient gradually sinks, and dies after a day or two, or perhaps three or more, of acute disease, and usually within a week of the administration of the poison. Death may occur, however, at any period, from one or two to eight or ten days, after a fatal dose of phosphorus, which may, perhaps, be taken as half a grain for an adult person.

Variations from the above course of symptoms may be noted. In one class of cases the symptoms betoken a predominance of nervous action. Thus there are cramps and pains in the limbs, great prostration and faintness, convulsions, and, finally, coma. In another class, occasionally observed, hæmorrhagic symptoms are prominent, such as bloody vomits and hæmorrhagic diarrhœa. As an early symptom a phosphorescent condition of the vomited matters, and, more rarely, of the urine, may be noted; and in nearly all cases a peculiar garlicky odour of the breath is perceptible. The phosphorescence or luminosity of the rejected matters is of course best seen in the dark. If the phosphorescent condition of the vomit exist, this permits of no mistake in the diagnosis; but if this condition be absent, the garlicky odour of the breath, and an enlarged condition of the liver, greatly aid in the diagnosis.

2. *Chronic Phosphorus Poisoning.*—Chronic phosphorus poisoning consists in poisoning by phosphorus vapours. Workers in common or yellow phosphorus exhibit a singular form of disease from which workers in red or amorphous phosphorus are exempt. This consists in caries of the teeth and necrosis of the lower jaw, conditions which appear to be set up by the direct access of the phosphorus vapours to the parts, since those persons only are affected who suffer from decayed teeth.

PROGNOSIS.—This is in all cases very unfavourable, and no general rules can be laid down as to the issue.

TREATMENT.—We know but little respecting this matter. Good results appear to be obtained from the administration of an emetic of sulphate of copper, followed by a magma of magnesia, and the use of mucilaginous drinks. The best results, however, have followed the administration of oil of turpentine, which some regard as a specific antidote to phosphorus. It may be given in doses of 10 to 20 minims, frequently repeated.

The chronic form of the disease, which has led to horrible suffering and deformity, may be prevented by the use of red instead of yellow phosphorus in the making of matches. The use of inhalers, and the impregnation of the atmosphere with the vapour of oil of turpentine, are also preventive measures of great service.

THOMAS STEVENSON.

PHOTOPHOBIA (φῶς, light; and φόβος, fear).—Dread or intolerance of light; a symptom, more or less constant, of most forms of inflammation of the eye. In its most pronounced character it occurs in what is called 'strumous ophthalmia,' or phlyctenular keratitis. It is, however, present in all forms of inflammation and ulceration of the cornea, in iritis and cyclitis, and more rarely in choroiditis and retinitis. It is also often met with in many diseases of the nervous system, in cerebral irritation, meningitis, cerebritis, &c., and in many pyrexial states. As an ophthalmic symptom, it may occur in eyes perfectly blind, and is probably due to the irritation of the ciliary nerves by light. *See* EYE, AND ITS APPENDAGES, Diseases of.

PHOTOPSIA (φῶς, light; and ὄψις, vision).—The subjective sensation of flashes of light, or luminous spectra, due to an abnormal state of some part of the special nervous apparatus of the visual sense. It is a modification of the special sensibility, and, like photophobia, may occur in blind eyes. *See* VISION, Disorders of.

PHRENIC NERVE, Diseases of.—SYNON.: Fr. *Maladies du Nerf Phrénique*; Ger. *Krankheiten des Nerven Phrenicus.*—The phrenic nerve, arising from the third and fourth cervical roots, is the motor nerve for the diaphragm. Morbid states of the nerve, its roots and centre, are manifested by inaction or over-action of the diaphragm, its paralysis and spasm.

1. **Paralysis.**—ÆTIOLOGY.—Paralysis of the phrenic nerve, that is, of the diaphragm, is rarely due to disease of the nerve-trunk. Its common cause is disease at the origin of the phrenic—the anterior grey matter of the spinal cord at the level of the third and fourth cervical nerves. It is often met with as part of acute or chronic spinal muscular atrophy. But the nerve itself has sometimes suffered, with others, in multiple neuritis, such as is produced by lead. In a few cases the paralysis has been apparently due to cold, supposed to have caused a rheumatic neuritis. Rarely, also, the nerve has lost its function in consequence of compression in the neck by deep-seated morbid growths.

ANATOMICAL CHARACTERS.—Degeneration of the trunk of the nerve, wasting of the nerve-fibres, and increase of connective tissue have been found in cases of disease of the spinal cord; and in multiple neuritis acute degenerative changes in the nerve-fibres. Of the anatomical changes due to other causes nothing is positively known.

SYMPTOMS.—The evidence of paralysis of the phrenic is inaction of the diaphragm. When one nerve only is diseased there is imperfect action on one side, and this may be conspicuous or indistinct. When both nerves are affected, as is commonly the case in central disease, there is an entire absence of the normal protrusion of the abdominal wall during inspiration; there may even be a recession of the upper part of the abdomen, from the movement of the lower ribs, and a bulging during expiration in the same situation. In ordinary breathing the respiratory actions are not quickened by paralysis of the diaphragm, but if any exertions are made the respirations become more frequent, and the extraordinary muscles of respiration are thrown into action. All spasmodic respiratory actions—sneezing, coughing—are performed with less energy. Little inconvenience is experienced unless bronchitis comes on, and then the lessened respiratory power may place the patient in a condition of danger, which is especially great, if, as is often the case, the cause of the palsy has also weakened the intercostal muscles.

The phrenic nerve is accessible to direct stimulation in the root of the neck, and when it is paralysed, its irritability is usually lost, and the diaphragm can no longer be made to contract. In rare cases, however, the nerve-trunk retains its irritability.

DIAGNOSIS.—The diagnosis of paralysis of the diaphragm is not always so simple a matter as might be supposed. Its action should be looked for not only in deep breathing, but in ordinary respiration. Many persons, if told to 'take a deep breath,' do not put the diaphragm into action at all. In forced breathing the chief extra action takes place in the upper part of the chest, to which most of the muscles of extraordinary respiration are attached. It is probable that the centres for normal and extraordinary breathing are functionally not identical, and that the diaphragm is chiefly represented in the former, so that it does not necessarily act in deep breathing. There is a mechanical reason for this. In the extreme action of the intercostal muscles the thorax is widened to such a degree that the diaphragm becomes less curved by the movement outwards and elevation of its points of attachment, so that its contraction does not effect much additional enlargement of the capacity of the thorax. Hence, in many persons, without any paralysis of the diaphragm, if a deep inspiration is taken, the epigastrium does not advance; it may even recede, in consequence of this movement of the lower ribs. This is especially the case in women, in whom breathing is always less diaphragmatic than it is in men. In them, too, conscious attention to the act of breathing is apt to arrest the action of the diaphragm. The tendency of voluntary breathing is to be costal rather than diaphragmatic, no doubt because the centre for extraordinary breathing, which is chiefly voluntary, is brought partially into action. In a woman under the writer's care, paralysis of the diaphragm was suspected, and during two separate and prolonged examinations not the slightest action could be observed. On a third examination, however, more normal conditions were obtained, and the action of the diaphragm was natural. This is the condition which has been termed 'hysterical paralysis of the diaphragm.'

It must not be forgotten that immobility of the diaphragm may result from other causes than paralysis of the phrenic nerve. In diaphragmatic pleurisy, for instance, its movement is lessened by a reflex inhibitory effect of the pain. In emphysema of the lungs, in which the thorax is greatly widened, the contraction of the diaphragm produces less effect than in health.

On the other hand, when the diaphragm is really paralysed, a doubt may arise as to whether it moves or not. This is due to the circumstance that the movement of the lower ribs may drag forward the abdominal parietes close to them, and so the protrusion due to descent of the diaphragm may be simulated. This is especially the case when the abdomen is collapsed, so that when the patient is recumbent its level is considerably below that of the ensiform cartilage. This movement may be distinguished from that due to the descent of the diaphragm by a little care; the movement is confined to the part near the thorax, and there is not the general movement of the abdominal viscera and parietes which results from the contraction of the diaphragm.

Prognosis.—The prognosis of paralysis of the diaphragm is favourable in the rare instances which are due to exposure to cold, and in multiple neuritis, if the patient lives. This nerve, however, is seldom paralysed, except in severe cases of polyneuritis, in which the prognosis is grave; the prospect of recovery is rather less favourable in lead poisoning. It is also unfavourable when the diaphragm suffers as part of progressive spinal muscular atrophy. When there is acute spinal muscular atrophy (anterior polio-myelitis), the prognosis will depend on the indication afforded by other symptoms of the position of the chief disease, as to whether the region from which the phrenic nerve arises is gravely or slightly damaged. When the paralysis arises from compression, the prognosis depends on the nature and cause of the pressure.

Treatment.—The treatment of the paralysis, which is part of spinal amyatrophy, whatever the nature of the morbid process, is that of the central disease. In all cases causal indications must be met. When it is due to cold, sinapisms should be applied over the part of the phrenic nerve which seems, from any attendant pain, to be chiefly affected. If the nerve has not lost its irritability, it may be faradised systematically. The two points to which the rheophores should be applied are (1) in the neck, just above the scaleni, and (2) near the diaphragm. A strong current has to be used.

2. **Spasm.**—Spasm of the diaphragm occurs chiefly in the form of hiccough, and as part of the respiratory spasm in hydrophobia, and does not need further description. *See* Diaphragm, Diseases of; Hiccough; and Hydrophobia. W. R. Gowers.

PHRENITIS (*φρήν*, the mind).—An obsolete term, formerly associated with all forms of acute inflammation of the brain or its meninges, but especially the latter.

PHTHIRIASIS (*φθείρ*, a louse).—Synon.: Pediculosis; Fr. *Phthiriase*; Ger. *Läusesucht.*—This disease of the skin bears the same relation to the pediculus that scabies does to the acarus scabiei.

Description.—There are three varieties of phthiriasis, corresponding to the three species of pediculi that infest the human body. *See* Pediculus.

1. **Phthiriasis capitis.**—Phthiriasis affecting the head is met with chiefly in children. The eruption is an artificial pustular eczema, due to the irritation of the insect, and the scratching of the sufferer. In consequence of the sores on the scalp, the superficial lymphatic glands at the back of the neck often become enlarged.

2. **Phthiriasis corporis.**—Phthiriasis of the body is confined to the parts covered by the clothes, and is most developed on the back. It is especially met with in the old and feeble. The lesions of the skin consist of small excoriations and scattered papules, the tops of which are seen to be torn and bleeding from the scratching of the sufferer. These bleeding papules give to the eruption its characteristic appearance. In chronic cases the general colour of the skin is darkened from an excessive deposit of pigment.

3. **Phthiriasis pubis.**—This variety of phthiriasis differs little from that of the body, except that it is limited to the regions infested by the crab-louse.

All three varieties of the disease are attended with intolerable itching.

Treatment.—Phthiriasis is easily cured by means of an ointment containing one part of the oil of stavesacre and seven parts of lard; or the white precipitate ointment may be safely used for phthiriasis capitis or phthiriasis pubis. Robert Liveing.

PHTHIRIUM INGUINALE (*φθείρ*, a louse).—One of the synonyms of *pediculus pubis*, the crab-louse. *See* Pediculus.

PHTHISIS (*φθίνομαι*, I waste).—Synon.: Consumption; Fr. *Phthisie*; Ger. *Lungenschwindsucht.*

Definition.—Phthisis, or consumption, is the term used to designate a disease characterised by progressive wasting of the body; persistent cough, with expectoration of opaque matter and sometimes of blood; loss of colour and strength; shortness of breath; hectic fever, night sweats, and diarrhœa; these symptoms being associated with certain well-marked pathological changes in the lungs, namely, the formation of consolidations in a granular or diffuse form, associated with the presence and irritating influence of an organism, the *bacillus tuberculosis*; these undergoing either caseation or disintegration, leaving behind excavations in the lung-tissue, or, becoming indurated and shrinking, causing contraction of the affected organ.

Ætiology and Pathology.—Owing to the discovery by Koch of a specific organism, the bacillus tuberculosis, in the lesions of tubercle, phthisis must be counted among the diseases of germ origin. Whilst without the bacillus the disease cannot exist, a predisposing cause, to fit the individual's organs for the reception of the organism, appears as necessary for the production of phthisis as the bacillus itself. Such predisposing causes, to be alluded to presently, are family predisposition, impure atmospheres, unhealthy occupations, and the like, which weaken the system of the individual and lower his power of resistance. The tubercle bacillus is a rod-like organism, varying in length from $\frac{1}{8000}$ to $\frac{1}{12000}$ inch, and having a breadth one-fifth of its length, or from a quarter to half the diameter of a red blood-corpuscle. It has an external membrane capable of absorbing fuchsin but not methylene blue, hence the differences in the apparent thickness of the specimens stained by various methods. The tubercle bacillus multiplies by spores, each rod dividing into several smaller rods, and each division containing spores, the rate of multiplication being very rapid. The tubercle bacillus has been detected in the sputum of consumptives not only with cavities, but with tubercular consolidations, though in this case in smaller numbers; and it has been sought for in vain in the sputum of other lung-diseases. It has been seen in the blood of phthisical hæmoptysis (by Perez and the writer), in the fæces from tubercular intestines (Gaffky and Taylor), in the urine from scrofulous kidneys (strumous pyelitis), and in the air exhaled by consumptives (by Ransome and the writer). Tubercle bacilli have been found in the various lesions of pulmonary tuberculosis, of tubercular meningitis, of tuberculous ulcer of the tongue; in tuberculous kidney, spleen, suprarenal capsule and testicle; in scrofulous glands of the neck, axilla, and groin; and, in larger abundance, in bronchial and mesenteric glands; in the various strumous lesions of the bones and joints; and finally in sections of the skin in lupus. Tubercle bacilli abound in *Perlsucht* or bovine tuberculosis, in the tubercle of the horse, and in all tubercular lesions of animals inoculated with tubercle. The milk, too, of tuberculous cows has been shown to contain them, though only where the udders have been the seat of the disease. The part played by the bacillus in the causation of tuberculosis is well illustrated by the changes in the eye of a rabbit after inoculation of the anterior chamber with tubercle, as practised by Baumgarten. The first change is the formation of a scar, and the encapsulation by granulation-tissue of any foreign body that has entered. After the second day the enclosed bacilli increase in numbers, penetrate the granulation-tissue, and press in masses into the iris and sclerotic. On the sixth day there are found, in connexion with tubercle bacilli in the cornea and iris, some few cells of an epithelioid kind, giant-cells, and lymphoid cells characteristic of miliary tubercle. On the tenth and eleventh days the changes become macroscopic, and indicate breaking down and disorganisation of the whole tissue.

Veragut's experiments on rabbits made to inhale a spray containing tubercle bacilli show that after fourteen days' inhalation bacilli were detected in the alveolar cells, and that their entry had been accompanied by hyperæmia of the capillaries, and exudation of lymphoid cells into the infected alveoli.

The tubercle bacillus being thus shown to be a cause of tuberculosis, we will now consider what agencies predispose the human body to its successful invasion; and these may be divided into (1) *general predisposing causes*, which act by weakening the constitution and rendering it more liable to bacillar attack; and (2) *local predisposing causes*, which act by interfering with the free play of the thorax and lungs during inspiration, such as tight lacing, dry pleurisy and pleuritic adhesions, old pulmonary lesions, &c.

The most important predisposing causes of phthisis will now be individually discussed.

1. **Family predisposition.**—The influence of heredity as a cause of phthisis cannot be doubted; it has been abundantly proved by observation and experiment on both man and the lower animals. The term *family* predisposition is substituted for *hereditary* predisposition, because the latter, from its limitation to direct descent, necessitates the omission of the evidence of disease in collateral relatives. The statistics of the first *Report of The Brompton Hospital for Consumption and Diseases of the Chest* on this point, as compiled by Sir Richard Quain, who contrasted them at the same time with the statistics of insanity, and those also of Drs. Cotton and Fuller, show that among the lower classes hereditary predisposition (that is, where one or both parents were affected) was traced in 25 per cent. The writer's researches among 1,000 cases of the upper classes show 12 per cent. of direct hereditary predisposition, and 48 per cent. of family predisposition.

Family predisposition is more common among women than men, in the proportion of 57 to 43, which may be accounted for by the more sedentary and less invigorating life of the former. The transmission of phthisis is more common through the mother than through the father; but where one parent alone is affected, fathers transmit more readily to sons, and mothers to daughters, than the converse. Dr. James Pollock lays stress on the influence of hereditary predisposition in the acute forms of phthisis, and states that out of 179 acute cases only 34 could positively declare absence of family taint. Dr. Reginald Thompson shows that double heredity, that is, both parents being affected with consumption, exercises a more unfavourable influence than single heredity, and specially among males, the result being a larger proportion of acute and fatal cases, and a greater tendency to hæmorrhage. Comparing the relative influence of father and mother on the children, the maternal heredity is worse for both sexes, as the paternal inheritance generally includes some of the resisting power to the disease which characterises the stronger sex. The principal effect, however, of family predisposition is to be seen, *not* in any peculiarity of symptoms, but by the influence it exercises over the age of attack. The writer's researches show clearly that this is much earlier in patients so predisposed than in others; and in females this influence is greater than in males.

2. **Acute febrile diseases.**—Continued fevers, measles, and scarlet fever act partly by exhausting the system, and partly by bequeathing to the individual the legacy of vulnerable areas either in the lungs or glands, which prove the centres of subsequent tuberculisation.

3. **Syphilis.**—Syphilis, by its debilitating influence, predisposes to phthisis; but it also appears to act as a cause capable of developing two forms of the disease, namely (1) limited consolidation with no great tendency to excavation; and (2) a form of laryngeal phthisis, characterised by ulcers in the larynx and in the pharynx, difficult to heal except by specific treatment. This last has been called syphilitic disease of the larynx; but, as in the writer's experience it is always associated with tubercle in the lungs, he thinks that the phthisis is caused by the syphilis, and should be classed accordingly.

4. **Debilitating conditions.**—Miscarriages, unfavourable confinements, over-lactation, insufficient food, and alcoholism are recognised causes. The cessation of habitual discharges is not so clearly to be admitted as a cause; but the stoppage of the discharge of a fistula in ano, or the drying up of an old ulcer, is frequently followed by the development of tuberculosis in the lungs.

5. **Mental depression.**—This is often mixed up with other causes, but occasionally acts alone.

6. **Bad ventilation.**—Dr. Guy has shown that consumption is more rife among persons of indoor occupations than among those employed out of doors. This is true not only of the working classes, as printers, compositors, and tailors, but also of the tradesmen who live in hot gas-lit shops, and often sleep in miserably ventilated bedrooms. These are not ill-fed, but are nevertheless twice as liable to consumption as the upper classes. Hawkers and other outdoor trades, though much exposed to catarrh, are shown to be less liable to consumption than indoor workers. Of nearly 6,000 cases of phthisis admitted into the Brompton Hospital during ten years, two-thirds followed indoor occupations. Amongst them milliners, sempstresses, and tailors, who work and possibly live in close rooms, to which they are almost entirely confined, furnish the largest quota.

7. **Climatic influences.**—A moist atmosphere is more favourable to the development of consumption than a dry one; and, while we recognise that the combination of cold and moisture is one of the principal predisposing causes of the disease in Great Britain, the testimony of Dr. Guilbert indicates that a combination of heat and moisture, as exemplified in the littoral of Peru, in the West Indies, and in other hot and moist localities, produces an acute form of consumption, largely prevalent in those districts, which attacks the abdominal organs in addition to the lungs.

8. **Dampness of soil.**—The researches of Sir George Buchanan have demonstrated that the death-rates from phthisis in the districts of Surrey, Kent, and Sussex, depend to a great extent on the geological formation of the soil; for while in the light and sandy strata deaths from phthisis are rare, in the heavy impermeable ones, in which clay predominates, the mortality from this cause is high. The conclusion that wetness of soil is a cause of phthisis to those living on it has been confirmed by the Registrar-General of Scotland, and by Dr. Bowditch of the United States; the latter testifying that this law holds good, not only as regards villages and towns, but even as regards individual houses—the houses on clay becoming the foci of consumption, while others but slightly removed from them, but on a dry soil, escape.

9. **Inoculation.**—From the time of Laennec until the present, experiments have been carried on by numerous observers to ascertain whether tubercle is, or is not, inoculable; and the results of the experiments of Villemin, Simon, Marcet, Sir Andrew Clark, and Lebert proved that in guinea-pigs and rabbits tubercle could be produced artificially by the insertion underneath the skin of tubercular material. In 1874 Demet and Zablonus of Syra inoculated a man of fifty-five suffering from gangrene with tuberculosis, by inserting phthisical sputum under the skin of the right leg. Three weeks after the inoculation signs of commencing induration of the right apex were detected, both lungs being previously healthy, and seventeen days later the patient died of gangrene. After death the right lung showed freshly formed tubercle of both apices, thus proving the possibility of inoculating man with tubercle. The experiments of Burdon Sanderson, Wilson Fox, Cohnheim, Fraenkel, and Schottelius, who apparently produced tuberculosis in animals by injecting non-tuberculous material, threw doubts on the specificity of tubercle; but the test observations made by Cohnheim, Fraenkel, and Dawson Williams showed the human experiments to have been made in atmospheres tainted with the

tubercular virus, and that when these sources of error were removed the inoculation of non-tuberculous material gave negative results. Koch inoculated with a fluid obtained from his culture-experiments on tubercle no less than two hundred rabbits and guinea-pigs, the points of insertion being the skin, the peritoneal cavity, and the anterior chamber of the eye. With one exception, all these animals acquired tuberculosis of the lungs, liver, spleen, and other organs; and the tubercles had the characteristic structure, with giant-cells, and contained tubercle bacilli.

Koch found that the results of the inoculation depended largely on the strength of the bacillar solution. If the fluid was weak, miliary tuberculosis resulted; if it was strong, then tubercular infiltration and rapid caseation occurred. Moreover, of all the methods of inoculation, that into the veins was the most effectual; but other channels, including the anterior chamber of the eye, were found to answer. Experiments on dogs, rats, goats, and hens were successful, though not so successful as those on rabbits and guinea-pigs.

Chauveau found that heifers might be infected by mixing tuberculous matter from their own species with their food. Bollinger confirmed this experiment, but found that carnivora could be fed with impunity on fresh tuberculous matter taken from animals of the bovine species.

10. **Infection.**—The idea of infection being a cause of phthisis largely prevails in the South of Europe, and was revived in England by the late Dr. William Budd. The evidence of the Brompton and Victoria Park Hospitals negatives the idea of a contagion such as is present in small-pox or scarlet fever; for it has been demonstrated that the percentage of acquired phthisis occurring among the resident staff of these institutions is less than that of most general hospitals; and even when any defective ventilation or overcrowding has given rise to evil consequences, these have shown themselves in outbreaks of erysipelas and sore-throat, and not in tuberculosis. Nevertheless phthisis has been shown to have been communicated by inhalation on some very rare occasions under the following circumstances: (1) close intimacy with a consumptive patient in advanced disease, such as sleeping in the same bed or room; (2) activity of the tubercular process, either in the way of tuberculosis or excavation; (3) neglect of proper ventilation of the room occupied.

That phthisis may be communicated from husband to wife is strongly maintained by Virchow and many English physicians, and Dr. Hermann Weber has indicated by some striking cases the danger of pregnancy to the wife of a consumptive.

Infection is possible through the milk of a tuberculous cow, provided the udder be affected; and the consumption of the meat of tuberculous animals has been proved to give rise to phthisis. Dogs have also become tuberculous from licking up the sputum of phthisical patients; and inoculation of a servant girl in the hand from the fragments of a spittoon containing the same material has been reported.

11. **Local predisposing causes.**—The local predisposing causes of phthisis are those which injuriously affect the bronchi and air-passages, causing large epithelial proliferation and various inflammatory lesions, which form a favourable nidus for the bacillus, followed by thickening and induration of the alveolar walls, and in time end in caseation or fibrosis.

Bronchitis, or bronchial catarrh, after existing in a person for many years, may extend more deeply into the alveoli and pass into a so-called catarrhal pneumonia, and produce consolidation. Bronchitis was the origin in nearly 12 per cent. of the writer's 1,000 cases; and a very large number of the poorer classes trace their disease to neglected catarrh.

Pneumonia is a fruitful source of phthisis, though some forms are more capable of giving rise to it than others. In croupous pneumonia, where the exudation is fibrinous, and has but little epithelium or leucocytes intermingled with it, absorption generally follows, if the patient's constitution be in a fair state, and few of these cases go into phthisis; but where leucocytes and epithelial products largely predominate, absorption is slow, the pneumonia becomes chronic, and thickening of the alveolar wall and degeneration of the epithelium take place, accompanied sooner or later by the signs and symptoms of consumption. A third form of pneumonia which may originate consumption is pleuro-pneumonia, or interstitial pneumonia where the inflammation extends to the pleura, and the interlobular connective tissue is largely increased. Many instances, too, of phthisis have arisen in empyema, through absorption of the purulent fluid, the channels being the elaborate network of lymphatics which Dr. Klein and others have shown the pulmonary pleura to contain.

12. **Trades and occupations giving rise to a dusty or gritty atmosphere.**—The constant inhalation of particles of flint, iron, coal, hard clay, and even of cotton, flax, and straw, as is the case in certain occupations, such as stonemasons, fork- and needle-grinders, colliers, potters, cotton-carders, chaff-cutters, and others, has been shown by the late Dr. Greenhow to induce phthisis. The various irritating particles have been detected microscopically and chemically in the lungs, where they appear to cause great irritation, followed by thickening of the bronchi and subsequent induration of the lung-tissue, with increase of pigment. Intermingled in the consolidations

are found caseous masses and also extensive cavities, in both of which tubercle bacilli have been detected in large numbers, proving the identity of the disease with phthisis.

18. **Injuries to the lungs.** — Injuries to the lungs through wounds are somewhat rare predisposing causes of phthisis. They chiefly act by inducing the inflammatory processes, chronic suppuration and abscess, or induration with shrinking of the lung-tissue.

Anatomical Characters. — The morbid anatomy of phthisis, acute and chronic, presents considerable difficulties, partly from the variety of pathological products, and partly from the complete disorganisation of the normal structure, and even of the invading growths. It often happens that several processes have been going on in the lungs simultaneously, each of which brings about the work of destruction by a different method and at a different rate, some by obstruction through consolidation, others by caseation and excavation. On the predominance of one or other of these depends the future of the lungs, for we sometimes see one pathological element which has invaded a large portion of these organs superseded and gradually destroyed by another of more recent date, but endowed with a higher degree of vitality.

In advanced cases the lungs are for the most part devoid of vesicular tissue, and consolidated by various kinds of growths and exudations. They are also occupied by cavities, varying in size from a microscopic point to one of so large a capacity that the lung is converted into a mere bag of thickened pleura. The cavities are of every conceivable form and shape, sometimes oval and well-defined, lined with a secreting membrane, at other times irregular, sinuous, anfractuous, and presenting on section either an uneven surface, from which portions of the wall stand out like the columnæ carneæ of the heart, or a very rugged surface, on which ulceration and suppuration appear to have done their worst; but, whatever be their shape or their size, they indicate the destructive character of the retrograde processes by which the disease called pulmonary consumption is characterised.

The consolidations vary, but all partake more or less of a tubercular character. In some cases the lungs are studded with miliary tubercles from apex to base, the intervening tissue being free from excavation, and either engorged or consolidated with red hepatisation, or sometimes apparently healthy; in other cases no trace of miliary tubercle can be found, but the lungs are consolidated throughout by caseous pneumonia, containing cavities of various sizes. Sometimes there are aggregations of the different forms of tubercles—white, grey, and yellow in the same lung, while the opposite lung may be entirely clear; sometimes a lung may be shrunk to the size of a closed hand, its pleura thickened, its lobules invaded with white fibrous bands, its tissue converted into an iron-grey structure by fibroid growth. All these, and many other diverse morbid appearances, are found in the lungs of persons dying of phthisis, and we must classify and distinguish them, first describing their naked-eye appearances; secondly, their histological phenomena; thirdly, we must consider the changes which take place in other organs of the body; and, fourthly, we must indicate the pathological relation these all bear to one another and to the disease generally.

The principal pathological elements and changes in the lungs are: (1) Grey and dark granulations, or miliary tubercles; (2) white granulations; (3) yellow granulations, or yellow tubercle; (4) caseous masses, or yellow infiltration; (5) grey infiltration, or catarrhal pneumonia; (6) red hepatisation; (7) fibrosis; (8) cretaceous masses; (9) fibrinous nodules (blood-residues); and (10) vesicular emphysema.

1. **Grey granulations, or miliary tubercles.**—These vary in size from a millet-seed (hence the name miliary) to a hemp-seed, scattered throughout the lung-tissue. When first formed they are greyish-white, more or less transparent, and will yield to firm pressure; but after a while they either undergo caseation, being converted into the yellow variety, or, losing moisture, become drier and harder, attaining the consistency of cartilage. At the same time pigment is absorbed by them; the colour passes from a light to a dark grey, or even to black; the granulations simultaneously drying up and becoming obsolescent. These hard grey granulations are not uncommonly found after death in old persons, and are an evidence of tubercle having appeared at some period of their lives, and of its having afterwards become obsolescent.

More commonly these grey granulations increase in number, and form aggregations or clusters, much resembling bunches of berries, standing out in bold relief against the healthy or congested lung-tissue; their principal locality being the upper lobes of the lungs, and especially the posterior portions. In some instances this aggregation spreads quickly and extensively, and the whole lungs become so densely packed with miliary tubercle that it is difficult to find any portion of the respiratory surface free. This rapid formation of tubercle is sometimes sufficient to cause death by asphyxia, but more commonly the intense crowding of the pathological products gives rise to their destruction. Caseation commences in the centre of the groups, and cavities subsequently form. The discrete form of grey tubercle is generally found in acute miliary tuberculosis, and does not vary much in size with the different organs or structures attacked by tubercle.

2. **White granulations.**—These formations are more opaque and softer than the grey, and differ from the latter, as we shall hereafter see, in the arrangement of the histological elements, there being more epithelium and less reticular growth in them than in the grey variety.

3. **Yellow granulations.** — Yellow granulations or yellow tubercles exist in varying sizes, from a pin's head to a pea. They are opaque, soft, granular, amorphous, easily separated from the adjoining tissue, and sometimes surrounded by a circle of pearly transparent material. The late Dr. Wilson Fox described a form of yellow tubercle in children dying of acute tuberculosis, which is with difficulty separated from the parenchyma of the lungs; but in adults it is generally easily removed, the grey granulations with which it is so often associated remaining behind.

Yellow granulation is by far the commonest form of tubercle, and its frequent occurrence in phthisis led Laennec not unnaturally to the conclusion that it was a *sui generis* production, essential to the disease. It seldom occurs alone, but is ordinarily associated with the grey and white granulations, sometimes forming with them racemose groups in various parts of the lung, chiefly in the upper lobes. At other times it is the centre of an affected portion, groups of grey granulations apparently radiating from it, thus naturally leading to the supposition that a species of local infection has been set up by the yellow or caseous mass. These groups, as they increase, exercise great pressure on the various granulations composing them and on the intervening lung-tissue, depriving them of nutrition, and thus causing death of the part by caseation. The decayed portion is gradually removed either by absorption by the lymphatics, or by expectoration; in the latter case cavities result. Careful study of one of these tubercular groups will demonstrate that the yellow tubercle is but a later condition of the grey, in which caseation has commenced; and that the cavities, large or small, in its neighbourhood are the result of the softening and removal of the yellow tubercle, and whatever lung-tissue happens to be intermingled with it. The caseation of miliary tubercle has generally been attributed to retrograde changes arising from deficient blood-supply, no blood-vessels having been discovered in miliary tubercle; but Mr. Watson Cheyne holds that it is caused by a chemical change in the epithelioid elements of which tubercle is composed, induced by the action of the tubercle bacilli which are found to swarm in fresh caseating centres.

4. **Caseous masses.**—Caseous masses and yellow infiltration are identical in constitution with the yellow tubercle, but differ in size and form, arising sometimes from the aggregation of a number of yellow granulations, but oftener from the rapid caseation of inflammatory exudations, the caseation being due in this case partly to obliteration of nutrient vessels from pressure, but chiefly to the action of the tubercle bacillus. Whole lobes become affected with what is then called yellow infiltration.

5. **Grey infiltration: catarrhal pneumonia.**—This change is identical with the 'gelatinous infiltration' of Laennec. The pressure on the walls of the alveoli caused by the epithelial aggregations, as well as by the inflammatory exudation, gives rise to obliteration of the vessels and consequent caseation, and in this way large tracts of grey pneumonia are converted into yellow masses, and subsequently become excavations. It is probable that here the caseous conversion is also due to bacillary action, but in the caseous masses themselves Dr. Percy Kidd and others have found but few, if any, tubercle bacilli. When liquefaction of the mass occurs, ending in excavation, the bacilli swarm, whence Koch infers that spores must have existed in the dry caseous tracts. Cavities formed in this way are large, and present ragged and granular interiors.

6. **Red hepatisation.**—The result of ordinary croupous pneumonia is often found associated with one of the above forms of tubercle, but more commonly occurring in the lower lobes than in the upper. *See* Lungs, Inflammation of.

7. **Fibrosis.**—Fibrosis is largely present in phthisis, but preponderates (1) in cases originating in pleuro-pneumonia, pleurisy or pneumonia; and (2) in cases of long duration. Fibrosis is the great element of the contractile process, whereby the lungs are reduced considerably in size, cavities of large capacity are cicatrised, and caseous masses encapsulated; and sometimes grey tubercle is converted into this tissue.

A lung invaded by fibrosis is reduced in size, and presents on section a dense, tough. and very hard structure, resembling cartilage in its resistance to the knife. All traces of the alveoli have disappeared, and nothing remains but a dark grey or black fibrous material, into which run long bands of whitish fibrous tissue, harder than the darker portions. The pleura is generally thickened, and the septa apparently arise from it and from the connective tissue at the root of the lung, which is also largely increased. Fibrosis is found in limited portions of the lung, in nearly all kinds of phthisis, forming the scars of contracted cavities, or tending to isolate caseous masses and tubercular aggregations. When miliary tubercle becomes converted into fibroid growth, the resulting tissue is of short duration, owing to its deficiency of blood and lymph vessels; caseation consequently takes place at various points, and it thus perishes. Tubercle bacilli are never found in fibroid tissue, which must be regarded as a secondary product, not a primary one.

8. **Cretaceous masses.**—Cretaceous or chalky material is found in chronic cases, lying in small masses in various parts of the lungs, chiefly at the apices, in the neighbourhood of old cavities or caseous tracts, and generally encapsulated by fibroid tissue. Cretaceous material is most common in tubercular bronchial glands, which by their enlargement and pressure on the bronchial tubes cause ulceration of these last, and discharge their contents through the openings. Much of the calcareous matter which consumptives expectorate is derived from this source.

9. **Fibrinous nodules.**—These bodies have been noticed by Dr. Reginald Thompson in cases where large hæmoptysis has occurred. They vary greatly in size; consist of inhaled blood; and are situated at portions of the lung where inspiratory action is strongest. When first found, they appear as white nodules with a zone of red colouring matter; and even in the old specimens some traces of blood in the form of crystals of hæmatin are to be found. Microscopically they are shown to consist of fibrin and red corpuscles, filling the alveoli and even penetrating the alveolar wall. The masses eventually either (1) separate from the surrounding tissue through contraction of the fibrin, leaving a capsule adherent; or (2) owing to admixture with bronchial secretion or some such septic matter, they soften into a mortar-like material, and are got rid of by expectoration; or (3) if the nodule be sufficiently large, and there be no exit for its contents, the result is the formation in time of a species of cavity filled with glairy yellow fluid, resembling honey.

10. **Vesicular emphysema.**—Two kinds are noted in the lungs of phthisical patients. *Acute vesicular emphysema* is found distributed throughout the lungs of those dying of acute tuberculosis; and *chronic local emphysema* occurs in connexion with chronic tubercular masses, and specially in the neighbourhood of cicatrised cavities. The vesicles are few in number, and often as large as a hazel-nut, and are generally to be found at the apex, or along the anterior border of the lung.

MICROSCOPICAL CHARACTERS.—In cases of tuberculosis and phthisis, the following histological elements (as classified by Dr. Green) are present in the lungs, in addition to the tubercle bacillus, which probably by setting up irritation in the tissues is the cause of their production. The amount of importance to be attached to each element has not yet been determined.

1. *Exudation.*—Exudation of fibrin and leucocytes into the alveoli, resembling that of croupous pneumonia, the fibrillation not being quite so distinct, nor the coagulum so abundant. In a large number of cases of phthisis, the lung-consolidation consists of exudatory products mingled with epithelial proliferation; and in some of the most acute instances these two processes have constituted the only lesion.

2. *Epithelial accumulations.* — Three forms of cell are generally present—(1) The ordinary epithelial cell lining the alveolus; (2) epithelioid cells. These are generally large spheroidal cells about four or five times the size of a leucocyte, containing granular matter, and a nucleus and nucleolus. They are derived (Watson Cheyne) from the epithelium, and are occasionally transformed later into giant-cells, or more commonly undergo caseation. Some smaller ones are also observed, indistinguishable from leucocytes. Within the alveoli also are found the (3) 'giant-cells,' held by Klein and Green to be derived from the alveolar epithelium by fission or excessive development, a view confirmed by Watson Cheyne, who has watched the actual stages of production, and has noted the presence of carbon particles in the interior of the epithelioid cells. The cells appear at first as spheroidal masses of faintly granular protoplasm, reaching $\frac{1}{200}$ inch in diameter, with numerous nuclei—sometimes as many as thirty, and bright nucleoli. After a while they increase in size, and send out branched processes, from which are developed other smaller protoplasmic masses, so that a branched reticulum is formed round the original giant-cell, connecting it with other giant-cells. These branches are often directly continuous with the lymphoid or adenoid network of the alveolar wall, to be presently alluded to, which forms a circle round the giant-cell system, and is in time converted into fibrous tissue. Giant-cells are not always found in the earlier stage of tubercle development, and are more plentiful in tubercle of slow than of rapid growth. They are devoid of any vascular supply, and are consequently subject to caseation, having in such cases previously undergone a peculiar transformation into a fibroid material. Giant-cells are regarded by Dr. Green as a product of low vitality, incapable of forming organised tissue; where the protoplasm grows, the nuclei multiply, but the highest manifestation of cell-life—division of the cell—does not take place.

3. *Interalveolar growth.*—This is a thickening of the alveolar wall by a small-celled lymphoid tissue, consisting of minute cells not larger than a leucocyte, separated from each other by a very delicate reticulum. This growth appears to commence in the walls of the alveoli and terminal bronchi, first in the form of a few lymphoid cells, the

network appearing later, and has been stated by Sanderson to be a hyperplasia of the adenoid tissue already existing in the lungs; for it must be borne in mind that lymphatics and lymphoid tissue are largely present in these organs, and that the alveolar wall is considered one of the densest lymphatic plexuses of the whole body. The existence of the delicate reticulum is denied by Cornil and Ranvier, and by Watson Cheyne, the latter ascribing the appearances to infiltration of the fibrous tissue around with leucocytes.

The small-celled tissue spreads rapidly through the alveoli, invading the walls of the capillaries, the peribronchial and perivascular sheaths, diminishing by pressure the calibre of the vessels, and in time obliterating them, and thus giving rise to necrobiosis by caseation and ulceration of the surrounding tissues. The growth fills up the alveoli, and thus infiltrates whole tracts of the lung, which in time become cut off from both air and blood supply. This either degenerates by caseation, giving rise to the formation of cavities; or the cells become more spindle-shaped and branched; the reticulum more fibrillated; and then gradual fibrosis of the nuclear tissue takes place. Owing, however, to the disappearance and obliteration of the vessels, this tissue is not properly supplied with nourishment, and soon undergoes caseation.

4. *Interlobular growth.*—Increase in the interlobular connective tissue resembles the process prevailing in the liver, kidneys, and other organs during chronic disease, and is not necessarily associated with consumption. This feature is most marked in cases of inflammatory origin, or where the disease is of very long standing; and the result is best seen in the large fibrous septa often accompanying the bronchi and great blood-vessels, as is specially exemplified in fibroid phthisis. Microscopically it is difficult to distinguish between the interlobular tissue and the alveolar adenoid growth in their early stages, both being richly cellular; the main differences being the situation of the former around the lobules, and in the neighbourhood of the great air and blood vessels, whereas the latter is found in the alveolar wall and smaller bronchioles. The interlobular tissue is not so liable to retrograde changes, owing to the vascular supply being less liable to obstruction and obliteration; and, again, the alveolar growth has, where present, a more delicate reticulum of fibres.

Changes in the bronchi, pleuræ, and bronchial glands.—The *bronchi* show, in many cases, catarrh of the mucous membrane, giving rise to a richly cellular secretion, which forms the greater proportion of the expectoration of phthisis, as the principal lesion, and extending in acute cases throughout the whole bronchial tree. In more chronic forms the catarrh is limited to the bronchi leading to the affected lobules. A second and more important change is the infiltration, noted by Rindfleisch, of the sub-epithelial connective tissue by large cells characteristic of scrofulous inflammation, and very difficult of absorption. The mucous membrane appears swollen and opaque; the epithelium may be shed; and should the sub-epithelial infiltration disintegrate, small ulcers are formed. A third change is the infiltration of the peribronchial tissue, and the proliferation of lymph-follicles in the walls of the smaller bronchi, owing to transmission of infective substances, including bacilli, from the bronchi through the lymphatics. The bronchi from these changes become reduced in calibre, and consequently the adjoining ones, as noticed by Grancher, are often dilated through the action of increased air-pressure on their walls. Rindfleisch holds that the earliest lesion of phthisis is a tubercular infiltration of the angles and projections of the terminal bronchi at their junction with the alveoli.

In laryngeal phthisis ulceration is to be found in the bronchi, as in the larynx. *See* Larynx, Diseases of.

The *pleura* is often adherent over the region of tuberculisation when the formation has taken place slowly, and is comparatively superficial. It is often considerably thickened, as in fibroid phthisis, to the extent of three-quarters or one inch in depth, the layers being sometimes separated, as Dr. Douglas Powell has shown, by a gelatinous material, consisting chiefly of connective tissue.

The pleura, peritoneum, arachnoid, and even the pericardium, may be the seats of miliary tubercle in the most acute form of phthisis, namely, miliary tuberculosis; but it is generally noted that the lungs are the first organs attacked, and it is extremely rare for tubercle to exist in any organ without being also present in the lungs.

The bronchial, cervical, mesenteric, and other *glands* undergo various changes. In many and especially in advanced cases, the bronchial glands enlarge and become deeply pigmented; in other cases they seem to partake of the changes proceeding in the lungs: they become affected with grey tubercle and caseate, and occasionally cretify, the cretaceous material being, as a rule, in the centre of the gland, though the reverse is occasionally the case, and the calcareous matter forms a shell over the whole gland (*see* Bronchial Glands, Diseases of). They exercise pressure on the trachea sufficient in infants occasionally to produce suffocation or to erode the wall, and then discharge their contents through the opening. The other lymphatic glands, especially the mesenteric, are liable to similar changes.

Other organs.—The stomach and intestines in protracted cases become greatly attenuated, all the coats being thinned and wasted; and in many cases they are found to have undergone lardaceous degeneration, which is a common cause of diarrhœa in phthisis. Where the diarrhœa has been very persistent, it is common to find extensive ulceration of the jejunum, ileum, cæcum, and large intestine, extending even to the sigmoid flexure and rectum; the cæcum being earliest attacked, and generally in a more advanced stage than the small intestine. Ulceration was noted in 71 per cent. of patients dying of phthisis at the Hospital for Consumption and Diseases of the Chest, Brompton. The ulcers vary much in form and extent: in some instances they are circular, clearly cut depressions; in others, and this is the commoner form, they present large, raised, irregular edges, with fæces adherent to their ragged surfaces, and they can be often seen through the attenuated external wall of the intestine. Tubercle bacilli have been detected in the intestinal ulcer and also in the ochrey stools. The peritoneal coat, as a rule, is thickened in their neighbourhood, and thus perforation of the intestine is prevented. The earlier stages of this process appear to be: Miliary tubercles form in the submucous coat, not only in the solitary glands and Peyer's patches, but scattered throughout the submucous layer, appearing as granules shining through the epithelium; yellow points of caseation become visible in some parts, and small abscesses form in others, the latter appearing to have their seat in the solitary and agminated glands; and, later on, these discharge, leaving ulcers of different forms. Ulceration of the large intestine penetrates very deeply, and often resembles that of old dysentery. Perforation rarely occurs, on account of the thickening of the peritoneal coat taking place outside the ulcers, but occasionally it does happen, causing fatal peritonitis.

The liver is rarely normal, but generally undergoes either fatty or lardaceous degeneration. The spleen is softened, and very commonly lardaceous. The kidneys are not generally affected, but where albuminuria has prevailed towards the close of the disease, fatty or lardaceous or granular changes occur. The heart is usually small, and the muscular tissue pale, and very often in a state of fatty degeneration (Quain). Fatty growths may be found on the surface.

Pathology.—The nature of tubercle has long been a subject of discussion. In the sixteenth century two forms of tubercle (scirrhous and caseous) were recognised, showing that even at this period a distinction had been drawn between grey and yellow tubercle. Later on, the similarity of the changes occurring in the tubercular masses to the softening of scrofulous glands, led Portal to conclude that tubercles were engorged lymphatic glands situated at various parts of the lungs, the engorgement terminating in suppuration. Laennec applied the term 'tubercle' to miliary and yellow granulations, as well as to grey and yellow infiltration, but considered that it was a *sui generis* production, unconnected with inflammation. Broussais, Andral, and Cruveilhier assigned an inflammatory origin to tubercle, the latter considering that tubercle is the result of chronic inflammation of the lymphatics of the lungs. At length Virchow restricted the term 'tubercle' to the grey granulation, which, according to him, originates in the connective tissue, and is of a cellular nature. Rokitansky, Dr. C. J. B. Williams, and others considered that tubercle was principally an exudation from the blood-vessels, the different varieties depending on the kind of exudation, and on the part played by the leucocytes. Drs. Sanderson and Wilson Fox held that the grey tubercle consisted of the small-celled adenoid tissue with such epithelial accumulations as may be imprisoned in the course of its growth; but the latter subsequently adopted Koch's discovery of the bacillus and the conclusions it necessitated. This discovery has undoubtedly revolutionised our views of the pathology of phthisis, for we must now regard the chief histological elements, enumerated above, not as essential factors, but as results of the irritation to the tissues caused by the presence of the bacillus, their number and variety depending on the rapidity of the onset, and the time permitted for reaction on the part of the tissues. For example, the first effect of the entry of the tubercle bacillus into the alveolus would be epithelial proliferation, and possibly, from penetration of the capillaries, exudation of fibrin, and leucocytes. Then if the bacilli are very numerous, or the irritation they set up be very considerable, the alveoli may be stuffed with exudation and epithelial proliferations, which would rapidly caseate. If, however, the irritation be less, the process is slower, and giant-cells are evolved, which, according to some authorities, are an attempt of the organ at self-protection (*see* Phagocytosis). These may in turn perish under the attack of the invader, or be converted into fibroid tissue, and thus resist further advance by encapsulation. The interalveolar lymphoid growth may be the result of bacillar irritation in the alveolar wall; but, being devoid of blood-vessels, it soon undergoes caseation through the action of the bacilli. The fourth histological element, the growth of the interlobular tissue, though it may be due to bacillar irritation, has a distinctly limiting influence on the advance of the organism, and no bacilli have hitherto been found in this tissue. Tubercle bacilli are found invariably in freshly formed tubercle, but in grey or miliary of some date they are often absent, owing to the tubercle having undergone fibrosis. They are present in white and yellow granulations, and in recently formed caseous masses, but not in the other pathological elements, which, though associated with tubercle, are mainly of inflammatory origin.

The process of softening is due partly to overcrowding of the corpuscular products and partly to a chemical process, arising, according to Watson Cheyne, from bacillar action.

When cavities have formed, bacilli swarm on their walls and in their contents, and the more rapidly they are formed the larger the number of bacilli present.

It is obvious that, whatever part the bacillus plays in the causation of phthisis, the condition of the individual attacked, and his constitutional powers of resistance, are quite as important, as on these depend the whole question of vulnerability. It is probable that in most cases of consumption the bacilli reach the lungs through inhalation ; but why, out of a number of persons placed under similar conditions, apparently necessitating the inhalation of tubercular bacilli, in only a few they increase and multiply, is hard to explain, but renders the existence of a predisposing cause necessary. Koch believes the denudation of the bronchial mucous membrane after measles renders the lungs liable to bacillar attack; and that, similarly, denudation of the intestinal mucous membrane by the shedding of its epithelium from any cause, offers the chance of infecting this part by the swallowing of bacilli-laden sputum. Moreover, chronic pleurisy or any cause which tends to cripple the movements of the lung, or to prevent the escape of its secretions, will predispose by forming aggregations of epithelial cells, which are the haunt of tubercle bacilli.

The spread of bacilli in the lung may proceed (1) by continuity, through the alveolar wall, the epithelium having been destroyed ; (2) by re-inhalation of bacilli-laden sputum, especially if expectoration be difficult—the secretion, being raised by coughing to a point where two or more bronchi join, is drawn by deep inspiration into a fresh set of alveoli ; (3) through the lymphatics, as is often seen in the stellate arrangement of grey tubercle round a cavity or caseous centre ; (4) through the arteries and veins, the entry of the bacilli into these having been demonstrated by several observers. This is the channel of infection in acute tuberculosis.

With reference to the order in which the various portions of the lungs are involved in phthisis, the posterior apex (Fowler) is first attacked, and the lesions spread downwards along the anterior aspect of the upper lobes ; the posterior upper border of the lower lobe is next infected, and tuberculisation spreads again forwards along its upper edge. The posterior region seems to be attacked altogether earlier than the anterior ; excavation is commonest and earliest (Ewart) at the apex, next in the dorso-axillary and mammary regions, and later and less common at the base. Cavities in the dorso-axillary and mammary regions are invariably secondary, and generally the result of re-infection of the lung from secretion from cavities.

SYMPTOMS. — (*a*) *Tuberculisation.* — The symptoms of pulmonary phthisis in the first stage may be thus summarised : Cough, becoming more persistent ; mucous expectoration ; loss of colour and strength ; emaciation ; night-sweats ; sometimes loss of hair ; pulse somewhat quickened, though this is not invariable ; and a temperature rising above the normal in the afternoon, and sinking below it in the morning. M. Peter has noted in many cases a rise in temperature on the affected side during this stage ; and with regard to the general temperature of the body, though slight pyrexia is often present, tubercle-formation is quite possible without any rise of temperature, or may even be marked by a depression, as Surgeon-Major Alcock and others have shown. Pain in the upper parts of the chest is occasionally present ; and the number of respirations are generally increased, though this depends on the amount of tuberculisation proceeding. Some hold that dyspnœa is an early symptom and precedes all others, but the writer has found quite the opposite—that patients do not notice their breath to be short until their lungs are seriously involved. Disturbance of the digestive powers, and considerable irritability of the intestinal mucous membrane, with a red line on the gums, are noticeable in some cases, though chiefly in the acute forms. The tongue becomes white, the bowels torpid, and the urine scanty. The most constant of the above symptoms are the persistent cough, with mucous expectoration, and the progressive emaciation ; and in many cases so obscure are the beginnings of the disease, that these are the only symptoms discoverable.

Physical signs.—The physical signs, after the first stage, depend to a great extent (1) on the number and aggregation of the miliary tubercles ; (2) on the amount of consolidation they give rise to ; and (3) on the irritation which their formation causes in the lung.

As a rule, tubercle-formation commences at the apex of one lung, and is detected by the presence of certain physical signs in the supra-scapular, supra-clavicular, or subclavicular regions, the signs extending downwards at a later date. The signs vary much in particular cases, but consist at the first in an impairment of the ordinary respiratory murmur by a species of crepitation, differing from the pneumonic crepitation chiefly in its more scattered character, in its being audible with both inspiration and expiration, and in its crumpling nature. Many authors, however, maintain that an earlier sign is the 'wavy' breathing (T. Thompson), or '*respi-*

ration saccadée' of the French (Fournet). A feature especially to be observed is increased loudness of the expiratory murmur. Accompanying these is increased vocal resonance and bronchophony, with more distinct conduction of the cardiac sounds; and percussion discovers dulness of varying shades in one of the above-mentioned regions. When a certain definite amount of consolidation has taken place some impairment of the mobility of one side of the chest may be noticed: this is to be detected under the clavicle, where, if any adhesion of the pleura exists, there may be some flattening. Another significant sign is the dry friction-sound, audible generally in the supra-scapular and scapular regions, and indicating limited pleuritis. The subclavian murmur, formerly much dwelt on, cannot be depended on. The dulness usually appears first above the scapula, next over the sternal end of the clavicle, and gradually extends downwards. being limited generally for a considerable period by the lower border of the third rib.

A careful comparison must be made between the two sides of the chest, and often between different portions of the same side, as otherwise the slighter shades of dulness, and the minor differences in the respiration-sounds, which characterise the presence of tubercle in the lung, will escape notice.

When the crepitation and the wheezing—which may be considered as indicative of irritation in the pulmonary tissue, caused by tuberculosis—have subsided, loud bronchophony, prolonged expiration. and certain varieties of tubular sound, show condensation of the lung-tissue around the neighbouring bronchi; and a certain amount of dulness is to be detected.

(*b*) *Softening and excavation.*—The symptoms which accompany the softening of tubercular masses and their subsequent excavation, are by no means uniform. Many authors associate this stage with marked signs of pyrexia, with copious night-sweats, and increase of cough and emaciation; but this is not always the case, for, according to the writer's experience, the process may go on with even subnormal temperatures, and with gain of weight; but as fresh formation of tubercle often accompanies the softening process, some of the above symptoms, which have been assigned to softening, may be due to the tuberculisation and pneumonia accompanying it. The symptoms which should be most depended upon for the detection of softening are increase of cough and expectoration of a yellow colour, occasionally streaked with blood. If the expectoration be carefully collected and boiled with an equal volume of caustic soda, of the strength of twenty grains to the ounce, and the sediment be then placed under a moderate magnifying power of the microscope, delicate filaments of yellow elastic tissue, of hook-like shape, or else exhibiting the characters of the alveoli, may be detected. The sputum chiefly consists of epithelial and pus cells, with 2 to 4 per cent. of albumen, and a large proportion of phosphates. Various organisms have been found, and in advanced cases the *bacterium termo* with different kinds of micrococci and diplococci; among them the '*micrococcus tetragenus*' of Koch, which appears on the walls of cavities in groups of four micrococci, arranged like the sarcina ventriculi, each group having a diameter of a third of a red blood-corpuscle. The characteristic organism is the tubercle bacillus, which, scanty and often absent from the sputum of early phthisis, abounds in that of softening and excavation, and specially in acute cases. *See* MICRO-ORGANISMS: Modes of Staining Bacteria; and SPUTUM, Examination of.

Physical signs.—The signs which these changes give rise to are often obscure. The percussion-sounds vary: sometimes there is an increase of dulness, possibly due to pneumonia of adjacent lobules; at other times, hyper-resonance, as if air had taken the place of the expectorated masses. In all these cases much depends upon the situation of the lesion. The formation of a cavity deep in the lung, and far from the chest-walls, may take place without being detected (except by the expectoration); whereas the formation of a similar cavity on the surface gives rise to unequivocal signs. Auscultation reveals—where formerly bronchophony and fine crepitus existed—crepitation of a very coarse character, commencing with a *click* sound, and after a while developing into a *croak*. When this last note has been reached, loud tubular sounds become audible on coughing, and we soon get the sounds characteristic of a cavity. The great distinguishing features of these moist sounds of softening are their variety, their short duration, and their concentration over one small portion of the lung. In phthisis, crepitation much more commonly signifies tubercle-formation or pneumonia than it does softening of already formed tubercular masses. The formation of a cavity is generally followed by regular morning expectoration, usually opaque, and nummular in form, and in the majority of cases, unless interfered with by treatment, by the usual train of consumptive symptoms, if these have not already appeared. These are—night-sweats, slightly elevated temperature in the afternoon, and rapid loss of flesh, strength, and colour. The drawn look of the face, the hectic spot on the cheek, the pearly-white colour of the sclerotic, the clubbing of the fingers, and other signs which mark the confirmed consumptive, generally belong to this stage, and all more or less denote blood-infection from the lung-products, sometimes even simulating pyæmia.

The weakness of voice, so common in chronic phthisis, is distinct from the total aphonia of laryngeal phthisis, and has been shown to be due to granular degeneration of the muscles of the larynx. Marcet states that in phthisis the muscles generally undergo degeneration.

The history of a cavity follows one of four courses. *See also* CAVITY; and VOMICA.

(1) It may remain patent, secreting pus, like a chronic abscess, but not increasing in size.

(2) It may enlarge by caseation and ulceration going on in its walls, by which process blood-vessels may become exposed. In this case the expectoration becomes more nummular and abundant, containing quantities of lung-tissue and remains of bronchi; and excavation may in time convert the lung into a mere pleural bag, devoid of lung-tissue, with what remains of the bronchi opening into it. The physical signs attending this increase in size are amphoric breathing, and often hyper-resonance on percussion, or cracked-pot sound; and the voice and cough may be accompanied by metallic tinkling, especially if the communication with the bronchi is narrow.

(3) It may open into the pleura, and cause pneumothorax or pyopneumothorax. That this does not occur oftener is owing to the adhesive pleurisy which so often accompanies the early consolidations of phthisis, especially if the tubercle be superficial. *See* PLEURA, Diseases of.

(4) It may contract, and the sides approaching each other form at length a firm, tough cicatrix, causing a stretching of the surrounding tissue and often considerable displacement of the neighbouring organs. This is the natural cure of the third stage of phthisis, and is evidenced in most cases by a flattening of the chest-wall, chiefly in the infra-clavicular space, a disappearance of the cavernous sounds, and a substitution of deficient or harsh breathing, and sometimes of healthy sounds over the seat of the cavity. Percussion often discovers that the sound lung is drawn across the median line to the affected side; and if the cavity be in the left lung, the heart and stomach may be displaced upwards, the former organ being generally tilted towards the axilla, the apex describing the arc of a circle, of which the centre is the commencement of the aorta. If the cavity be in the right lung, we may expect the liver to be drawn up, and the impulse of the heart displaced to the right of the median line, reaching occasionally beyond the right nipple. Contraction of a cavity always takes place towards a fixed point, which is sometimes an adhesion of the pleura, but more generally the root of the affected lung; and in this way the remarkable vagrancy of the physical signs is explained; for it is not unusual to find the cavernous sounds audible above the scapula long after they have ceased to be heard in the sub-clavicular region, and again in the inter-scapular regions after they have ceased to be audible in the supra-scapular fossa.

Of these destinies of a lung-excavation, the first two are undoubtedly the commonest. Where the cavity remains quiescent, and no fresh tubercle-formation takes place, the patient may live on for years, with only the inconvenience of regular expectoration and occasional dyspnœa, and preserve the appearance of actual health. Where a cavity continues to increase by further ulcerative processes, tuberculosis soon attacks the opposite lung; and this organ passing rapidly from consolidation into excavation, the cough and expectoration increase, hectic fever becomes more frequent, the patient reaches an extreme state of emaciation, the adipose tissue disappears from all parts of the body, the temporal and malar bones become prominent, the jaws are sharply defined, the scapulæ, ribs, and sacrum all stand out, as if, as is really the case, they were only covered by skin, and the patient becomes to all appearances a mere skeleton. By an all-wise arrangement a kind of balance seems to be maintained between the diminished requirements of the body and the mass of the blood, for this latter is reduced in bulk in proportion to the lessened respiratory surface, and the individual thus gradually dwindles and sinks.

In the last stage of phthisis various symptoms appear indicative of the disorganisation the blood has undergone, and the manifest lowering of the standard of life. Thromboses may arise in the veins of the extremities; œdema of the ankles and feet ensues; bed-sores form on those parts where the pressure is greatest, as, for instance, on the hips, buttocks, and sacrum; and thrush appears on the tongue and fauces, and when removed is succeeded by a fresh crop, rapidly spreading round the hard palate, buccal surface, and gums. Ulceration of some part of the mucous membrane of the mouth and pharynx is not uncommon, the part affected being generally the soft palate, less commonly the hard palate, the edge of the tongue, or the buccal surface in the region of the back molars. Near the end profuse sweats follow the swallowing of all fluids. The breathing becomes quicker, and expectoration more and more difficult. Diarrhœa prevails at this stage, and often proves fatal before the pulmonary lesions have reached their furthest development.

Death may occur in several ways, either—(1) by apnœa, from inability to expectorate; (2) by thrombosis of the pulmonary artery, inducing lividity and dyspnœa; (3) by pneumothorax; or (4) by exhaustion, the heart's action gradually failing, the patient being utterly prostrated, either by the wasting course of the disease or by the attendant diarrhœa. Hæmoptysis may cause death, either by collapse from loss of blood, or by suffocation through the blood rapidly filling the air-cells.

Some of the principal symptoms of phthisis require a fuller description.

Temperature, Pulse, and Respiration.—The *temperature* of phthisis is both pyrexial and subnormal, its varieties depending partly on the amount of tuberculisation and inflammatory process going on, and partly on the extent to which the constitutional powers are depressed. The high temperatures are due to the former, the low ones to the latter cause. The range extends from 106° or 107° F., noted in acute phthisis, down to 90·5° F. observed by Lebert. The writer has seen morning records as low as 91·6° F. In many cases of quiescent phthisis in the first and third stage, the observations are for the greater part of the day subnormal, and only reach the healthy standard in the afternoon. It is said to be even possible for tubercle to form, and for softening and excavation to take place, without any rise of temperature.

Where, however, tubercle-formation is accompanied by elevation of temperature it is post-meridian, and by no means continuous in character, the phenomena being as follows: The rise commences after 2 P.M. and continues till 8 P.M., when the maximum, which may attain 103° or 104° F., is reached. A fall then begins, and continues till 4 or 5 A.M., when the minimum, which may be as low as 94° F., but is generally about 95° or 96° F., is attained. After this a gradual recovery takes place, and by 10 or 11 A.M. normal temperatures are reached. During the process of softening, the post-meridian rise appears to be maintained later in the day, the maximum being reached at 10 or 11 P.M. In active cases in the third stage, where excavation is proceeding or extending, and where also fresh tuberculosis may be taking place, the thermic chart approaches more closely to that of suppuration and pyæmia, and shows great extremes, the highest and lowest temperatures of phthisis being noted at this stage. The rise commences soon after noon, and continues till 5 P.M., or even till 10 P.M., when the maximum of 103° to 104° F. is reached, and a fall rapidly follows, 95° and 94° F. being very commonly reached before 6 A.M. Then recovery sets in, and normal records are observed about 10 A.M. The chief characteristics of the temperature in phthisis are—(1) the post-meridian form of its pyrexia; and (2) the remarkable fall at night to subnormal figures, showing collapse of the vital powers. Pyrexia is compatible with large gain of weight in phthisis, provided the food-supply is carefully maintained.

Peter maintains that the formation of pulmonary tubercle causes an elevation of from ·5° C. to 1·5° C. above the mean temperature of the body in the intercostal space overlying the granulations; but the writer has failed, after many observations, to verify this conclusion.

The occurrence of hæmoptysis does not generally affect the temperature, unless a large amount of blood has been inhaled into the air-cells. Under these circumstances catarrhal pneumonia is set up, and the temperature remains elevated until its subsidence; or, if it does not subside, but gives rise to secondary tubercle, the chart will assume the pyrexial character of acute tuberculosis. Night-sweats, as a rule, lower the temperature for the time, but they are not to be regarded as a consequence of the pyrexia, as they are noted sometimes in non-pyrexial cases, but rather as a flux from the skin, due to loss of power in its vaso-motor nerves. The influence of diarrhœa on the temperature depends entirely on its form and causation. Where it depends on acidity of the primæ viæ and dyspepsia, it exercises no influence; where it arises from lardaceous degeneration of the intestines, and is accompanied by dropsy, a lowering of the standard may be looked for. Where, as is generally the case, it is due to intestinal ulceration, a decided rise of temperature takes place, generally in the evening, succeeded by equally well-marked morning remissions, if the ulceration is extensive. Albuminuria, from whatever cause arising, tends to lower the temperature, and the more so as the kidneys become more deeply involved, the blood is more disorganised, and dropsy supervenes.

The *pulse* varies greatly, according to the form of the disease, and the amount of lung-surface involved. In the greater number of cases of chronic phthisis its character is weak, regular, and little above the normal standard. In cases of acute disease, it has a frequency of 100 to 140, but its rise, as a rule, follows, sometimes after a long interval, that of the temperature. Considerable changes may take place in the lungs without any rise of pulse.

Respiration varies according to the amount of lung-surface involved, being normal in early quiescent stages, and rapid in cases of extensive advanced disease. Nevertheless in acute phthisis and acute tuberculosis, the respirations are generally rapid, even before the lungs are largely obstructed, and in these cases there is a definite pulse-respiration ratio. In phthisis generally this cannot be said to exist, but the observation of the number of respirations is of far more importance than that of the pulse.

Diarrhœa.—Diarrhœa has a great influence on the course of the disease, and tends more to weaken and emaciate the patient than the harassing cough, the persistent pyrexia, or the drenching night-sweats. In the first stage an opposite condition, namely, constipation, prevails, but in the third stage diarrhœa is tolerably common and very obstinate in character. It varies in intensity, according to its cause. Sometimes it proceeds from (1) acidity of the primæ viæ and consequent indigestion, and is trivial in character. Sometimes it is due to (2) atony of the intestines, and partakes of the character of a flux, like night-sweats; (3) in other cases it is due to lardaceous degeneration of the intestines, especially of the small intestine, causing increased permeability of the infiltrated vascular walls. The diarrhœa is not always very profuse in these last cases, but it is very persistent, and not uncommonly accompanied by vomiting of a very obstinate kind. Lastly (4) it may originate in ulceration of the intestines, and it has been attributed to the swallowing of bacilli-laden sputum, which is common where expectoration is difficult. Here the diarrhœa is very persistent, the stools ochrey and soft, containing abundant tubercle bacilli, and sometimes streaked with blood; the patient often complains of pain in the abdomen, referred to the seat of ulceration, and feels tenderness on pressure. This is usually found over the ileo-cæcal valve, but it may be traced in cases of extensive ulceration throughout the whole of the ileum, into the colon (ascending, transverse, and descending), and the sigmoid flexure. Flatus and a tympanitic condition of the abdomen are often present in extreme cases. The diarrhœa prevails most at night, but in advanced instances continues day and night, and exhausts the patient greatly. Ulceration, according to *post-mortem* examinations, commences at the ileo-cæcal valve, and involves the solitary and Peyer's glands, tubercular ulcers being more irregular in form and often deeper than those of enteric fever. They are scattered through the duodenum and ileum, but are always more advanced and extensive in size in the large intestine, which is often a mass of ulceration, this being attributable to the long retention of fæces and the disengagement of foul gases in this portion of the intestinal tract.

State of the Blood.—The principal changes in phthisis are a diminution of the red corpuscles (Malassez), and of the hæmoglobulin (Quinquand); and an increase in the number of leucocytes, and in the proportion of fibrin and phosphate of calcium. In advanced cases aggregations of granules, varying in size from $\frac{1}{10}$ to $\frac{1}{2}$ a red corpuscle, have been observed. The masses are often large enough in size to occupy a considerable part of the field of the microscope; and when observed at a temperature of 98° or 100° F. these granules show amœboid movements in the blood. Their nature and function are unknown, but they are regarded as an altered form of leucocyte.

VARIETIES.—We have hitherto traced the course of a typical case of consumption in its various stages, and we must now draw attention to the different forms the disease includes, always premising that while they differ in symptoms, in prognosis, and in duration, they cannot be described as distinct pathological varieties, as they are merely forms of the same disease, and between each is to be found every kind of anatomical and clinical connexion.

The following table gives the principal forms:—

I. *Acute.*—(1) Acute tuberculosis; (2) Scrofulous pneumonia, or acute phthisis; (3) Acute tuberculo-pneumonic phthisis.

II. *Chronic.*—(4) Catarrhal phthisis; (5) Fibroid phthisis; (6) Scrofulous phthisis; (7) Hæmorrhagic phthisis; (8) Laryngeal phthisis; (9) Chronic tubercular phthisis.

1. Acute Tuberculosis.—This term is restricted by the Germans to cases of general tuberculosis where more than one serous membrane is affected with tubercle, in addition to the lung; but it is here used to denote all acute pulmonary cases where miliary tubercle, which has not begun to caseate, is the principal lesion. The history is as follows: A young person of either sex is attacked with feverish symptoms, pungent heat of body, rapid pulse, extreme oppression, and overwhelming weakness, dry-coated tongue, red at edges, soon becoming brown in the centre, sordes on the teeth and lips, gastric disturbance and diarrhœa, and occasional delirium, the symptoms closely resembling those of enteric fever, for which the disease is often at first mistaken. Cough and slight expectoration come on; fine crepitation and bronchial rhonchus take the place of the ordinary vesicular sounds; and occasionally some dulness is detected over the posterior regions of the chest. The patient wastes rapidly; the breathing becomes more and more embarrassed; the sputum rusty; the crepitation more general and louder. Later on, the symptoms of collapse appear—the pulse becomes more rapid and feeble, the aspect ghastly or livid, cold perspirations appear; and death occurs within a few weeks from the date of the first onset. Or the symptoms may be more cerebral in character, denoting that the meninges are the seat of miliary tubercle. The patient complains of pain in the head, vomiting, and intolerance of light; begins to mutter and to give wrong answers; and then has marked delirium. The aspect is heavy and confused; hyperæsthesia of skin appears (Empis); and double vision, though squinting is not always noticeable. Granulations can often be detected with the ophthalmoscope in the fundus oculi. Twitchings of the muscles of the extremities and sometimes of the face occur, followed by convulsions, and by paralysis of the sphincters. Dilatation of the pupils and other signs of effusion supervene, and the patient dies comatose. In this variety, as a rule, the temperature remains continuously high (between 100° and 102° F.), but in some instances it may be observed to rise above 100° F. for the last ten days of the patient's life. After death the lungs are found highly congested and pervaded with miliary tubercle, soft in character, but devoid of caseation and containing abundant tubercle bacilli; the bronchi are full of frothy mucus; and tubercle may be found in the pleura, peritoneum, or brain membranes, with effusion into the ventricles. This form is distinguished from capillary bronchitis by the presence of fever; from enteric fever by the different physical signs; from scrofulous pneumonia by the great dyspnœa and scanty expectoration; and by the head-symptoms (when present) from all the above.

Acute tuberculosis is the most fatal form of consumption, terminating in a few weeks or even days, and is characterised by gastric disturbance, by the presence of family predisposition (Pollock), and the absence of hæmoptysis. It may be primary or secondary, but in each case is equally fatal.

2. **Acute Phthisis.**—Acute phthisis, or scrofulous pneumonia, is another very acute variety. The patient, generally young, who may have had cough previously, is attacked with sharp pain in one side of the chest, quick pulse, high temperature, the skin being quite burning to the ear of the auscultator, alternating with night chills and sweats. The general appearance betokens pneumonia, but the crepitation commences at the apices, extending to the whole lungs, and is not so fine and even as in pneumonia. The cough increases; the expectoration becomes opaque and purulent, containing quantities of lung-tissue and swarms of tubercle bacilli; and the temperature assumes the intermittent type. The physical signs show at first gradual consolidation of both lungs, but later on indicate that excavation has taken place; and this continues, the patient rapidly wasting and dying in a few weeks. Sometimes the cavity opens into the pleura, which in these cases is rarely adherent, and death ensues by pneumothorax. This form is not quite so hopeless as acute tuberculosis; and in some instances the disease may stop short of utter lung-destruction and become chronic, the patient remaining in a state of crippled respiration and of health for months and even years. Such cases may last for periods extending from three and a half to sixteen years. After death the lungs are found more or less consolidated, with adherent pleuræ, the indurations consisting of red hepatisation and caseous infiltration, the latter largely predominating. Excavations abound in all directions, and but little or no miliary tubercle is present. The characteristics of this form, are (1) the acuteness of the disorganising processes, excavation quickly succeeding consolidation; (2) the inflammatory nature of the lesions, and the rarity of miliary tubercle; (3) the occurrence of pneumothorax; and (4) the freedom of other organs from tuberculosis.

3. **Acute Tuberculo-pneumonic Phthisis.**—This is a third variety, which constitutes a connecting link between the above forms, scrofulous pneumonia and acute tuberculosis, as it presents some of the clinical and pathological features of each, resembling the latter in so far that the tuberculisation takes place rapidly in the lungs, and often involves other organs, as, for instance, the intestines; and being more akin to the former in the presence of consolidations of a pneumonic origin, yet differing from them both in that the tubercle aggregates, tends to caseate, and thus to form cavities, through the breaking down of tubercular masses and not of catarrhal pneumonic products, this occurring while rapid tuberculisation is taking place in another part of the lungs.

4. **Catarrhal Phthisis.** — Catarrhal phthisis somewhat resembles the last-named variety, and has its origin in bronchitis, which has gradually passed into catarrhal pneumonia. The patient has been subject for years, perhaps, to attacks of winter catarrh, which disappear in summer; and at last, owing to a severe season, or from his being in less favourable circumstances than usual, his cough does not cease, as formerly, but remains persistent, and is accompanied by some purulent expectoration, loss of flesh, and night-sweats. The bronchial *râles*, sonorous and liquid, as they disappear from certain parts of the lung, become more prominent and localised in others, especially under the clavicles, and above and between the scapulæ. The *râles* become coarser, and the sonorous rhonchus assumes a croaking character. Signs of consolidation soon appear, but are never so prominent as in other forms, owing to the temporary emphysema accompanying the bronchitis; the dulness appears in patches over the centres of increased rhonchus; the liquid *râles* diminish, owing to increasing obstruction, and give place to a tubular sound conveyed by the extending consolidation from the larger bronchi, and heard best in situations overlying them, as below the clavicle, and above and within the scapula, in the axillary and middle dorsal regions. The tubular sound has a sharp, whiffing character, and is often unaccompanied by bronchophony, from the consolidation being insufficient, and the bronchial tubes too choked to produce it. If the case goes on unfavourably, the expectoration becomes more abundant, and is found to contain both tubercle bacilli and shreds of lung-tissue, and excavation is proved to have taken place, with the usual symptoms; the patient assumes all the appearances of advanced cavity-phthisis, and the case from this date can hardly be distinguished clinically from those of a strictly

tubercular origin. After death the lungs are found to be more or less consolidated, the indurations taking the direction of certain lobules and generally not affecting entire lobes. The indurations are of a grey or yellowish tint, with numerous yellow masses of caseation intervening, which abound in tubercle bacilli. Another form of catarrhal phthisis follows on attacks of unresolved pneumonia or of pulmonary affections tending to lung consolidation. Portions of the lung may be found in the first stage of catarrhal consolidation, so well described by Dr. Hamilton, with isolated lobules or groups of lobules of a leaden or purple colour, and the adjoining ones may be emphysematous. Wedge-shaped patches of consolidation can be traced on the pleural surface, exuding on section yellow catarrhal fluid similar to that contained in the bronchi. Numerous excavations of irregular form are seen containing bacilli, but in most instances no trace of tubercle is to be found, though it is occasionally present. The bronchi are generally dilated, and full of purulent matter. This form is more common among the young than the old, and arises from whooping-cough, measles, and bronchitis, the pathology being extension of catarrh from the bronchi to the alveoli, implication of the interstitial tissue, large epithelial proliferation, causing pressure and emptying of capillaries, degeneration and caseation of the alveoli and their contents, and consequent excavation, with occasionally lymphatic infection.

5. **Fibroid Phthisis.**—This term, introduced by the late Sir Andrew Clark, is applied to cases of which fibrosis is the principal feature. While this process accompanies most instances of chronic phthisis, it specially characterises those in which interstitial pneumonia is present, and entirely modifies their history and symptoms. It is generally secondary to attacks of pleurisy and pleuro-pneumonia, or to chronic pneumonia, resulting from long continued irritation of the lungs, through the inhalation of dust or grit, as prevails among fork and knife grinders, colliers, and button-makers. Taking the pleuritic origin as an example, the following are the symptoms.

A patient has an attack of pleurisy with effusion, from which he recovers with absorption of fluid; but percussion shows dulness over the whole side, and somewhat feeble respiration. The patient experiences dragging pains in the side; a dry, hacking cough, somewhat paroxysmal in character, with little expectoration, continues; and the breathing, always short, becomes still more so on exertion. These symptoms increase, and a few months later we find marked immobility of the affected side, dulness throughout, and now considerable shrinking, the circumference of this side measuring one or two inches less than the healthy side. On auscultation we notice the breathing to be very deficient in some parts, and in others bronchial, and sometimes cavernous in character; but generally there is everywhere absence of true vesicular breathing. Careful percussion of the opposite side of the chest shows the line of resonance to extend beyond the usual limit, passing to the edge of the sternum, and often an inch or two farther; demonstrating that the contraction of the affected lung has caused the healthy one to be drawn across. Other organs are likewise displaced. If the left lung be affected, the heart is tilted, not necessarily upwards, as when a cavity is contracting, but outwards. The stomach rises, its note being audible as high as the fourth rib. The heart is not only displaced, but is uncovered by the retreating lung; and the right auricle and ventricle are clearly distinguished by their pulsations. If the right lung is affected, the left may be drawn over, and the area of resonance may extend as far as the inner half of the right clavicle, and a line drawn thence sloping towards the middle of the sternum. The heart is transposed, and its impulse may be traced in the fourth interspace on the right side. The liver rises up to the fifth rib, and shrinking of the chest-walls takes place, as on the other side. The expectoration, if there be any, has been occasionally but rarely found to contain tubercle bacilli. The pulse may be slow; the respiration often rapid, rising to 50 and 60 per minute. The temperature seldom rises above the normal and is sometimes subnormal. When the temperature rises over 100° F. it signifies that something beyond fibrosis is going on. The cough is troublesome, and often induces vomiting; and the expectoration becomes more and more difficult, and in time, on account of retention, fœtid. Meanwhile the dyspnœa increases, the other lung becoming involved; signs of obstructed circulation appear; dropsy of the extremities takes place, and rapidly increases; the urine becomes albuminous; and the patient dies, either of dyspnœa or of uræmic poisoning, his death contrasting strongly with the ordinary termination of consumptive disease. The patient may, however, die of apnœa, without albuminuria or dropsy. After death we find a lung contracted to the size of a man's fist, with enormously thickened and adherent pleura, and widely dilated bronchi, with interlobular septa much increased in size and encroaching on the lung-structure, which seems to be replaced by a fibrous hard tissue, in parts mottled with grey, deeply pigmented, and resembling cartilage in its resistance to the knife. Imbedded in this structure are found caseous and cretaceous masses, or, again, excavations of various sizes; the walls of these and of the dilated bronchi being rigid and inelastic, from the presence of the fibroid material, and thus affording some explanation of the difficult expectoration and consequently troublesome cough. Careful examination of microscopic sections of this fibroid tissue have, according to Sir Andrew Clark, Watson Cheyne, and Percy Kidd, failed to detect tubercle bacilli; but in the caseous masses imbedded in it Watson Cheyne has found them. Besides these changes, we may find the other lung the seat of tuberculosis, though this is not constant; but commonly the bronchial glands are hardened and deeply pigmented. There is often amyloid disease of the liver, spleen, and kidneys.

6. **Scrofulous Phthisis.** — This is a variety where consumptive disease of the lung is preceded by, or accompanies, scrofulous affections of various joints, caries of the sternum, ribs, and vertebræ, lumbar and psoas abscesses, otorrhœa, fistula in ano, or, as is most common, enlarged and caseating glands—cervical, bronchial, axillary, or mesenteric. Rindfleisch explains the non-absorption of scrofulous matters by the presence in exudations of this character of relatively large cells with glistening protoplasm, and by the fact that the emigrated leucocytes, which pass from the blood-vessels of the inflamed part into the adjoining structures or into the lymphatics, in scrofulous persons tend to grow larger on their way through the connective tissue, by absorption of albuminous substances. The large size of the cells has been verified by Godlee, Schüppel, Green, and others. Cases of scrofulous phthisis show an early infection of the lymphatic system, and a remarkable correlation appears to be established between the external gland or discharging surface and the condition of the lungs. If the glands are suppurating, or if the fistula is open, or if the carious bone freely discharges, the lung-disease will remain quiescent, and progress may be made towards arrest; but if, on the other hand, any of the above discharges, in the most of which tubercle bacilli have been detected, should be checked or cease, the lung-disease passes into fresh activity, making considerable advance and extension. This has been used as a strong argument against operating on fistula in ano if the lungs have been affected. The temperature-course in these cases, if active lung-changes are taking place, is remarkably fitful, showing evening exacerbations of 102° to 104° F. and morning depressions of 96° to 97° F.; and night-sweats are usually very profuse. Patients of this type lose and gain flesh with great rapidity, owing probably to the pyrexia and fitfulness of the appetite.

Scrofulous phthisis is strongly hereditary; it prevails chiefly among children not exceeding fifteen years, as shown by Pollock, many of these presenting the well-known strumous aspect, the clear complexion, enlarged glands, chronic inflammation of the eyelids, or discharging ears. They are attacked early with hæmoptysis, accompanied by cough and wasting. The course of the disease, probably on account of the relief afforded by the various discharges, is slow, and the patient lives on for a considerable period; but, as might be expected, the development of the individual is slow and often stunted. *Post-mortem* examination generally shows the ordinary destructive lung-changes of advanced tubercular phthisis, with considerable enlargement of the various glands—bronchial, mesenteric, cervical, &c. The characteristics of this form are (1) the relation of the lung symptoms to the state of the other organs affected; (2) the tendency to excavation, and to cavity-contraction; (3) its distinctly constitutional character; (4) the great extremes of the temperature-chart; (5) the rapid changes in the patient's weight.

7. **Hæmorrhagic Phthisis.**—This name is intended to designate, not phthisis arising from the results of hæmoptysis (*phthisis ab hæmoptoë*—Niemeyer), but a form recognised by C. J. B. Williams, Peacock, Hughes Bennett, and the writer, in which large and repeated hæmorrhage is the principal feature, associated with a small amount of detectable disease. It is more common among men than women, in the proportion of five to one; and the period of attack is later than in the ordinary forms, possibly owing to the element of heredity being generally absent. The patient may have had signs of failing health before the hæmoptysis, but often he is apparently in good health when he is suddenly attacked with profuse hæmoptysis, the blood being florid, the hæmorrhage sometimes lasting many days, and always causing a reduction in flesh and strength. Cough and expectoration follow, yet examination of the chest only indicates slight signs, and sometimes none at all. When present they are to be found in the supra- or inter-scapular regions, or below the clavicle. The patient improves, and often entirely loses his cough before the recurrence of the hæmorrhage, which may not take place for days, weeks, months, or even years. If the attacks recur often, the cough becomes persistent; the expectoration, when not sanguinolent, is muco-purulent; wasting and night-sweats appear; and the physical signs now show unmistakable consolidation, which goes on to softening and excavation. In most cases the disease does not extend beyond consolidation, and large quantities of blood are expectorated without fatal results, the patients recovering in the intervals, and sometimes living to a considerable age. Peacock stated that in most instances some more or less exciting cause of a depressing character is to be detected, in the form of syphilis, cold, dysentery, bodily strain, exertion of voice; but the observer will often fail to find one. The exact pathology of this form of phthisis is uncertain, because few of the patients die

in the early stage; but it is probable that the hæmorrhage is produced by the erosion of the pulmonary vessels by bacillar invasion, masses of tubercle bacilli having been shown to be present in the walls of both arteries and veins by Weigert, Koch, Mugge, and Percy Kidd; and in hæmorrhagic phthisis it is probable that the larger vessels are thus attacked. Though this can be considered only a clinical variety of pulmonary phthisis, the cases are genuine instances of consumption, as is proved by the fact that, if the patients live long enough, they present the same phenomena of increasing consolidation and excavation as ordinary phthisis.

8. **Laryngeal Phthisis.**—*See* LARYNX, Diseases of.

9. **Chronic Tubercular Phthisis.**—This constitutes the ordinary type as sketched under the head of Symptoms. In the necropsies of this form are to be found all the pathological elements of phthisis, namely, tubercle—miliary, grey, and white, caseous masses, and infiltration—grey and catarrhal, croupous pneumonia, fibroid tissue, and calcareous deposits, showing that no abrupt pathological line of demarcation can be drawn between the different varieties of phthisis, whatever clinical peculiarities they may present; and that the appearance of miliary tubercle is a matter of infection of the lymphatics, in which time plays an important part.

DIAGNOSIS.—Phthisis is distinguished from other chest-affections principally by the evidence of physical signs. The evidences of consolidation separate it at once from bronchitis; while the tendency of the signs to become localised in the apices of the lungs, their special characters, and the combination of consumptive symptoms, distinguish it generally though not invariably from pneumonia.

Of the various forms of phthisis, the most difficult to diagnose from other diseases is acute miliary tuberculosis, which at its onset is sometimes mistaken for acute bronchitis, from the fine *râles* and rhonchi accompanying the miliary formation. It has also been confounded with enteric fever, from the high pyrexia, the depression of the patient, and the occasional diarrhœa accompanying it; but in both cases the rapidly advancing symptoms, and the steadily progressing physical signs, such as increased and scattered crepitation, if frequent careful examinations be made, ought to leave us in no doubt as to the nature of the case.

The diagnosis between scrofulous pneumonia (acute phthisis) and croupous pneumonia is not easy at the ushering in of these complaints, the physical signs not always sufficing for this purpose. In a short time, however, the detection of tubercle bacilli, and later of lung-tissue in the sputum, and the rapid wasting, make matters quite certain.

The diagnosis of chronic tubercular phthisis from anæmia and chlorosis, sometimes confused with it on account of the amenorrhœa often common to both, is made by the physical signs; by the different kinds of pallor in the two diseases; and, lastly, in chlorosis, by the absence of wasting. The diagnosis of excavation in phthisis from bronchiectasis is by no means easy, as the position of the cavernous sounds is not always sufficient to determine the nature of the lesion. Dilated bronchi are found in the subclavicular and interscapular regions, and where ulceration is proceeding in bronchiectasis lung-tissue may be detected in the sputum; but the presence of tubercle bacilli at once settles the question in lesions of phthisis, while the convulsive character of the cough, and the fœtid expectoration, abundant, but mixed largely with air, generally enable us to decide in favour of dilated bronchi.

DURATION AND PROGNOSIS.—Early detection of the disease, and improved treatment, have worked a great revolution in our ideas as to the *duration* of phthisis.

The estimates of Laennec, Louis, Bayle, and others assigned two years as the mean duration of life in phthisis generally. Pollock's statistics, founded on between 3,000 and 4,000 hospital cases, give a considerable extension of this, inasmuch as at the end of two years and a half the majority were sufficiently recovered to have a fair expectation of life.

The statistics of C. J. B. Williams and the writer, founded on 1,000 cases among the upper classes, give an average duration in 198 deaths of 7 years 8·72 months; and in 802 living of 8 years 2 months. The fact of these patients having all been one year and upwards under observation necessarily excludes some of the acute cases; but with this limitation these figures, striking though they be, may be taken as a correct average for the duration of the disease among the upper classes under modern treatment, especially as 72 per cent. of the living had recovered sufficiently to pursue their usual avocations, and many among them had already lived upwards of twenty years since their first attack. The duration of the disease is found to be considerably influenced by age; for it is longer in proportion as the age of attack is later, this retarding influence being more conspicuous among males than females. Females are attacked earlier, and the disease in them runs a shorter course by nearly two years than among males.

Of the varieties of phthisis, acute tuberculosis is the most rapid in its course, generally terminating in a few weeks, or occasionally in a few days. Scrofulous pneumonia has hardly a less rapid course, though it may occasionally be retarded, the disease becoming chronic, and the patient surviving for many years. Laryngeal phthisis has a short duration, and most unfavourable prognosis. Catarrhal phthisis has an average duration somewhat below the average of eight years of ordinary phthisis. Fibroid phthisis, on the other hand, exceeds the ordinary duration by nearly two years. Hæmorrhagic and scrofulous phthisis are both of long duration. These calculations are based on statistics of patients of the upper classes treated according to the best medical and hygienic treatment known; but if hospital cases are reckoned, the average duration of phthisis generally, and of its various forms, must be held to be much lower than the above estimate.

The prognosis in phthisis depends chiefly on the extent to which the system is infected, and especially whether or not other organs are the seats of tubercle. Cases of acute tuberculosis resemble closely those of pyæmia in their symptoms and fatal course, and only differ in the nature of the pathological products. Similarly single-cavity cases, where the disease is strictly limited, bear a strong resemblance to chronic abscesses, which go on discharging for long periods, without materially curtailing the life of the patient. The future, therefore, of the patient depends to a great extent on whether the disease may be considered local or general, though of course we admit in both instances a constitutional predisposition, possibly of different degrees of intensity. Where the infection is rapid and complete, as in acute tuberculosis and most instances of scrofulous pneumonia, the prognosis is most unfavourable. Where, again, the disease is limited to one lung, and associated with similar processes in the joints, as in scrofulous phthisis, which act as diverticula to the central disease, the prognosis becomes far more hopeful, and the individual may last on for many years.

The prognosis in laryngeal phthisis is most unfavourable, in consequence of these cases being always associated with extensive lung-tuberculosis; while in hæmorrhagic phthisis, where the pulmonary mischief is small and limited to the root of the lungs, it is favourable, excepting of course the accident of death during an attack of hæmorrhage. The most favourable prognosis of phthisis must be retained for cases of inflammatory origin, for here the disease often remains limited for considerable periods of time, and the patient may live on, almost unconscious of it, to the natural term of life. If, however, the fibroid element be largely produced, a new danger arises from the obstruction to the circulation caused by the contraction of the lungs, which may be followed by dilatation of the heart, dropsy, and death.

The influence of *heredity* on prognosis lies in its precipitating the onset of the disease, and not in its curtailing its duration, though, of course, an individual attacked earlier will die at an earlier age, the duration of the disease being the same. Maternal inheritance is worse for the children of both sexes than paternal, for while the father transmits with the disease a certain degree of resisting power, the mother transmits with the disease the lack of resisting power which is the characteristic of her sex. The influence of *stage* must be duly taken into account, for statistics show a far more favourable prospect for mere consolidation than when a cavity is formed, and this is obvious from the increase of danger arising from two sources, namely, from purulent infection and pulmonary aneurysms. The use of mountain climates is believed to have improved the prognosis of tubercular consolidation, and to have increased the percentage of recoveries in this stage.

The grounds for an unfavourable prognosis are: (1) rapid extension of disease or of lung-excavation; (2) persistent afternoon pyrexia; (3) symptoms of great irritability of the gastro-intestinal tract, red tongue, diarrhœa, pain in the abdomen; (4) great wasting with, or without, pyrexia, combined with a good appetite; (5) strong hereditary predisposition, showing itself in several brothers and sisters being attacked at an early age; (6) the presence of albumen in the urine, with or without some form of dropsy; (7) marked dyspnœa, especially if not warranted by the condition of the lungs; (8) the existence of considerable excavation in both lungs and the occurrence of pneumothorax.

TREATMENT.—The treatment of phthisis may be considered under four heads: (1) *treatment by inoculation*; (2) *medicinal*; (3) *dietetic* and *hygienic*; and (4) *climatic*.

1. *Inoculation.*—In 1890 Koch introduced the treatment of phthisis by hypodermic injection of *tuberculin*, a glycerine extract of a pure cultivation of tubercle bacilli, in which the parasites had been killed; and maintained that early-stage cases could be cured after four to six weeks of this treatment. Subsequent experience from all parts of the world did not confirm this statement, but demonstrated that, while tuberculin had a strong affinity for tuberculous lesions in various organs of the body and gave rise to characteristic constitutional reactions, it caused breaking down of the tubercular masses, and of the lung-tissue in their immediate neighbourhood, fresh eruption of tubercle, and extension of old cavities, the sputum containing an increased number of tubercle bacilli, and a considerable amount of lung-tissue. Virchow found in the necropsies of patients treated by this method various kinds of pneumonia, including what he termed 'injection catarrhal pneumonia,' and in one case tubercular meningitis, which he attributed to this treatment. Klebs extracted from tuberculin

an albumose called tuberculocidin, by treating it with platinum chloride, and certain alkaloids, and attributed to it the power of arresting tubercle; and these and other modifications of tuberculin have been tried in the treatment of phthisis, without any success.

2. *Medicine.*—The medicinal treatment must be directed to four objects: firstly, antiphthisical, to raise the standard of nutrition and to fortify the individual against the bacillar invasion; secondly, antiseptic or bacillicide, to promote the destruction and elimination of the bacillus tuberculosis; thirdly, to reduce and allay the local inflammations and congestions which accompany and considerably complicate the tubercular changes; and, fourthly, to relieve the various urgent symptoms. The first object is carried out by tonics, such as iron, quinine, arsenic, the mineral acids, and, above all, cod-liver oil, which has been shown to be the most effective agent of all in improving nutrition and rendering the individual less liable to bacillar attack. Some precautions are, however, necessary to ensure its being tolerated for long periods. The pale oil should be preferred, and ordered in doses of from ʒj to ʒss shortly before or after meals. The best vehicles for it are the vegetable bitters—such as gentian, calumba, quassia, nux vomica and strychnine, hop, camomile, and cascarilla—combined with an acid or alkali, according to the state of the gastric mucous membrane, and rendered more palatable by the addition of tincture or infusion of orange peel, or syrup of ginger. Various other vehicles are used, such as milk, salt and water, lemon-juice, orange wine, and sherry; while many patients, especially children, take it best in an emulsion, composed of cod-liver oil, a few drops of liquor potassæ or liquor ammoniæ, with an essential oil, like that of cloves or cinnamon, to cover the taste. In the great majority of cases cod-liver oil is well borne, if exhibited with discretion. Other oils are of use, but few equal the cod-liver oil in efficacy, on account of its great penetrative power, and of its forming with the biliary and pancreatic juices a compound easily absorbed by the lacteals. Malt extract and similar preparations, though of greatly inferior nutritive power to cod-liver oil, often cause increase of weight, chiefly by assisting the patient to digest more starch, and are often with advantage combined with cod-liver oil, forming a palatable compound; but the stimulating quality of the malt sometimes causes increase of the patient's cough, and does not augment appetite. Of greatly inferior utility to the oil are the preparations of phosphorus and sulphur.

In France the sulphur springs of Eaux-Bonnes, Cauterets, Bagnères-de-Luchon, and Bagnères-de-Bigorre are largely frequented by consumptives, the ground of this treatment being that the results of Claude Bernard's experiments show that sulphur when absorbed is excreted through the respiratory mucous membrane. Peter considers that any benefit that may accrue is owing to the influence of sulphurous acid on the catarrhal conditions. Arsenic appears to exercise a most beneficial effect in those consumptives who can digest it, and often under its influence fever and night-sweats disappear, and weight is gained; and the arsenical waters of Mont Dore, La Bourboule, and Royat are much frequented by consumptives.

The second object of treatment is antiseptic. The admixture of antiseptics with tubercle and tuberculous sputum has rendered the inoculation of guinea-pigs and rabbits with them harmless, namely, sulphuretted hydrogen, iodide of mercury, corrosive sublimate, iodine, carbolic (2 to 3 per cent.) and boric acid, helenine, creasote, phenyl-acetic and phenyl-propionic acids, and sulpho-carbolate of sodium. Some were actually mixed with tubercle, and then injected; others were injected afterwards, separately from the virus. All, when used in sufficient strength, were successful in checking the evolution of the disease in animals, and have been used in consequence in phthisis; but only with very moderate success. Moist heat is, however, the most powerful bacillicide; tubercular sputum can be rendered innocuous by exposure to a boiling temperature. The application of antiseptics has been made—(1) through the air-passages by sprays, inhalations, and 'antiseptic respirators'; (2) by hypodermic injection; (3) by injection per rectum of sulphuretted hydrogen and carbonic acid (Bergeon); (4) through the stomach as medicines; and (5) by intra-pulmonary injections through the wall of the thorax into tubercular cavities. It cannot be affirmed that any of these forms of antiseptic treatment have succeeded in destroying the bacillus or in counteracting the effect of the ptomaïnes which it is supposed to propagate; and far better results have been obtained by constitutional measures which render the individual less vulnerable to bacillar attack.

The third object of treatment, the reduction of local inflammation, is best accomplished by mild antiphlogistic means, such as salines, with or without antimony; and counter-irritation to the chest-wall by blisters, iodine, or vesicating liniments, mustard, or the milder but still effectual application of linseed-meal poultices. Steady continuance with these will often render sedatives for the cough unnecessary. The *pyrexia* in many cases does not require special treatment, but will subside under the general measures directed towards the reduction of local inflammation. Where this is not the case, and the excessive temperature, rising to 103° to 105° F., torments and wastes the patient, phenazone (gr. x. xv. every four hours) during the pyrexia, acetanilid and phenacetin (gr. v. twice a day), salicin (gr. v. to x. every four hours), or tincture of aconite (♏ v.) with digitalis, will cause temporary lowering of the body heat, with free perspiration.

The fourth object, namely, the palliative treatment, includes that of the various urgent symptoms.

The *cough*, when not reduced by the counter-irritation, may be to a certain extent allayed by a combination of sedatives, such as opium and its alkaloids, conium, henbane, diluted hydrocyanic acid, American cherry, with mild expectorants, of which chloric ether, lemon juice, and squill are examples. Where the cough is frequent and the expectoration difficult, and there is proof of active disease, tubercular or pneumonic, proceeding in the lungs, an effervescing saline, containing carbonate of ammonium, with small doses of opium and antimonial wine, taken two or three times at night, will greatly relieve the symptoms, the rule in the treatment of consumption being to restrict the sedatives, as far as possible, to the night, so as not to interfere with the appetite and digestion. The preparations of tar, in the form of capsule, pill, or solution, are useful in reducing profuse expectoration. The inhalations of iodine, compound tincture of benzoin, carbolic acid, creasote, larch, and turpentine are useful if expectoration is offensive or requires stimulating; or, again, those of chloroform, conium and hop, when the cough is convulsive and dry.

The *pains* in the chest may be alleviated by blistering, painting with tincture of iodine, or stimulating liniments, such as turpentine and ammonia; or else on Dr. Frederick Roberts's plan, by securing the immobility of the side by strapping.

Night-sweats, when profuse, may be reduced by oxide of zinc (gr. ij. to iv.), by gallic or sulphuric acids, by sulphate of iron, by arseniate of iron (gr. $\frac{1}{6}$ to $\frac{1}{3}$), or most effectually of all by the preparations of belladonna, in the form of the extract (gr. $\frac{1}{4}$ to gr. 1), or as the solution of sulphate of atropine (♏ j. to ij.), or used hypodermically; but these often cause dryness of the mouth and fauces. Dover's powder in 10 gr. doses is useful, but nitrate of pilocarpine (gr. $\frac{1}{20}$), and picrotoxine (gr. $\frac{1}{80}$, in form of a pill), are more effectual.

Diarrhœa, where due to bilious derangement and an acid state of the primæ viæ, is best treated by mercurial aperients, combined with carbonate of sodium or lime water. Where it partakes of the nature of a flux, accompanied by a pale tongue and great debility, it may be checked by astringents, such as hæmatoxylum, catechu, krameria, bael, and carbonate or subnitrate of bismuth. When ulceration of the intestine is present, it is generally but not always characterised by a red, irritable tongue, pain and tenderness of the abdomen, and persistency of the diarrhœa. Here, as in other forms of ulceration, opium and its alkaloids answer best, and may be given internally with sulphate of copper (gr. $\frac{1}{4}$ to $\frac{1}{2}$) every three or four hours. When the stomach is too irritable to tolerate medicine by the mouth, opium or morphine suppositories are useful, but still better are opiate enemata, which, acting more directly on the ulcers, check the pain and diarrhœa, and often afford considerable relief. The amount of injection to be used at a time must be regulated by the probable extent of ulceration; and as a vehicle, in cases of irritability, linseed tea will be found most serviceable. In very obstinate cases tannic acid (four to five grains) and acetate of lead (three to four grains) may be added to the injection. The opposite state of bowels, namely, constipation, is very common in the early stages of phthisis, and is best corrected by changes in diet, such as the use of brown bread and oatmeal, cooked and fresh fruit, regular exercise, and, if these prove insufficient, a mild aloetic or rhubarb pill, or the use of some mineral water, as Friedrichshall, Pullna, Carlsbad, Æsculap, Rubinat, Hunyadi Jànos, and others.

The *dyspnœa* of advanced cases generally arises from difficulty of expectoration and the greatly curtailed respiratory power, and may be relieved by spirit of ether, carbonate of ammonium, and other diffusible stimulants, or by the inhalation of oxygen or of iodide of ethyl (capsules ♏ iij. to v. for inhaling). The pain arising from perforation in pneumothorax is best treated by diffusible stimulants, and strapping the side to limit the movements of respiration; and if much liquid effusion or accumulation of air takes place, it is sometimes advisable to tap the chest; but, as a rule, the state of the patient does not allow of very active measures.

Bed-sores should be prevented by the use of a water-bed, and the skin of the dependent parts can be fortified by a lotion of spirit and water (1 part in 4). If a bed-sore has formed, it is best to protect it from friction by the use of circular air or down cushions, or thick felt plaster, and the raw surface can be painted with collodion, or be regularly dressed.

3. *Diet.*—The great object being to introduce as large a quantity of nutritious food as can be digested, abundance of meat, plainly cooked, with fresh vegetables, and a fair amount of bread and starchy food, should be given. Fatty material, if it can be digested, should be largely represented in the dietary, and many physicians advise large quantities of cream, butter, and suet; but, considering the large amount of fatty matter included in cod-liver oil, which is a severe test at first to

the digestive powers, it is not advisable to increase the amount of fat until the oil is well tolerated. Milk, if it agrees (1 to 1½ pint a day), alone or with lime water, is a staple food for the consumptive; and when cow's milk disagrees, ass's or goat's—the unpleasant flavour of the latter disguised by orange-flower water—may be substituted with advantage. Koumiss and Kèfir, prepared from fermented mare's or cow's milk, are frequently used in Germany and Russia, but they have not become popular in this country. The digestive powers being, as a rule, weakened, much good may be done by the addition of animal ferments, such as liquor pepticus and liquor pancreaticus, to the food, which, becoming peptonised, is much more easily assimilated (*see* PEPTONISED FOOD). In the early stages stimulants are not largely required, as they increase the cough and lung-irritation; but when the strength fails, and the powers of digestion are weak, they may be given frequently in the form of brandy or whisky, and advantageously combined with liquid nourishment, such as eggs, soups, various meat-essences and panadas, arrowroot, and jelly. When wine is required, in chronic cases, it will be found that claret, hock, sauterne, and chablis tend to irritate the cough less than the stronger wines. Champagne should be given where the prostration is great, and it often is useful in aiding expectoration. In cases of laryngeal phthisis where the dysphagia is urgent, it is often advisable to feed the patient by nutritive enemata or suppositories.

Hygiene. — The consumptive patient should inhabit a well-ventilated, well-drained house, built on a dry soil, sand or gravel, sheltered from cold winds and well exposed to the south, not hemmed in by trees, the most suitable for the neighbourhood of the house being of the coniferæ order. The bedroom should be lofty, provided with a fireplace for warmth and outlet ventilation; and unless the cubic space be abundant, 1,500 to 2,000 cubic feet per head, inlets for the supply of fresh air, in the form of Chowne's tubes, should supplement the ordinary indraught of the door and window. Both bedroom and sitting-room should be exposed to the sun's rays, for the vivifying influence of which there is no substitute; and it is well to secure for the patient himself their benefit as long and as often as possible. Even pyrexial cases are the better for being exposed (as is the custom in German hospitals) on couches in open balconies adjoining the wards during the best hours of the day, and thus enjoying the full influence of sunshine and fresh air. The sputum should be received into a vessel containing a disinfectant, to be frequently emptied, or it may be burnt, as is done at the Hospital for Consumption and Diseases of the Chest, Brompton.

Clothing and Exercise. — The underclothing should be woollen, either flannel or lambswool, or perhaps in summer merino may be allowed, the object being to secure a good non-conductor of changes of the temperature which will, at the same time, absorb cutaneous moisture. The rest of the clothes must be adapted to the season, the invalids, male or female, always bearing in mind their greater liability to catarrh than ordinary persons, and using wraps freely, more especially when driving. The wearing of respirators, though undoubtedly a protection against cold, is not always desirable, as, unless the wire meshes are widely separated, they considerably impede free respiration, and form a kind of muzzle. A woollen scarf passed over the mouth and nose, in the fashion of omnibus drivers, or for ladies a good Shetland veil or 'fleecy cloud,' answers the same purpose without obstructing respiration.

Exercise must depend on the stage of the disease and the strength of the patient. In the first stage, especially when the disease is limited to one lung, and no fever or hæmorrhage is present, active exercise in the form of walking is advisable. Under careful superintendence, certain gymnastic exercises may be of benefit, which, by raising the arms, lift the upper ribs, and increase the size of the thoracic cavity, especially in the upper regions, and thus necessitate a larger inspiration of air; and in time this leads to further development, and even to hypertrophy of the healthy lung. Emphysema may be produced in the diseased lung by this means, which is useful in limiting any further advance of infective tubercular disease.

Riding is excellent for a large number of patients, being intermediate between the active and passive varieties of exercise. Where the disease is more extensive and advanced, only the passive forms of driving and sailing are possible.

4. *Climate.*—The main point to be held in view is to give the consumptive a climate in which he can breathe freely, take abundant outdoor exercise, and experience that amount of stimulating influence which, while it improves his appetite and powers of digestion, does not irritate the mucous membrane of the lungs or increase the cough. The selection is generally difficult, and not only depends on the class of cases, but must be sometimes modified by individual peculiarities. *See* CLIMATE, Treatment of Disease by.

The writer's statistics, founded on 251 consumptives, who passed one or more winters in warm climates out of England, assign the most favourable results to sea-voyages, and the next to Egypt and other dry climates. The Mediterranean basin, including Riviera, Malaga, Algiers, and the islands of this sea, follows next in point of success; while the moist temperate climates of Pau and Rome give far less good results, and Madeira only slightly surpasses these. The same statistics show the foreign health-stations to be on the whole more successful in prolonging life than the English ones; but we must not forget that the most advanced cases fall to the lot of the latter, on account of the difficulty of travelling; and, on the other hand, a great advantage enjoyed by the home stations is the superiority of the food, which may in some degree compensate for the smaller number of days in which exercise can be taken, and the greater vicissitudes of weather. Of the British Channel health-resorts the more easterly, such as Hastings, Ventnor, and Bournemouth, have afforded more favourable results than Torquay and Penzance. It is impossible in a few sentences to lay down rules for climate-selection, but a few general outlines may be given of the suitability of different groups of agencies.

The British south-coast stations are beneficial in scrofulous phthisis, and in many cases where the appetite is poor, and tendency to catarrh not the prevailing feature. They are beneficial too in cases of chronic limited cavity. In the catarrhal form of phthisis the Canary Islands, Madeira, and the West India Islands, especially the Blue Hills of Jamaica, are advantageous; the combination of warmth with saline influence, and the absence of stimulating qualities, seeming to answer best.

Dry stimulating marine climates, such as the Riviera and Malaga, are recommended in phthisis supervening on inflammatory attacks, and in all cases where it is desirable to combine stimulating influence with a moderate degree of warmth, and decided dryness of atmosphere. Where greater warmth with a little more moisture is required, Algiers, and the islands of Corsica, Sicily, and Corfu will suit better. As better examples of warm dry climates may be instanced those of the Pacific—of Sierra Madre, Coronado Beach, Santa Monica, and Los Angeles.

Where the stimulating influence is undesirable, as in patients of excitable temperament, or irritable gastric mucous membrane, the *very dry inland climates*, like those of Egypt or South Africa, are preferred.

Sea-voyages to South America, Australia, and New Zealand, round the Cape, or the shorter one to the Cape itself, are indicated in cases of hæmorrhagic phthisis, of scrofulous phthisis especially with fistula in ano, of phthisis with emphysema, in cases of limited first or third stage, where the strength is unequal to much exercise, and where the patients have suffered from overwork or close confinement in crowded cities. *See* SEA-VOYAGES.

High altitudes.—The considerable mass of testimony in favour of this form of climatic treatment for consumption, in Europe, Africa, and North and South America, has rendered it the most popular one of the day. The writer's statistics of 247 consumptives treated in Davos, St. Moritz, Colorado, and the South African highlands show that in unilateral tubercular consolidation more or less extensive improvement occurred in 97½ per cent., and complete arrest of the disease in 66⅓ per cent., and that even in bilateral cases the percentage of arrest was 40. The results in cavity cases were not so favourable, about 54 per cent. improving and 35 per cent. becoming worse. These results are the most favourable, but it must be remembered that the greater part were achieved in incipient and limited cases after residences varying from months to years.

At present the Andes, the Rocky Mountains, and the Alps, and even the South African highlands, are frequented by consumptives; but the conditions of temperature and altitude manifestly vary greatly, and while the climates of Quito and Santa Fé di Bogota resemble in temperature that of Malaga, the winter extremes of Davos and St. Moritz in the Alps are more nearly akin to those of Canada. The Colorado climate is a very sunny mountain climate, with considerable extremes, but drier than the Swiss. In all these places, however, there exists a distinctly specific influence apart from that of heat and moisture, in the form of diminished barometric pressure, producing rarefaction and diathermancy of the atmosphere, which is shown in the patients residing at high altitudes. The chest becomes expanded, and hypertrophy of the healthy lung-tissue takes place, accompanied by vesicular emphysema around the lesions. Patients with tubercular consolidation of one or both lungs, provided the lesions admit of sufficient lung surface for proper aëration, the powers of the circulation be sufficiently good to allow of exercise, and there be no pyrexia, are the proper cases for this form of climate, and in many of such complete arrest of the disease may perhaps be predicted. These high altitudes are also suited for hæmorrhagic phthisis or phthisis of distinctly hereditary origin, provided it be not too advanced; and they are contraindicated in (1) old patients, (2) catarrhal and laryngeal phthisis, (3) phthisis with albuminuria, (4) phthisis with double cavities, and wherever the extent of the disease or the condition of the lung places the patient in the category of 'advanced cases.'

C. THEODORE WILLIAMS.

PHYSICAL EDUCATION.—INTRODUCTION.—*Physical education* concerns itself with the fullest development of the body, just as education, in the general sense of the term, has for its object the fullest development of the manifold qualities of the mind. A child of normal faculties brought up in the midst of a civilised people, and deprived of systematic teaching of any kind, would, when manhood was reached, exhibit a degree of intellectual development which might surprise those who can conceive no mental worth unless it be the product of the pedagogue. An individual thus left to himself would learn much from observation, experience, and example, but the methods of his mind would be clumsy and imperfect, and he would lack those arts whereby knowledge can be economically and systematically acquired and conveniently employed. He would, in fact, remain imperfectly developed, and would have missed the opportunity of making the best of his faculties.

It is precisely the same with the physical development of the body, if it still be assumed that the individual is born among a civilised people. To simply leave a child to his own devices when he is not engaged in school work, is not to provide him with a sound or even an efficient education of the body. It must be borne in mind that the modern child has departed very far from the primitive savage, and that his environment, the claims upon his energies and the trammels of civilisation, no longer render it possible to leave the perfecting of his body solely to 'nature.' It cannot even be said that the physical development of the higher race of savage, when mythological matter is excepted, leaves nothing to be desired.

Physical education, therefore, to be of the highest service, must be precise and systematic, must be graduated and progressive, and must be adapted to the personality of the individual. It must be conducted, indeed, upon precisely the same lines as is the better formulated education of the mind.

Physical education involves exercise and movement. Save by exercise, there is no means of developing any portion of the organism, even provided that the supply of food and of air be sufficient. Exercise means growth, functional vigour, and the maintenance of a high standard of organic life. Undue rest is followed by feebleness and decay. Absolute rest is found only in death.

It is assumed in the present article that exercise is confined within proper limits. The subject of the abuse of physical exercise is dealt with in another article. *See* EXERCISE.

1. The effect of Exercise upon the Body.—Exercise increases the size of a muscle, the stoutness of its tendon, and the power it can command. The stronger the muscles, the finer and denser are the aponeuroses with which they are connected, and the firmer are the fasciæ which hold them in position. Muscles act upon articulations. The duly exercised joint has a good covering of cartilage, powerful ligaments, and well-developed bony parts. Exercise, moreover, influences the size of the bones upon which the muscles act, renders them stronger and denser, and emphasises their anatomical details.

Exercise induces a more vigorous respiration, and under increased breathing efforts the lung-capacity and the size of the thorax are augmented. It accelerates also the blood-circulation, and the effect of an increased blood-supply upon the size and condition of the tissues concerned is well known.

The secret of the size and proportions of the future man lies buried in the ovum from which the individual is developed. It may be said, indeed, that there are two proportions possible in every human body: first, that which is congenital, inherited, and predetermined; and, secondly, such an increase or modification of these proportions as may be effected by proper exercise.

The child of short and stunted parents will probably also be short and stunted, and remain so in spite of an elaborate physical training.

A young child is a very plastic object, but it cannot quite be moulded as potter's clay; and there are many cases of congenital narrowness of chest and lack of symmetry in limbs which no system of physical education can remove.

The effects of systematised exercise upon the growth and development of the body have been demonstrated by many observers, and have been expressed in the form of actual measurements by Maclaren and others. In the *Report* of the Anthropometric Committee, the measurements of eighty-nine professional and amateur athletes are given, with the following results: 'Their average stature exceeds that of the general population from which they are drawn by 0·68 inch, while their average weight falls short of that standard by 14·5 lb. The ratio of weight to stature is 2·100 lb. in the athlete, 2·323 lb. in the general population, for each inch of stature.

In noting the effects of physical exercises by means of measurement, the most conspicuous attention is drawn to the increase in height and in the circumference of the chest. In young subjects there is strong evidence in support of the belief that systematised exercise may actually increase height. In cases in which the training has been commenced after the growth of the body has ceased, any increase in stature is to be ascribed to a straightening of the spine and an improved carriage.

In considering the general question of increase in chest-girth, care must be taken not to ascribe this improvement—as some are apt to do—entirely to an increase in the capacity of the thoracic cavity. This is probably in all cases of much less effect than muscular development. In measuring the chest, the tape passes over those very muscles which are prone to the most conspicuous development in those who practise gymnastic exercises, for example, the pectorals and the great muscles passing from the trunk to the upper limb. The effect of proper exercise in augmenting the respiratory capacity to a certain degree is, however, undoubted.

A physical training does something more than merely increase the size of the limbs, and add to the stature. It tends to render all parts of the body symmetrical, and more perfectly proportioned. Of all animals, man is the most subject to variations in proportion and symmetry. Not only do children often grow in a fitful and irregular manner, but they may exhibit unequal developments, one side appearing to be larger than the other. Such deviations, which are distinct from actual deformities, a well-directed system of training will usually correct.

There must needs be a limit to the growth of muscles, and those exercised to too great a degree will, after attaining a certain size, commence to waste.

Moreover, from exercise there result an increase in the contractile force of the muscles, and an improvement in the speedy and complete contraction of their fibres. The muscles of an athlete when in training contract with extraordinary force under the electric current; the muscular sense is developed to its utmost; the perfection of the reflex act is attained; the power of coördination possessed by the individual is augmented; and movements at one time complex and difficult are carried out with ease. In this way the nervous system is saved a great expenditure of force.

One conspicuous feature in muscular training is the increase in the possibilities of automatism, and another remarkable element is the economy of force which results from muscular education. He who has been well trained physically, possesses not only a complete, but an intelligent, use of his muscles. His movements are powerful, are under absolute control, are precise, and capable of the finest and most elaborate adjustment. The art of the athlete consists not in employing the greatest amount of power in effecting a movement, but in carrying out that movement with the least possible expenditure of force.

Not only does a systematic training promote the fullest growth of the body, and help the individual to attain to something approaching a perfect symmetry, but it gives to him an easy and graceful carriage, and a bearing which has about it the mark of vigour and completeness. With suitable exercises, the shuffling and shambling gait disappears, the loutish boy ceases to look loutish, and the gawky girl no longer excites comment, rounded shoulders become square, and bending backs are made straight. The athlete, so far as his body and his personal equation are concerned, has reached the full and perfect stature of a man; and the girl whose physical education has been complete, reaches her point of physical perfection as a woman. It must not be forgotten that the beauty of the body depends upon a fully formed skeleton and perfectly developed muscles, and not upon deposits of fat.

The tissues of the ill-developed are flabby and lacking in elasticity and consistence; those of the well-developed are, on the other hand, firm, resisting, and full of evidence of living. The delicate and sensitive complexion of a young woman whose physical training has been efficient is in conspicuous contrast with the dull lustreless integument of the individual who 'never stirs out of the house.' The skin of the recluse is grey, greasy, and unpleasant-looking. Exercise involves more living in the open air, a freer and deeper respiration, and the coursing of a more vigorous flow of blood through the integuments. In the matter of personal comfort, no greater sense of pure pleasure can illumine the human mind than that which results from perfect health; and such health cannot be attained without a full exercise of the manifold energies of the body. He who takes no exercise remains an imperfect creature—he misses at least one-half of the delights which are available to man during a comparatively short existence, and it is not to him that 'joy cometh in the morning.'

2. **The effect of Exercise upon the Mind.**—Moderate, regular, and systematic exercise, by stimulating the circulation of the body, improves also the circulation of the brain, and is therefore an aid to cerebral movements. By improving the health and physical strength it increases the capability of the individual for mental work, and for the physical strain consequent upon mental concentration. It offers, too, an admirable change of employment, and in this way becomes a valuable means of rest. 'Prescribe fencing, gymnastics with apparatus, and lessons in a riding school,' writes Dr. Lagrange, 'to all those idle persons whose brain languishes for want of work. The effort of will and the work of coördination which these exercises demand will give a salutary stimulus to the torpid cerebral cells. But for a child overworked at school, for a person whose nerve-centres are congested owing to persistent mental effort in preparing for an examination, we must prescribe walks or rides, the easily learnt exercise of rowing, and, failing better, the old game of leap-frog and prisoner's base, running games—anything, in fact, rather than difficult exercises and acrobatic gymnastics.'

An excessive and absorbing indulgence in physical exercises is undoubtedly bad, and it may be that in some public schools too great significance is attached to mere athleticism. The all-engrossing pursuit of athletics tends to make the individual too much of an animal, and to afford neither time, opportunity, nor suitable conditions for the development of his brain. Still, on the other hand, in these days of cramming and intense competition, many a man can base his success in life upon physical health before all things; and there are not a few who have attained to eminence among their fellows who have to thank Providence for the tardily recognised blessings of an idle youth.

The systematic and properly arranged pursuit of physical exercise tends to develop certain admirable qualities, and notably those which are so much prized among Englishmen, and which are well designated as 'manly.' These qualities are brought out in those who are enthusiasts in outdoor sports and games. The football player has done more than merely develop his muscles; and the man who has rowed in his college eight has learnt something beyond the mysteries of the sliding-seat. Such lads and men have learnt in a school where the principles of pluck, courage, endurance, and self-reliance are acquired. They will have learnt to be ready, to be quick of eye and hand, and prompt in judgment. They will have appreciated the value of discipline and of self-control. They will have felt the inspiration of the chivalry of days gone by, and have experienced the influences of good fellowship and loyal comradeship. They will probably have learnt what it is to be patient, to be fair, to be unselfish, and to be true. The following utterances by the head-master of a large public school in England are worthy of note: 'The worst boys intellectually, physically, and morally are the loafers.' 'The boys who work hard and play hard do not ape the vices of men, and are free from the insidious evils that often fasten on unoccupied boyhood' (*Cathcart's Health Lectures*: Edinburgh, 1884).

3. The Elements of Physical Education.

(*a*) *The exercises should be adapted to meet the needs of each individual case.*—The object of a proper physical education is to develop health and not mere strength, to bring the body to its highest degree of perfection, and not to convert children and youths into gymnasts and acrobats. Its principal purpose is to best fit the individual for the duties and work of life, and not to elicit proficiency in mere feats of skill and adroitness.

It must not be forgotten, moreover, that individuals vary greatly in the quality of their physical powers, and in their capacity for muscular exercise. It is just as impossible to form a great mass of children into one gymnastic class as it is to place those children in one school standard under one teacher. Neither age, height, size, nor sex affords sure means of classifying children, so far as the needs of a proper physical education are concerned. Each individual must be considered upon his or her own especial merits, and there is no method of physical training which is universal or all-sufficing, and adapted for all sorts and conditions of human beings. The sending of a child to a gymnasium, or the placing of it under the care of a drill-sergeant, is as crude a procedure as the conducting of a child within the walls of the first school met with, and leaving it there with the impression that it will somehow be educated. Physical education requires as much care as does mental education, and calls for as much subdivision both in the teaching and in the taught. Before planning out a course of instruction, a child's physical condition should be inquired into with as much care as is exercised in examining an adult for life insurance.

(*b*) *The exercises should be carefully devised, systematically arranged, and suitably graduated.*—The exercises should be planned upon a definite system, should be suited for the individual, and should aim at the equal employment of all the muscles, and not at the developments of a few. The work in an ordinary gymnasium tends to throw strain mainly upon the upper extremities, while most of the outdoor games tend to develop the lower limbs. No great good can be obtained from tedious drilling and purposeless marching, and the time devoted to physical training should never be so absorbing as to allow no leisure for games and other pleasant forms of recreation. It is desirable that the lessons should be as varied and as interesting as possible, and that reasonable opportunity be given for competition, and the encouragement of those who are specially fitted to excel. In every instance violent intermittent exercises should be forbidden, and the performance of feats of strength should never come within the scope of the education scheme.

(*c*) *The exercises should be carried out under proper guidance, and with suitable and efficient apparatus.*

(*d*) *The time for the exercises should be carefully selected.*—Violent exercise after a full meal is obviously bad, and a course of physical instruction should not be carried out in the case of children who are tired from a long day's attendance in school, or who are feeble from want of food.

In the matter of schools, it is well that the period for physical training should be interpolated among the hours devoted to ordinary school work. The Rev. Dr. Warre, of Eton, advises that a schoolboy's day should be disposed of as follows: Rest, ten hours; work, seven hours; meals and play, seven hours.

So far as adults are concerned, the taking of violent exercise in the evening, after a long and arduous day's work, is often injurious in its result. There is no better time for such individuals than the early morning.

(e) *Exercises, so far as is possible, should be taken in the open air, or in a large and well-ventilated room, and the subjects of the instruction should be properly clad.*—The atmosphere of many gymnasia and fencing saloons is, especially in the winter-time, close and unwholesome. The garments worn should be light, loose, and always made of wool.

4. The Selection of Exercises according to Individual Needs.

Children.—The physical training of the child should be commenced early, should be made as interesting as possible, and be represented in the main by what may be termed scientific romping.

The exercises should be given, whenever possible, in classes.

The set exercises should not be too formal, and never be too long; and in no instance should they be allowed to take the place of the ordinary outdoor games of children.

Games which involve shouting should be encouraged, and a very prominent position given to running, skipping, games with balls, and jumping.

The most rudimentary of all games, 'touch,' is one of the most excellent. The upper limbs may be encouraged by such amusements as battledore-and-shuttlecock, and the lower by such a game as hop-scotch.

The set exercises should take the form of what are known as Swedish gymnastics, the vocal march, musical drill, and the class exercises with dumb-bell and bar-bell.

Children should avoid exercises of strength; and, in the main, exercises of speed. There is little need for especial gymnastic apparatus. Those best suited for children are the climbing-rope, the inclined ladder, the vaulting-horse, and the parallel bars. The detailed exercises are described in the writer's work on *Physical Education* (London: 1892).

Girls and Women.—The physical condition of a large proportion of the girls and women in this country is quite deplorable, especially among the middle and upper classes. It is apt to be ascribed not to a totally neglected education, but to the belief that growing girls are always awkward, uncouth, and weedy. This belief is not well founded.

The girl is too often encouraged to be dull, to be prim, to be subdued, to suppress the outbursts of pure animal spirits. She is more or less under the curse of that detestable adjective, 'lady-like.' She spends hours in an ill-ventilated schoolroom and upon a piano-stool, and the rest of her time is occupied in eating and sleeping, in preparing lessons, in stooping over needlework, and in taking formal walks with the governess.

A good digestion and vigorous lungs are more useful to a woman in the battle of life than a knowledge of advanced mathematics; and sturdy limbs and strong hands are of more value to the mother of children than even decimal fractions and a familiarity with irregular verbs.

Younger girls may pursue the exercises named in dealing with the education of children. Those who are a little older have an infinite variety of healthy pursuits at their service—running, skipping, outdoor games, riding, skating, swimming, cricket, games with balls, archery, tennis, and certain exercises in the gymnasium. They should practise also such movements as develop the abdominal muscles, and should never neglect rowing.

Fencing in moderation is good; a tendency to flat feet and weak ankles may be met by such games as hop-scotch, by step-dancing, and the hornpipe.

Cycling may as well be avoided, and jumping is probably not advisable for girls who have passed the period of puberty.

For women, such exercises as have just been detailed are open, with the obvious modifications which their age and dispositions suggest.

Lads.—Lads between fourteen and eighteen have almost every form of exercise and physical recreation open to them. They should avoid feats of strength, paper-chases, and exercises of extreme speed, such as sprint-running, which are apt to cause strain of the heart as well as other kinds of injury.

Adults.—Adults between eighteen and twenty-five have the whole of the joys of the athletic world open to them, and if a man keep in training and in practice his period of athletic life may be extended to thirty. The middle-aged and elderly must anticipate a progressive curtailment of their more active pursuits. There remain, however, walking, and all the milder forms of outdoor exercise—riding, rowing, skating, cycling, golfing, and the use of the simpler gymnastic apparatus. After thirty, few men are capable of undertaking exercises of speed without actual risk.

FREDERICK TREVES.

PHYSICAL EXAMINATION.—The object of a physical examination is to ascertain the precise seat, limits, and characters of those evidences of disease which are recognisable by our senses, and which are called physical signs. In making such an examination we bring to bear all our senses, with whatever instrumental aids may be available, to detect the signs of disease. In the present article a description will be given of the physical examination of—(1) the Patient Generally; (2) the Cerebro-spinal System; (3) the Respiratory System; (4) the

Organs of Circulation; (5) the Mediastinum; and (6) the Abdomen.

1. General Survey.—Our attention will first of all be naturally attracted to the *physiognomy* of the patient, that is, to his general appearance and build. We note his apparent *height* and *weight*, and, if possible, correct our observation by scale and measure. We observe the *state of nutrition*, firmness or laxness of muscle, corpulence, thinness, emaciation—atrophy of any particular muscle or group of muscles. The *complexion* of the patient is to be remarked, whether clear, sallow, dark, fair, jaundiced, or pigmented: also lividity or pallor of surface and mucous membranes. The *apparent age* as contrasted with actual years of the patient; elasticity of features, condition of hair, presence of arcus, &c. The *symmetry* and *play of features*, the expression whether of vivacity, despondency, suffering, anxiety, paralysis, or hysteria. *See* PHYSIOGNOMY.

Whilst making these preliminary observations, a general outline of the history of the patient and of his present illness will have been elicited.

The *pulse* should next be noted (*see* PULSE). We may, in important cases, extend our inquiries or record our observations by means of the sphygmograph. *See* SPHYGMOGRAPH.

The *respiration* of the patient requires attention as regards rapidity; mechanism, that is, whether abdominal or thoracic in normal proportion; rhythm, regular or irregular, easy or laboured; and freedom or otherwise from pain. The action of the nares, and any recession or otherwise of soft parts during respiration, should be especially observed.

In health and under physiological conditions of age, exercise, emotion, &c., there is a tolerably constant ratio between the respiration and pulse-rate, namely, one respiration to from three to four pulse-beats. In disease this ratio is often much altered. The average respiration-rate in a healthy adult is from 17 to 20 per minute, in the infant about 40 per minute, between one and five years about 26 per minute. In old age the respirations are very slightly accelerated: in children they are quick and often irregular, being momentarily suspended by anything that excites their wonder or close attention.

The *odour of the breath* may attract attention. It may under morbid conditions be fœtid, urinous, 'mercurial,' alcoholic, or gangrenous. *See* BREATH, THE.

The condition of the *skin*, whether dry or hot, moist or sweating, and the presence or absence of any eruption, scars, ulcers, or pigmentation, will be duly noted. The presence of *pyrexia* will be exactly ascertained by the use of the clinical thermometer, an instrument which ranks with the stethoscope in value; but the employment of the thermometer does not exclude the necessity of testing the condition of the surface by the hand, whereby we observe the resultant, so to speak, of the bodily heat, tempered it may be by evaporation, or exaggerated by undue dryness in exposed parts. Probably the use of the surface thermometer, in combination with the ordinary clinical instrument, would more exactly give us this information, upon which important therapeutical indications rest; but the hand of the skilled observer fully suffices for the purpose. The surface thermometer is of value in estimating localised elevations of temperature; for example, over the site of an empyema, in peritonitis, and in connexion with certain nerve-lesions. *See* THERMOMETER, CLINICAL.

The condition of the *finger-ends*—clubbing, lividity—must be observed. Important information as to the previous acute illnesses within the past six months can be obtained by inspecting the nails, a transverse furrow marking the period of defective or arrested nutrition during such illness.

The condition of the *teeth* may indicate previous illness or syphilitic inheritance.

The state of the *eyes*, and especially any irregularity of the *pupils*, requires attention.

The condition of the *tongue* and *gums* furnishes us with valuable information.

The careful superficial inspection of the patient in the manner above sketched will perhaps at once lead to a more minute examination of some one organ or system of organs as the probable seat of disease; and having thus far succeeded in locating the disease, the other organs and functions of the body will of course come under review, but the physician will be more especially inquisitive with regard to such organs or functions as may be in sympathy with those in which disease has been detected.

It may be, however, that on careful examination we fail to find any organic lesion to account for the symptoms present, and for signs of wasting, pyrexia, &c., which notify the illness of the patient. We may then—but not till then—refer the case to one of those blood-conditions which for a time run their course without manifesting any definite lesion.

Again, it may be that certain signs of general illness, and especially pyrexia and wasting, cannot be accounted for sufficiently by the amount of disease discovered. Here we must suspect that the lesion we have ascertained is but an expression of a more general state.

Having made these remarks—relating to orderly measures of inquiry, without a due regard to which no physician or surgeon, however skilful in any one department, can fail to commit the errors of the narrowest specialist—we will proceed to consider the physical examination of those regions of the body, especially the chest and abdomen, in which objective signs can be accurately observed.

2. **Cerebro-spinal System, Physical Examination of.**—The objective phenomena of disease affecting the nervous system are often very obscure, and it is the more important that they should be sought for in a methodical manner.

(*a*) The Head.—The head should be examined as to size, shape, condition of fontanelles, the presence of wounds, tumours, or depressions.

The *size* of the head varies greatly in different persons and individuals, without any seemingly corresponding variation in the condition of the brain. It is very difficult to say whether enlargement of head is due to thickening of the skull or enlargement of its contents. In rickets and in hydrocephalus the head is relatively large; in idiocy relatively small.

The *shape* of the head is of more importance than the size. We may recall the long head, with square, high forehead, of rickets; the broad, vaulted skull, with shallow orbits and prominent eyes, of hydrocephalus.

The condition of the anterior fontanelle must be carefully observed in all cases of children with cerebral symptoms—it should be neither tense nor depressed.

The detection of *local changes*, such as thickenings, tumours, scars, or depressions over the skull, will throw much light upon a case presenting cerebral symptoms.

(*b*) The Spinal Column.—The spinal column must be carefully examined for undue prominence or depression of spinous processes, or other tumours, and for lateral or antero-posterior curvature. Kneading and percussion should be employed over each spinous process to elicit any tenderness. The fingers should be passed firmly along the spinal groove on either side to ascertain if there be any painful point, and much care must be taken not to confound such pain (commonly neuralgic) with true spinal tenderness. The application of the hot sponge, or ice-bag, successively to different parts of the spine is a means of eliciting valuable signs of disease.

In all cases of suspected spinal or cerebral disease the *superficial* and *deep reflex actions* should be tested, as affording important indications respecting the integrity of successive portions of the cord, and the condition of the parts above. *See* Spinal Cord, Diseases of.

By the *ophthalmoscope* an example of the cerebral circulation may be observed in the retina, and the condition of vessels noted. Certain lesions of the optic disc correspond also with deeper and more widespread nervous disease (*see* Ophthalmoscope in Medicine). By the use of *graduated compasses* the sensibility of the peripheral nerves may be estimated. *Electricity* enables us to ascertain the irritability of voluntary muscles; and by the *dynamometer* we may compare muscular power on the two sides. *See* Electricity in Medicine; and Dynamometer.

Further details respecting the diseases of the nervous system, and the methods for their diagnosis, will be found under appropriate headings.

3. **Respiratory System, Physical Examination of.**—The respiratory system includes the respiratory tract and lungs.

(A) Larynx.—The condition of the larynx and trachea is examined into by listening to the voice, whether husky, altered in tone, or suppressed. Any tenderness or external deformity is ascertained by careful palpation.

By means of the laryngoscope the condition of the epiglottis, larynx, and trachea can be thoroughly explored. *See* Laryngoscope; and Larynx, Diseases of.

(B) Chest.—In making an examination of the chest, the physician should follow a methodical routine of **inspection, palpation, percussion,** and **auscultation.**

(1) **Inspection.**—The *general shape* and *build* of the chest is observed—whether it be the broad, well-formed chest of robust health; or the small, narrow, long chest, with antero-posterior and lateral diameters diminished, costal angle narrow, and ribs oblique and approximated—adapted to small lungs. Or the thorax may be unduly expanded, with wide intercostal spaces, straightened ribs, widened costal angle, and deep antero-posterior diameter, to accommodate large lungs. Again, the thorax may be distorted by various kinds of spinal curvature, or as the result of rickets, or from external pressure, as in the depressed lower sternum of shoemakers (*see* Deformities of the Chest). Lastly, there may be *local* flattenings or bulgings.

The *movements* of the chest are of great importance in diagnosis. We estimate the freedom or otherwise with which air enters the chest during inspiration by the equable expansion of its several parts, or by the immobility or recession of any portion the entry of air into which is retarded or impeded; and this can be accurately done by means of the pneumograph. In cases of general obstruction to entry of air, whether by impediment at the main air-passage or in its entire distribution, there is universal recession of all the soft parts—the supraclavicular region sinks downwards, the hypochondria recede, and the intercostal spaces deepen during the effort to expand the chest against atmospheric pressure. On the other hand, when the difficulty of expansion, whether from intrinsic disease or obstruction of passages, is restricted to one side of the chest or to a portion of one lung, the restrained expansion during inspiration is limited to that portion. Thus from inspection alone we may often form a shrewd guess as to the seat and even the nature of the disease present.

In estimating local alteration of shape, the eye is perhaps more useful than any instrument of measure. *Calipers* of various patterns may be used for taking diameters in different directions. But for *recording* differences of shape on the two sides the *cyrtometer* is very useful. This instrument was originally introduced by M. Woillez, and consisted of two halves of a jointed whalebone measure, connected by a hinge, which could be adapted accurately to the shape of the chest, and after removal the various curves on the two sides could be traced on paper. The cyrtometers now most in use are made of soft metal, two sufficiently long pieces of which are connected by an indiarubber joint or hinge.

Double tape-measures are also used for ascertaining the circumference on the two sides, and by their means the relative expansion during respiration on the two sides can be compared. Various forms of stethometer have been designed for the same purpose. *See* STETHOMETER.

The *vital capacity* of the lungs may be very accurately estimated by means of the spirometer. *See* SPIROMETER.

(2) **Palpation.**—Palpation is employed in aid of both inspection and percussion.

(*a*) During preliminary inspection of the chest the *position of the heart's apex-beat* should be invariably, and as a matter of habit, ascertained, and any deviation from its normal seat, namely, the fifth intercostal space one inch to the sternal side of the left nipple line, should be noted.

(*b*) Any local bulging or tumour will naturally be *manipulated* to ascertain its relation with bone, or soft structure, whether it be solid or soft, fluctuating or pulsatile.

(*c*) In connexion with percussion, the trained observer will note differences of *resistance*, as well as of sound, over diseased areas.

(*d*) Increase or diminution of *vocal vibration* or *fremitus* will be noted over any spot of altered resonance, by applying the hand and making the patient utter some resonant words, such as 'ninety-nine.'

Vocal fremitus is *increased* by consolidation of lung (unless the bronchus be obstructed by growth or otherwise); *diminished* by much thickening of the pleura, by obstruction to the main bronchus, or by air in the pleura; *annulled* by fluid in the pleura. N.B.—In many cases of fluid in the pleura some vibrations are felt, probably communicated from above. The loudness or feebleness of the voice must of course be taken into account in estimating fremitus, and corresponding parts on the two sides should always be compared.

Loud, coarse, bronchial *râles* may cause the chest-walls perceptibly to vibrate, producing *rhonchal fremitus*. Pleuritic friction may likewise be perceptible to the hand applied—*friction fremitus*. In cases of effusion into the pleural cavity, or in hydatid cysts near the surface, *fluctuation* may be elicited on palpation.

(3) **Percussion.**—Percussion is the method of examination by which we detect the various degrees of resonance of different parts of the chest, depending upon the relative amount of air and solid structure.

It is best to use the fingers for percussing, one finger of the left hand being placed firmly over the point to be percussed, and struck with one or two of the fingers of the right hand, semi-flexed, so that the tips of the fingers fall vertically upon the pleximeter finger. Percussion should be made from the wrist, not from the elbow; the stroke should, as a rule, be light, and always perfectly even on the two sides; sometimes a heavier stroke may be needed, but, as a rule, far more information is obtained from light than from heavy percussion. In comparing the percussion note over the two sides of the chest, points exactly corresponding must be taken, and the pleximeter finger must be placed in a corresponding position; for example, it must not be placed parallel with the ribs on one side and across them on the other.

The sense of touch is very valuable in percussion in estimating *resistance* of the part struck. Dulness, and particularly the hardness and want of resilience over thickened adherent pleura, may thus be readily *felt* by the pleximeter finger during percussion. This sense of touch should be carefully cultivated, and its deprivation is a great disadvantage in the use of the artificial pleximeters and percussors first introduced by Piorry, although possibly these may be useful for demonstration to a class. The observer should not be content with comparing corresponding points on the two sides of the chest from above downwards, but he should invariably trace any dulness or resonance from either side across the sternum to ascertain the limits of resonance or dulness in this direction. From neglect of this, important information is often missed. The height to which the pulmonary note extends above the clavicle on the two sides should be compared.

Regions of the chest.—For convenience in describing the distribution of signs, both of percussion and auscultation, it is customary to divide the chest into regions. The names employed to distinguish these regions sufficiently define their limits, namely, the supraclavicular, clavicular, infra- or sub-clavicular, mammary, infra-mammary regions on each side in front; the superior and inferior axillary regions; the supra-spinous, infraspinous, inter-scapular, and infra-scapular regions on each side posteriorly.

(*a*) NORMAL PERCUSSION SIGNS.—There is a certain standard degree of resonance over the lungs, only to be duly estimated by experience, which is known as *normal pulmonary resonance*. In certain regions of the chest the pulmonary resonance is naturally lessened or replaced by dulness. Pulmonary resonance should commence 1½ inch above the level of the clavicle. In the clavicular and sub-clavicular regions, on firm percussion, the note should be even on the two sides, as low as the third rib. Below this level, on the *right* side, we still obtain full resonance until we arrive at the fourth space, where in the mammary line the note becomes slightly raised and shortened, becoming dull in the fifth space and downwards to the margin of the cartilages. On very light percussion the pulmonary resonance may be obtained half a space lower; and at least an inch to two inches difference in level may be obtained between the extreme limits of deep expiration and inspiration. In the lateral (axillary) region the limit of percussion-resonance reaches about an interspace lower. At the sternal margin it is a little higher, from the encroachment of the right side of the heart upon the inferior angle of the lung. Roughly, and for clinical purposes, a line drawn outwards from the base of the xiphoid cartilage may be said to define the upper border of the liver-dulness.

On the *left* side, in the line midway between the sternum and nipple, we already, at the third cartilage, obtain elevation of pitch and shortening of the percussion note; and at the fourth space dulness, from the underlying heart. Between this (mid-sterno-nipple) line and the sternum, and bounded above by the fourth cartilage and below by the level of the apex-beat, is the normal area of superficial cardiac dulness. In the nipple line at the corresponding levels[1] some deadening of percussion note may be obtained, but pulmonary resonance is otherwise clear to the sixth rib; in the lateral axillary region to the seventh. Below the sixth rib in front, and the seventh laterally, stomach resonance is obtained.

Over the *sternum*, percussion is naturally somewhat wooden and resisting, within degrees varying with the condition of the bones. The first piece of the sternum is normally somewhat less resonant than the next two pieces, but it should be, on firm percussion, by no means dull. Below the level of the fourth cartilages the heart and liver cause the note to be dull, although even here a certain degree of resonance is in health communicated from the adjacent right lung.

In the *posterior* regions of the chest the degrees of resonance are almost entirely in accordance with the thickness and character of superjacent tissues. Thus in the scapular and inter-scapular regions increased force of percussion is necessary to elicit pulmonary resonance, whilst in the lateral and infra-scapular region the percussion note is full and low-pitched. On the right side this resonance is replaced by dulness below the tenth rib, and deep percussion will elicit a certain impairment of resonance as high as the ninth rib, in the mid-scapular line. On the left side resonance should be good to the extreme base, except that in the posterior axillary line a small and restricted area of dulness may be sometimes made out, corresponding with the position of the spleen.

(*b*) Morbid Percussion Signs.—Modifications in the distribution of percussion resonance over the chest may be produced either by general or by local causes.

General causes.—Pulmonary vesicular emphysema, by enlarging the lungs and extending their boundaries, causes encroachment of pulmonary resonance over those regions—the præcordial, right infra-mammary, sternal, and right inferior basic—which are normally dull. In congenital smallness of lungs the boundaries of pulmonary resonance are somewhat retracted, so that liver-dulness in front and behind is slightly higher, and heart-dulness more extensive.

Local causes.—One class of these are encroachments of other organs. Enlargement of the heart will cause increased area of præcordial dulness upwards and to the left, or upwards and to the right, according as the left or right side of the heart is most affected. Effusion into the pericardium will cause similar dulness, extending upwards towards the manubrium sterni, and to the right beyond the sternum. Aneurysmal tumours in connexion with the heart or great vessels, give rise to dulness, chiefly in the neighbourhood of the sternum above the fourth cartilage, or in one or other inter-scapular region. Enlargement of the liver and spleen will cause them to encroach upon the pulmonary resonance. Effusion into the peritoneum, if extensive, will cause displacement upwards of the abdominal organs and diaphragm, encroaching upon the lower area of pulmonary resonance, and even causing collapse of the lower portion of the lungs, thus giving rise to dulness.

Effusion of fluid into the pleura will give rise to absolute dulness to the level to which the effusion extends upwards. The upper boundary of this dulness, if the lungs be sound, varies slightly with the position of the patient. In order, however, accurately to define the upper margin of dulness from fluid effusion the lightest possible percussion must be employed. In any case of considerable effusion into the pleura the dulness encroaches upon the median line, and towards the opposite side. *See* Pleura, Diseases of.

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[1] By employing the terms 'lines' and 'levels' to mean the vertical lines and horizontal levels, in connexion with definite anatomical points, *e.g.* mid-scapular, nipple lines, nipple-, second-, third-, fourth-, &c., rib levels, any portion of the chest-surface may be accurately defined.

The chief kinds of morbid percussion signs will now be discussed.

Dulness, hardness, flatness.—These terms are by no means synonymous with regard to percussion sounds. *Dulness* varies infinitely in degree. Thus over a pleuritic effusion the tonelessness is absolute; and to this degree of completeness of dulness the term *flatness* of percussion note is sometimes applied. There are but a few other chest-conditions in which such absolute dulness is obtained; for example, extensive pericardial effusions, hydatid tumours, extensive malignant growths invading the lungs and infiltrating the bronchi. In inflammatory consolidation of the lung there is always a certain degree of wooden tone in the percussion note. In cases of scattered patches, or nodules, of consolidation in the lungs, with air-containing tissue around, the dulness may be only very slight, amounting to a mere shortening of the note with elevation of pitch. In estimating the slight shades of dulness elevation of pitch is the first point to arrest the attention. *Hardness* of percussion, always more or less appreciable with dulness, is associated especially with consolidations of lung overlaid by thickened adherent pleura.

Skodaic resonance.—In all cases of considerable effusion of fluid into the pleura, in which the lung is not completely collapsed, a peculiar high-pitched tympanitic resonance is found at the sterno-clavicular region on the same side. This resonance, called Skodaic resonance, is a very characteristic sign, and has been attributed to relaxation of lung still in contact with the chest-wall. As the effusion advances to completely fill the chest, this resonance becomes replaced by dulness.

When effusion of fluid follows upon pneumothorax, the lung, unless held above by strong adhesions, is already completely collapsed; and above the level of the dulness caused by fluid there is a tympanitic note, caused by free air in the pleura. In this case the level of the fluid in the pleura shifts with every change in the position of the patient.

Whether the effusion be of serum, pus, or blood, the percussion signs are the same.

Wooden percussion note is obtained by percussing over thickened pleura with some air-containing tissue beneath. The sense of resistance is marked, the pitch high, and the duration of sound short. This degree of dulness, with increased resistance, is commonly present below the clavicle in cases of phthisis, with thickened pleura, and perhaps small, empty cavities, bounded by hardened lung-tissue.

Amphoric or tubular percussion is the sound elicited by percussing over a superficial empty cavity, connected by adhesions to the chest-wall. The pitch varies with the size of the cavity, but is always somewhat high. The sound can be exactly imitated by percussing the cheek drawn tensely over the teeth, with the mouth slightly open.

Cracked-metal sound, or *bruit de pot fêlé*, is obtained by sharp percussion over a cavity such as the above. Sudden displacement of air in the cavity will cause the sound, which somewhat resembles that produced by placing the two hands hollowed in apposition, and striking upon the knee. A little secretion in the cavity will facilitate the production of the sound. This physical state may often be appreciated by the touch before the sound can be heard. It is of little clinical value.

Bell sound is elicited by combined percussion and auscultation, and *when present* is characteristic of a very large thin-walled cavity in immediate contact with the thoracic wall, and is most generally significant of pneumothorax. The stethoscope must be applied over the resonant part of the chest, and at another point within the same area a piece of metal, such as a coin, laid upon the chest, must be smartly struck with a second piece of metal. The auscultator hears a sound of a clear bell-like character within the chest, which is of quite a different quality from that produced by the mere contact of metals. It is essential for the production of this sign that the stethoscope and the struck metal be both within the area of chest-surface corresponding with the air-containing sac of the pleura. If, for instance, either be placed over a point below the level of any fluid effusion present the sound will be lost, to be recovered on altering the position of the patient so as to displace the fluid. By means of this sign, the limits of a pneumothorax may be accurately defined.

Hydatid fremitus is a vibratile sensation, sometimes to be felt on smart percussion over an hydatid effusion. In cases of pyopneumothorax a similar sensation may sometimes be felt, on percussing at the exact level of the surface of the effused fluid.

(4) **Auscultation.**—Auscultation simply means the act of listening; but the art of auscultation implies a great deal more than this, namely, the appreciation of the healthy or morbid conditions which produce the sounds heard on applying the ear to the chest or to other parts. If the ear of the observer be directly applied to the chest or part under observation, auscultation is said to be *immediate*. If some substance or instrument be used as a medium between the ear and the part under observation, *mediate* auscultation is said to be practised. Such an instrument is named a stethoscope. *See* STETHOSCOPE.

(*a*) NORMAL RESPIRATORY SOUNDS.—If the stethoscope be applied over the trachea of a healthy person, tubular blowing, or bronchial respiration, is heard—that is, a sound as of air blown to and fro through a tube, and with moderate velocity; the mechanism of the sound being the entrance and outflow of air-currents through the narrowed glottic aperture of the trachea, producing sonorous vibrations within the tube below. As the stethoscope is passed downwards to the first piece of the sternum, the same sound is still heard, but more distant and muffled. In the upper inter-scapular region, where the great divisions of the bronchi are comparatively superficial, the tracheal sounds may still be indistinctly recognised; but below and aside from these points these sounds are normally obscured by the vesicular pulmonary sounds, into the production of which they, however, necessarily enter.

The *pulmonary vesicular breath-sound* is produced by the friction of air entering the air-sacs from the minute bronchioles, and it is supplemented by the conduction of what remains of the glottic breath-sound, now infinitely subdivided. During calm breathing the sound accompanying *inspiration* should be soft and breezy, giving the idea of innumerable similar and associated sounds. In intensity the sound is uniform from commencement to near the end, when it fades without perceptible interval into the expiratory sound. The *expiratory* sound commences at the moment inspiration ceases, being continuous with the inspiratory sound, but it rapidly fades in intensity, ceasing to be audible after the first one-fifth or one-third of the expiratory *act*. Of the time occupied between the commencement of one inspiration and that of the next, the inspiratory *act* occupies nearly one-half ($\frac{5}{11}$ths); the expiratory act occupies the remainder, with the exception of a very brief interval of pause, between the end of expiration and the commencement of the next inspiration. It may here be observed that when the 'expiration' is said to be *prolonged*, it is meant that the expiratory *sound* is audible through a longer period of the act than natural.

If the respiration be hurried and forced, the inspiratory sound is coarser and louder, and the expiration more audible, these sounds approximating to the *puerile* breathing which is normal to young children.

In health the vesicular breath-sound should be about equally well heard over the front and back of the chest, allowance being made for additional thickness of covering over certain regions.

(*b*) Morbid Respiratory Sounds.—*Puerile, compensatory*, or *supplementary breathing* is characterised by increased loudness of vesicular breath-sound, with some prolongation of expiration. Besides being audible over the chest generally in healthy young children, this exaggerated breath-sound may be heard over certain parts of the chest in persons who have some other part disabled or diseased. Thus, with effusion of fluid into one pleura, the respiratory sounds over the opposite lung are exaggerated or puerile. If one apex be diseased, the breath sound at the other apex is exaggerated. This increased breath-sound to make up for deficient function elsewhere is called *compensatory* or *supplementary breathing*.

The breath-sound may be *enfeebled* over the whole chest, as in cases of emphysema or thoracic muscular debility. Localised enfeeblement of breath-sound may be due to several causes—(1) local emphysema; (2) adherent and thickened pleura, as after old pleurisy at the base; (3) blocking of the alveoli by catarrhal products—common in commencing phthisis at one apex; (4) closure of bronchial tubes by plugs of mucus, or from spasm. If the rest of the lungs be free, this local enfeeblement is made up for by compensatory breathing on the opposite side, or in other parts of the same lung.

Suppressed breath-sound signifies removal of lung from the surface by effusion of air or of fluid into the pleura, or occlusion of a main bronchus by compression or morbid growth.

Wavy and *jerking* respiration are terms characterising a kind of respiration in which the inspiration is either partially or completely interrupted several times. The expiration is rarely thus affected. Waviness of respiration may be due—(1) to an irregular action of the inspiratory muscles, common in nervous people; (2) to cardiac impulse, in which case these interruptions are rhythmic with the heart's pulsation; (3) unequally distributed impairment of the lung elasticity, for example, in early tubercle-deposits. Dr. Walshe considered that pleuritic adhesions may have the same effect. It will be seen then that waviness of breath-sound is very commonly independent of any organic change, and requires other signs to render it of any value in diagnosis. Jerking respiration or interrupted breath-sound is more commonly due to organic lesions of the third kind mentioned.

Cogged breath-sound is a somewhat clumsy term applied to a form of interrupted respiration in which the interruptions are very even, three or four to each inspiration. Much importance is attached to the sign by some authors. It appears to be due to obstruction in the smallest bronchioles, either by dryish secretion or small nodules of tubercle, requiring some accumulation of inspiratory force to overcome it. The sounds commonly give place to a bubbling *râle*.

Harsh respiration with prolongation of expiration implies a want of vesicularity in the sound. Whilst vesicular breath-sound has been compared to the sound produced by the breeze passing through leaf-laden trees, harsh breathing, on the other hand, resembles a similar breeze traversing their naked branch-tops. Some prolongation of the expiratory sound is inseparable from harshness of breath-sound. Harshness of breath-sound by no means implies increased loudness—rather the contrary. Enfeebled respiratory murmur is commonly harsh—always so when due to alveolar obstruction. The meaning of harshness of breath-sound is simply commencing consolidation; it goes with incipient dulness, and is one of the earliest signs of apex-disease in consumption. There can be little doubt that its real mechanism depends upon the extinction of the vesicular part of the normal breath-sound, and the better conduction of the glottic sounds, which at peripheral parts of the lung are usually muffled and obscured by the vesicular sounds. The prolongation of the expiration is very characteristic of this early alteration of the respiratory sounds; and it may here be observed, in passing, *with regard to morbid breath-sounds, that the expiration is the most important part of the respiratory act to attend to in auscultation.*

Divided respiration, usually described as a separate evidence of disease, is really an inseparable factor of harshness of respiration. Instead of the two component sounds, inspiration and expiration, fading imperceptibly into one another, they are more or less distinctly separate, the more so as the more typical bronchial type of breathing is acquired. Deficiency of elasticity is the cause to which the division is usually ascribed; it is, however, a significant feature of glottic breathing.

Bronchial respiration is most typically heard over simple lung-consolidation, as pneumonia at the base or apex. Skoda well describes the sound as acoustically identical with that produced by placing the mouth in the position to pronounce the guttural *ch* (as in *ch*oir or *ch*ristian), and drawing the breath to and fro. The inspiratory and expiratory sounds are about equal in length, nearly identical in pitch, and distinctly divided from one another. The sound varies in intensity and definition, from the most intense *tubular* or *tracheal* breath-sound, to the lower-pitched and more diffuse *blowing respiration* (*diffused bronchial breathing*). Besides hepatisation of lung, this form of respiratory sound may be produced by other condensations of lung, for example, from pressure, or by tumours extending from the neighbourhood of a large bronchus to the surface, such as enlarged bronchial glands, mediastinal growths, and aneurysmal tumours. The more diffused blowing sounds are due to less complete consolidation. It is essential that the bronchi be patent, in order that bronchial respiration may be heard; thus, in cases of cancerous growth invading a lung from its root and occluding the bronchi, no respiration is audible. As regards mechanism, however, it can scarcely be maintained that the sound is produced by the passage to and fro of the air in the bronchi of the consolidated lung; for (1) at the period when bronchial breathing is most distinct, the lung is immovably fixed by exudation; (2) the play of the chest-wall on the affected side is almost or quite restrained; (3) the air cells being occupied, there is no reason why air-currents should penetrate the bronchi. Hence it would seem that bronchial respiration is but the glottic breath-sound reverberating through the bronchial tubes, and well conducted to the surface. A remarkable experiment of MM. Bondet and Chauveau (*Revue Mensuelle*, 1877) strikingly confirms this view. In a horse with hepatisation of the base of one lung and bronchial breath-sound over the part affected, the trachea was incised below the glottis, and the wound held widely open; the bronchial breathing immediately disappeared, all respiratory sounds ceasing over this portion of lung, whilst elsewhere the vesicular breath-sound was unimpaired. A musical reed was now inserted into the wound, and the musical sounds were well conducted over the consolidation, but little audible over the healthy portion of lung.

Cavernous respiration is a breath-sound in which the inspiration and expiration have both a hollow blowing quality. It is to the expiration that the hollow wavering quality characteristic of this breath-sound is especially attached, and, as pointed out by Dr. R. Thompson, the expiratory sound is lower in pitch than the inspiratory. Cavernous breathing signifies pulmonary cavity usually phthisical—(1) exceeding in size an unshelled walnut; (2) either empty or at least partially so; and (3) communicating with one or more patent bronchial tubes. Softening of tubercle or caseous pneumonia, pulmonary abscess, or bronchial dilatation of sufficient size, are the most common causes of cavity in the lung. This abnormal sound is formed by—(*a*) the passage to and fro of air into a cavity with the respiratory movements; (*b*) the conduction and modified reinforcement of the glottic respiratory sound within a cavity.

Amphoric breath-sound is a variety of cavernous respiration having the same characters, but on an exaggerated scale; that is, not necessarily exaggerated as regards loudness, but having all the qualities—blowing character and hollowness—intensified. This sound is heard over a large superficial cavity, either in the lung, or in the pleura freely communicating with the lung. Its mechanism is identical with that of cavernous respiration, only that the size of the cavity is large.

(*c*) ADVENTITIOUS AUSCULTATORY SIGNS.—A *râle* or *rhonchus* is a sound produced by impediment to the entry or escape of air within the lungs or bronchial tubes. The impediment may be from narrowing, or secretion within the tubes; from secretion within the alveoli; or from destructive softening or œdema of the lung-tissue. The *râles* that may be audible over the chest, are —*sonorous, sibilant, crepitant, sub-crepitant, mucous, dry crackling, moist crackling*, and *cavernous*.

Sonorous and sibilant râles are noises of a snoring or whistling kind, which are produced in the air-passages. They are audible with both inspiration and expiration (or with either), and are for the most part transitory sounds, being temporarily or permanently removed by cough, or in other cases by the relief of the spasm which has occasioned them. They obscure or altogether mask the normal respiratory sounds. Any narrowing of an air-tube will give rise to a sonorous or sibilant *râle* according to the degree of narrowing and the size of the tube. Thus, if the larger tubes be affected, and the narrowing not great, the coarser sound is produced. If, on the other hand, the finer tubes be partially occluded, or a larger tube be greatly narrowed, the finer sibilus is caused. The *râles* are audible throughout the territory of the tubes affected. Thus if a main bronchus be compressed or narrowed, the sonorous *râle* so occasioned will be heard throughout the lung on that side. Throat-sibilus in croup is conducted all over the chest.

The precise causes of these *râles* are—(1) narrowing of a bronchus from external pressure (uncommon); (2) narrowing from local, cicatricial, thickening and contraction of the fibrous coat of the tube (uncommon); (3) mucous collections in the tubes giving rise to imperfect plugs which vibrate, causing the musical sounds (very common); and (4) spasmodic contraction of the medium-sized tubes (sibilus in asthma).

Dry râles signify—(1) Bronchial catarrh, or bronchitis, local or general, as the case may be, affecting the larger and medium-sized tubes; (2) tumours pressing upon the trachea or one of the main bronchi; (3) numerous minute bronchial obstructions occasioned by pulmonary miliary tuberculosis; or (4) asthma.

Stridor is a variety of sonorous rhonchus, due most generally to pressure of a malignant or aneurysmal tumour upon a main bronchus, and heard chiefly over the corresponding side. It is a coarse, vibrating sound, which, however, the trained ear can readily detect to be of distant origin. Paralysis of the vocal cords will, in some cases, lead to stridor.

Crepitant râle, or *fine, dry crepitation*, is a minute, dry, crackling sound, in which the crackles are infinitely small and even, and occupy chiefly the latter part of inspiration. The sound has been compared to the crackling of salt upon the fire, or that produced by rubbing a pinch of hair between the fingers close to the ear. Probably the exact mechanism of the sound is the abrupt separation of alveolar surfaces, collapsed by inflammatory or other œdema. But there are difficulties in the way of any present explanation of the sound. There are at least four conditions which will give rise to identically the same sound, as far as the ear can appreciate it—namely (1) incipient pneumonic consolidation (inflamed œdema stage); (2) œdema of the lungs when not excessive, as in certain stages of kidney-disease, in obstructive heart-disease, &c.; (3) mere collapse of lung from disease, crepitant *râle* being often temporarily heard from this cause at the extreme posterior bases, to disappear after a few deep inspirations; and (4) certain cases of œdema of the pleura dependent upon old lung-disease. The fine crepitation of pneumonia is peculiar only in being associated with commencing tubular breath sound, the consolidation associated with which gives an increased intensity and definition to the crepitant *râle*. When associated with acute febrile symptoms, fine crepitation indicates the congestive stage of acute pneumonia. If seated about the base, the pneumonia is most commonly of the typical croupous or exudative variety. If at the apex, or in patches, the disease may be incipient catarrhal or embolic (pyæmic) pneumonia.

Sub crepitant or *muco-crepitant râle* is a fine bubbling *râle*, of sharp definition, and well-conducted to the ear, audible principally during inspiration, but in less degree also with expiration. This *râle* is produced in the minute bronchioles and alveoli, by the penetration of air through a thin liquid. A certain amount of lung-condensation is necessary to give sharpness of definition to the sound. Sub-crepitant *râle* is most typically heard in the resolution stage of pneumonia. In the second (secretion) stage of broncho-pneumonia it is also heard. There are many *râle* sounds intermediate between true dry crepitation and the sub-crepitant *râle*, which are fairly described by the general term crepitant *râle*, fine or coarse, according to their size. Many degrees of fineness or coarseness may be distinguished in different parts of the same lung in some pneumonic forms of phthisis, and it will be generally found in any such cases that the *râles* increase in coarseness as we ascend from below upwards.

Dry crackle is the term used to describe a *râle* consisting of three or four distinct small crackles heard during inspiration. The crackles are dry in character, and sharply defined. The inspiratory breath-sound attending this rhonchus is usually feeble and harsh, the expiration harsh and prolonged, but unattended with any *râle*, unless it be some sibilus. Dry crackling most commonly signifies commencing softening of 'tubercular' deposits, and the sound may be most frequently recognised in the sub-clavicular region, where this condition is most often found uncomplicated by conditions depending upon other stages of the disease.

Moist crackle, or *humid clicking râle*, consists of a few crackles, heard during the latter part of inspiration and the commencement of expiration, sharply defined, sometimes metallic in quality. The crackles vary in size and in the degree of liquidness, as must be the case from the mechanism by which they are produced. For this *râle* is significant of liquefaction of tubercular or caseous pneumonic nodules in communication with bronchial tubes; and as such adjacent softenings coalesce and increase in size, the crackles become larger, until they develop into the *gurgling* or *cavernous râle*. The moist crackle may be associated with other *râles*, since a softening caseous nodule is often surrounded by congested pulmonary tissue or pneumonia, giving rise to fine crepitant or sub-crepitant sounds. As a rule, the breath-sound is more or less masked by the crackling *râle*.

Cavernous and gurgling râles are but larger and more liquid *râles*, produced in a cavity or cavities of moderate dimensions.

Metallic tinkling râle requires for its development a large empty cavity in which it may be produced—(1) by the bursting of one or more air-bubbles through viscid contents; (2) by the impingement of a drop of secretion against the cavern-wall; or (3) by a bubbling *râle* produced in a bronchus near the cavity, and freely communicating with it. In either case the large empty cavity, necessarily near the surface, resonates and re-echoes the sounds, and gives them their peculiar metallic quality, which has been likened to that produced by a pin dropping into a large empty bottle. Metallic tinkling is by no means solely significant of pleuritic cavity, as was supposed by Laennec; it may be most typically heard over a large dense-walled empty pulmonary cavern.

Metallic echo is sometimes confounded with metallic tinkle, with which it is often associated, and, indeed, of which it may be said to form a part. It is really not a *râle* at all, however, but an echo in a large cavity, produced—(1) by air-vibrations caused by cough; (2) by vibrations on the surface of fluid with a large air-space above; or (3) by vocal vibrations reaching through the cavity after true voice-sound has died away.

Hippocratic succussion-sound is the splashing sound heard in a pleura containing both air and fluid, on shaking the patient somewhat vigorously, while the ear is applied to the chest-surface.

Cough-sounds.—A cavernous splash-sound may frequently be heard on listening over a cavity, and causing the patient to cough, the forcible entry of air into the cavity in itself largely contributing to the sound, and setting up gurgling and splashing *râles* by the disturbance of contained fluids.

Cough-sounds require no explanation, but they should be invariably tested in chest-examination. Crepitant sounds are often developed after a cough, which are not to be heard either on ordinary or deep inspiration without it. *Cavities* which are not in free communication with bronchial tubes may yield no characteristic breath-sounds; but the forcible propulsion of air into them at the moment of chest-compression with closed glottis elicits at once a characteristic localised succussion-sound, attended with more or less coarse gurgling *râle*.

Voice-sounds.—In the ordinary healthy spongy condition of lung, the voice-sounds are heard but distantly and imperfectly, save in certain parts of the chest in the neighbourhood of the trachea and its bifurcation—that is, in the upper sternal and the upper interscapular regions, where the sounds are better conducted.

Bronchophony.—At any portion of the chest where there is consolidation of lung, in association with patent air-tubes, the voice-sound is heard loudly, as though produced near or close, under the stethoscope. Although loudly heard, the sound appears to pass away from under the stethoscope. Any solid medium of conduction between a large bronchus and the stethoscope will give rise to bronchophony, whether by super-position, or by the portion of bronchial tree concerned being imbedded in solid lung, as in lobar pneumonia, of which the sound is most typical. If, however, between the conducting medium and the larynx the bronchial channel be occluded, bronchophony is no longer heard, the voice-sounds being enfeebled or annulled.

Pectoriloquy.—If, on the other hand, a cavity be present beneath the spot auscultated, and in free communication with a bronchus, the voice-sound appears to be concentrated at the end of the stethoscope, and to pass *through* the instrument direct to the ear, with exaggerated and even painful distinctness. It is rather the *noise* of the voice that we hear in bronchophony, but in pectoriloquy the sounds are most distinctly *articulated*. This distinction is even better appreciated by listening to a whisper, which under bronchophonic conditions is merely a conducted hissing sound, whilst in pectoriloquy each syllable penetrates distinctly to the ear. Pectoriloquy may, however, be clearly, although not exactly, imitated by consolidated lung in the neighbourhood of a large bronchus. Hence the diagnosis of a cavity near the root of the lung requires much caution.

Ægophony.—Ægophony is a form of modified bronchophony in which the voice-sound, conducted through condensed lung, has further to penetrate a thin layer of fluid in which the coarser vibrations are lost, a certain quavering nasal quality being given to the sound that reaches the ear. It is significant of effusion into the pleura. The sound is only to be heard near the upper limits of the effusion, where the layer of fluid is thin.

With regard to the mechanism of these three sounds—bronchophony, pectoriloquy, and ægophony—there can be no dispute about their being glottic sounds. In *broncho-*

phony they are conducted through subdividing tubes of increasing fineness enveloped in solid tissue; hence the sounds, although loudly heard, are not well-defined, being largely converted into the coarser vibrations perceptible to palpation as *fremitus*. In *pectoriloquy*, on the other hand, the glottic sounds are conducted through tubes which, after one or two divisions, terminate in a resonating cavity; hence the vocal vibrations are concentrated and conducted with intensity to the ear as through a speaking-tube. Finally, in *ægophony* one may suppose the bleating character of the sound to be due to secondary, and to a certain extent disturbing vibrations in the fluid medium through which the sounds are conveyed. In ægophony one may commonly note a lisp or whisper-sound in addition to the voice-sound, and better conducted than the voice-sound. And it has been affirmed by Bacelli that in cases of *serous* effusion into the pleura the whisper is heard well-conducted with distinct articulation—*pectoriloquie aphonique* through the thickness of the fluid, whereas in *purulent* effusion such whisper is not conducted. This statement will be found to apply, however, only in certain cases. The whisper may sometimes be heard well-conducted through purulent fluid.

The voice-sounds are *weakened* or wholly *extinguished* by conditions which: (*a*) shut off the main bronchi from the part auscultated, as in malignant growths invading the bronchus at the root of the lung; (*b*) separate the lung-surface from the thoracic wall, as in pleuritic effusions, œdematous thickening of pleura, &c. Here, however, we must make exception in certain cases, in which pectoriloquie aphonique is heard. In (*c*) rarefaction of the lung by emphysema the voice-sound is enfeebled; and in (*d*) pneumothorax it is either much enfeebled or annulled. In cases of pneumothorax, however, a faint *metallic echo* may often be heard with, or rather after, the voice-sound. This echo has probably a precisely analogous mechanism to ægophony, save that the medium of secondary conduction is air instead of fluid, and hence the conduction is less distinct.

Autophony.—On listening over a superficial cavity with condensed lung-tissue around, the voice of the auscultator—for example, when requesting the patient to cough or to speak—will be noticed by himself to be intensified. The term *autophony* is applied to this increased resonance, which is a sign of little clinical value.

Pleural sounds.—The sounds originating in diseased conditions of pleura are commonly included under the general term 'friction sounds'—a term, however, very inadequate to describe the varieties.

The *pleuritic rub or dry friction* is a wavy or uneven rubbing sound heard close under the ear with both inspiration and expiration, but chiefly with the former, unmoved by cough, and usually attended with pleuritic pain. We may often fail to obtain this sound, through the patient involuntarily restraining the movement of the affected side on account of the pain. A deep inspiration must, therefore, be always called for. In well-marked cases the friction is very loud and leathery, and may be perceptible to the hand applied—*friction fremitus*.

Pleural creaking is a sound that may be sometimes distinguished over a portion of the chest, when the pleuræ are densely thickened and adherent.

Moist or spongy friction is most difficult to distinguish from fine moist crepitation. It is heard almost entirely at the end of deep inspiration, and closely resembles the crepitation of a moist sponge. The sound is due to the pleura being adherent by moist, recent lymph, as in the early stage of adhesive pleurisy in pleuro-pneumonia.

In cases of œdema of the pleura a fine crepitating inspiratory sound or *pleural crepitus* may be heard, which it is impossible to distinguish from a pulmonary sound. The diagnosis must rest upon the very superficial character of the sound, and its being unchanged by cough; also upon its being associated with deficient breathing without tubular quality, and with lessened vocal fremitus. It is an inspiratory not an expiratory sound, being engendered by the pulling out of the spongy œdema-tissue during inspiration.

4. Circulatory System, Physical Examination of.—The condition of the heart and circulation may be investigated with great exactness, chiefly by palpation, percussion, and auscultation.

Pulse.—The pulse gives us very important information respecting the state of the circulation. For a full description of the pulse and its different characters in disease, *see* Pulse, The; and Sphygmograph.

Heart.—(*a*) **Inspection.**—In health and during quietude the cardiac impulse is barely perceptible. Under excitement, however, throbbing impulse may be noticed over the præcordia and left epigastrium. In cases of great hypertrophy and dilatation of the heart, especially in children, the præcordial region may be obviously bulged. The impulse of the heart may be observed to be diffused over an increased area, between the nipple line and sternum, in cases of hypertrophy and dilatation. In cases of dilated hypertrophy of the right ventricle, or in displacement downwards of the heart in emphysema, the impulse is very perceptible at the epigastrium to the left of the ensiform cartilage. A diffused undulating impulse may be observed in some cases of pericardial effusion and in adherent pericardium. The heart is often uncovered, and its impulse revealed on one side or the other by retraction of the lung in contractile or wasting pulmonary diseases.

(*b*) **Palpation.**—The position of the heart's apex should first be ascertained; and the area, force, and rhythm of the cardiac pulsations, and the presence or absence of thrill or other adventitious palpation-signs, should next be noted.

Normally the heart, enclosed in its own pericardial sac, is situated in the anterior and central part of the thoracic cavity, immediately above the diaphragm. Its position may be roughly defined as within the area bounded above by a line drawn across the sternum at the level of the lower border of the second cartilages; on the left by a vertical line passing just within the left nipple; and on the right by a similar line drawn at one-third of the distance between the border of the sternum and the right nipple line. A slanting line from the base of the ensiform cartilage to the upper border of the sixth rib in the left nipple line defines the lower border of the heart. Behind this area the heart lies obliquely, its base directed upwards to the right and backwards, its apex to the left downwards and forwards. The organ, moreover, is so placed that the right auricle and ventricle occupy nearly the whole anterior surface; the left auricle and ventricle the posterior and left surface.

The apex of the heart in the adult impinges in the fifth interspace, one inch within the left nipple line. The aortic and pulmonary valves correspond with the upper border of the third left cartilage at its junction with the sternum, the aortic being on the right of and a little lower than the pulmonary. A line drawn from the middle of the third left cartilage as it joins the sternum, to the upper border of the fifth right cartilage at the sternal margin, would correspond with the mitral valve superficially and above, the tricuspid more deeply and below.

An *altered* position of the apex-beat may arise from congenital displacement of the organ, for example, from transposition of viscera. It may arise from enlargement of the organ by hypertrophy or dilatation, affecting its right or left cavities; or from displacement of the organ, for instance, *downwards*, by emphysema, aneurysm, or tumour; *aside*, by pleuritic effusion, malignant disease, or contraction of lung; *upwards*, by abdominal distension, disease in the abdomen, or contraction of lung.

In continuance of palpation, the condition of the arteries and veins at the root of the neck must be observed: whether the arteries unduly pulsate, or the veins on one side or both remain full, or pulsate.

(*c*) **Percussion.**—The præcordial dulness may be enlarged by retraction of the margin of one or both lungs; by effusion of fluid into the pericardium; or by enlargement of the heart itself, either general or restricted to one or more of its divisions. The cardiac dulness may be diminished or obscured by enlargement of the lungs enveloping it, or by gas in the pericardial sac.

(*d*) **Auscultation.**—By the simultaneous contraction of the ventricles, the closure of the mitral and tricuspid valves, and the impingement of the apex of the left ventricle against the ribs, a single sound is produced, the first sound of the heart. The sudden tense closure of the mitral valve is the principal cause of this sound. The first sound is closely followed by the second sound, which is more tapping in quality, and corresponds with the closure of the aortic and pulmonary valves. Then comes the diastolic pause, which may be said to equal in duration that of the two sounds. The first sound is most loudly heard at the apex, the second at the base of the heart.

The sounds of the heart are subject to considerable variations under varied general conditions of health and disease.

(1) In general debility, anæmia, and wasting diseases, the tendency is for the first and second sounds to approximate to each other in character. As the ventricular wall becomes atrophic or ill-nourished the first sound becomes more purely valvular, and at the same time more feeble and tapping, approaching thus in character to the second sound. Sometimes in cases of anæmia the first sound is peculiarly ringing and hollow in character.

(2) In chronic Bright's disease, with thickened vessels and hypertrophied ventricles, the first sound is peculiarly muffled and indistinct, compared with the recognisable force of the beat.

(3) The rhythm of the heart's sounds may be greatly changed: (*a*) The first or second, or both first and second sounds, may be reduplicated. This may occur as a temporary phenomenon in apparent health, but it is more commonly traceable to increased resistance either in the pulmonary or systemic circulation. (*b*) Excessive rapidity of action. (*c*) Irregularity in time and force of beats. (*d*) Intermittent action. These several phenomena may be significant of disease of the heart itself; or, as is frequently the case, they may be due to functional disturbance through the nervous apparatus, from dyspepsia; or from excessive smoking, tea-drinking, or venery.

A *murmur* or *bruit* is an abnormal sound, invariably of a blowing character, which may more or less replace or obscure the normal heart's sound. Either of the sounds of the heart may be replaced or attended by a murmur; and in auscultation, with regard to prognosis, it is much more important to note whether a murmur wholly or only partially replaces the normal sound—that is, whether the function of the valve be wholly or only partially disabled—than to be guided by mere loudness of *bruit*. The first sound at the apex may be preceded, or, very rarely, succeeded by a murmur. For a description of these murmurs, and of morbid pericardial sounds, *see* HEART, VALVES AND ORIFICES OF, Diseases of; HEART, Functional Disorders of; and PERICARDIUM, Diseases of.

5. **Mediastinum, Physical Examination of.**—Having examined the thorax with regard especially to the great organs, the lungs and heart, contained within it, the mediastinal region should next be explored, both anteriorly and posteriorly.

NORMAL SIGNS.—The anterior mediastinal region, clinically speaking, corresponds with those portions of the sternum not underlain by lung, namely, the manubrium and the left half of the body, extending from the fourth cartilage downwards.

The lungs normally approximate beneath the upper portion of the second part of the sternum; from that point to the lower border of the fourth cartilages hiding the subjacent parts. In the triangular space behind the *upper* sternum, with its apex at the lower border of the manubrium and its base at the episternal notch, lie the inferior extremity of the trachea, covered by the left innominate vein, the summit of the arch of the aorta, and a prolongation of the pericardial sac, with connective tissue, and a few small lymphatic glands. The summit of the arch of the aorta corresponds with the level of the upper border of the second rib-cartilage.

Imperfect percussion-dulness and modified bronchial respiration, with weakly conducted heart-sounds, are usually presented over this region. On deeply depressing the finger behind the sternum in the episternal notch, a slight pulsation, communicated from the aorta—which vessel, however, the fingers cannot reach—is felt. The lower region of mediastinal dulness, that is, below the fourth cartilage level, is continuous on the left of the sternum with the heart's dulness, and, indeed, corresponds with the præcordial region.

MORBID SIGNS.—The *upper* mediastinal dulness may be replaced by resonance—(1) from enlargement of the lungs in emphysema; (2) in cases of contraction of the upper part of one lung, enlargement of the opposite lung wholly occupying the sternal region, and effacing the normal mediastinal dulness. The limits of normal mediastinal dulness may be *extended*, from displacement of the anterior margin of the lungs—(1) by dilatation or aneurysm of the aorta; (2) by mediastinal abscess; (3) by simple enlargement of the mediastinal or thymus glands; or (4) by morbid growth—cancer, or lymphoma. (For the diagnosis between these several conditions, *see* AORTA, Diseases of; and MEDIASTINUM, Diseases of.) It must be borne in mind that considerably increased dulness, and even prominence, may be due to intrinsic disease of the sternal bone, or to thickening from periostitis.

Alterations in the boundaries of the *lower* region of mediastinal dulness are most often due to enlargement of the heart, or dilated pericardium. Aneurysm of the aorta or the heart, or a growth extending forwards, between the heart and the lung, from the posterior mediastinum, are the other causes of increased inferior mediastinal dulness.

Posteriorly there is no inter-pulmonary space apparent save that occupied by the spinal column. But in disease, and especially in tumour, whether aneurysmal or of the nature of morbid growth affecting the root of the lungs (*see* BRONCHIAL GLANDS, Diseases of), the posterior mediastinal dulness involves the right or left interscapular region, as the case may be.

The bifurcation of the trachea corresponds with the body of the fourth dorsal vertebra. The descending portion of the arch of the aorta corresponds with the left side of the third dorsal vertebra.

6. **Abdomen, Physical Examination of.**—The abdomen is that portion of the body included between the diaphragm above and the brim of the true pelvis below; and is usually divided, for convenience of clinical reference, into regions. Two horizontal lines drawn at the level of the ninth ribs, and the highest point of the crest of the ilia respectively, and intersected by vertical lines drawn from the eighth rib on each side down to the middle of Poupart's ligament, divide the abdomen into nine regions, namely, epigastric, umbilical, and hypogastric in the middle; and hypochondriac, lumbar, and iliac on each side, from above downwards.

(*a*) **Inspection.**—When examining a case of abdominal disease the position naturally assumed by the patient should be noticed: whether it be indifferent; or dorsal with the knees drawn up—a position very characteristic of peritonitis; or lateral, with the thighs flexed and the body bent, as in renal or hepatic colic. Sometimes in cases of colic, especially lead-colic, the patient lies on his belly with the arms compressing the part. Frequent changes of posture are also characteristic of colic rather than of peritoneal inflammation. The general size, shape, tenseness, flaccidity, or retraction of the abdomen will be next observed. Any alteration from perfect symmetry will be noted, with the region of any swelling. The superficial veins of the abdomen may be enlarged, the internal mammary from above meeting the superficial and deep epigastrics, to secure collateral circulation between the superior and inferior cavæ, when either is from any cause compressed or occluded.

(*b*) **Palpation.**—On placing the hand over the abdomen for the purpose of palpation, the rigidity or otherwise of the muscles, especially of the recti, will be noticed; and the observer will be careful to note whether the muscle becomes contracted during manipulation, or was from the first unduly tense. The muscles of the abdominal walls are rigid, as a rule, in all inflammatory conditions of the peritoneum. In local peritonitis, and over special organs or tissues which are painful, the muscles are also tense; thus it is not uncommon to find one rectus notably more rigid than its fellow.

In order properly to examine the abdomen by palpation, it is necessary to place the patient flat on his back, on a slightly inclined plane, with a round pillow placed under the head, so as to flex the chin upon the sternum. The thighs should be similarly flexed upon the pelvis by means of a second incline, on which the legs should rest, or by placing one pillow beneath the thighs and two pillows beneath the legs. In this manner the muscles of the abdomen will be rendered as lax as possible. The patient should further be held in conversation, or told to breathe deeply, but without effort, in order that he may not keep his diaphragm fixed. It is often a good plan, when other efforts fail to prevent the patient from keeping his diaphragm fixed, to make him go on counting 'one,' 'two,' 'three,' up to as high a number as he can possibly reach without drawing breath. In this manner we get the diaphragm thoroughly relaxed; and by keeping the hand on the abdomen, deep palpation can be effected at any period of the counting most suitable for the purpose. The observer should be comfortably placed at about the same level as his patient. The whole hand, previously warmed, should be evenly applied to the surface, and the fingers then depressed in different directions as the hand is smoothly conveyed to different regions. If the patient be poked about with the ends of the fingers by the physician stooping over him, he is either tickled or hurt, his muscles contract, and proper examination is impossible.

It is sometimes useful to make the patient change his position first to one side, then to the other. This method is particularly to be adopted in examining tumours which are movable, such as floating kidneys, some uterine tumours, and aneurysmal sacs. In the case of tumours lying over the aorta, it may be impossible, without adopting this plan, to be sure whether the pulsation felt over them is communicated or intrinsic.

It is sometimes doubtful whether a tumour is situated within the rectus muscle, or in the abdomen beneath it. By keeping the hand over the tumour and making the patient raise himself half to the sitting posture, so as to cause the recti to start forward in contraction, this point can be cleared up.

The temperature of the surface of the abdomen to the hand applied, and to the surface thermometer, may be distinctly raised above that of the general surface in peritonitis.

It is often difficult to estimate the true degree and nature of pain in the abdomen caused by pressure. In hyperæsthesia of the surface the slightest pressure causes suffering; whilst deep, even palpation gives little inconvenience. If the surface be pinched up the pain is acute. Pain in the abdominal muscles is less acute, and is intensified by bringing these into action. The pain of peritonitis is superficial in so far as it is commonly associated with hyperæsthesia of surface; but gentle, steady pressure is acutely painful, and deep palpation intolerable. The pain of peritonitis may, with the disease, be general or local. There is often some difficulty in differentiating the pain of localised hyperæsthesia—hysterical pains as they are called—from those of inflammatory origin or from tenderness of organs. By holding the patient persistently in conversation respecting symptoms associated altogether with another part, as minute inquiries about headache, cough, &c., and thus keeping off attention whilst the hand is steadily compressing the supposed painful parts, all doubts can be removed. In neuralgic and hysterical pains simulating peritonitis, the tenderness extends beyond the confines of the peritoneum.

Abdominal organs may be tender to palpation.

Fluctuation.—Fluctuation is an important sign of the presence of fluid in the abdomen, whether the fluid be free in the peritoneum or enclosed in a sac. It may be obtained by placing one hand lightly on the abdomen, whilst the fingers of the other hand smartly tap over another part, when a fluid wave will be felt to impinge against the applied hand. In certain tense conditions of the abdomen, a deceptive sense of fluctuation may be obtained from the vibrations of the abdominal walls. To prevent this fallacy the hand of a bystander should be applied edgewise on the abdomen, midway between the two hands of the observer, so as to check superficial vibrations.

Hydatid fremitus.—This is a kind of tense fluctuation appreciable by the pleximeter finger on sharp percussion over certain cysts, more particularly hydatid cysts. *See* ENTOZOA.

(*c*) and (*d*) **Percussion** and **Auscultation.**—Percussion and auscultation of the abdomen are adopted in accordance with the methods already described. The distribution of dulness and resonance, varying or not with the position of the patient, affords important evidence respecting fluid collections, whether peritoneal or encysted. *See* ABDOMEN, Diseases of; and ASCITES.

By auscultation friction-sounds may be heard over the seat of peritonitis; vascular, aneurysmal, and placental bruits; or the sounds of the fœtal heart may be detected.

Physical Examination of the Liver.—In the right mammary line the liver underlies the region from the fifth rib to the costal margin; in the median line from the base of the xiphoid cartilage to an inch and a half below that level. The left extremity of the liver lies just within and behind the apex of the heart. It may, then, be roughly said that a horizontal line drawn from the base of the xiphoid cartilage to the right side of the chest and to the apex of the heart, and a second line slanting from within the apex-beat to the right costal margin in the nipple line, would mark the site of the liver. It has already been observed how this surface is partially covered above by lung. In health the margin of the liver becomes lost to palpation beneath the cartilages in the right nipple line. Its upper margin may be defined, as already shown, by deep percussion, its lower margin by very light percussion.

Displacements.—The liver may be *lowered* in position by certain thoracic conditions, such as emphysema, fluid in the pleura or pericardium, thoracic tumours, or compression by tight-lacing. When the liver is thus lowered, it is somewhat anteverted; and in lax conditions of the abdomen its lower margin may be covered by a coil of intestines, thus requiring somewhat deep palpation in tracing it.

The liver may be *raised* by contractile thoracic diseases, especially on the right side, so that its margin recedes considerably within the costal margin. In cases of doubt as to whether extension of dulness upwards be liver or lung consolidation, the observer must notice whether the level be shifted by respiratory movements. When the abdomen is distended from any cause, the liver is pushed upwards; and in this case, and also in many instances where the liver is drawn upwards, it becomes also tilted somewhat backwards, so that but little more than the margin presents anteriorly. In this condition there may be but little, if any, liver-dulness discoverable anteriorly, and it may erroneously be concluded that the liver is much diminished in size. In these cases, however, the posterior dulness of the liver is increased in the right lower thoracic region. In cases of enlargement of the liver, therefore, the upper margin must be accurately defined, to see if there be extension upwards, and whether that extension be even or uneven. The lower margin must be traced by palpation; the *mobility* of the organ with respiration estimated; its hardness, softness, sharpness, evenness, or distortion ascertained; and whether it be free or connected with other parts—for example, the spleen, or an abdominal tumour.

The lower margin of the liver, when the organ is enlarged or depressed, very frequently cannot be defined by percussion, being overlapped by intestines. For instance, in cases of lax abdominal parietes, with moderate fluid effusion in the peritoneum, the intestines float up and press between the margin of the liver and the surface. In other cases the front surface may be unduly rounded, and the margin thus incurvated to a certain extent and covered by intestines. The *surface* must be felt—whether smooth, or rough, or nodulated. The *consistence* must be estimated by palpation—whether hard or soft, or fluctuating at any part. *See* Liver, Enlargements of.

The *gall-bladder* cannot be felt unless it be distended, when it presents as a rounded tumour attached to the margin of the liver in the right nipple line. *See* Gall-Bladder and Gall-Ducts, Diseases of.

Physical Examination of the Spleen.—Normally, splenic dulness may be ascertained on light percussion in an area on the left side extending from the ninth to the eleventh ribs, and between the mid-axillary and mid-scapular lines. The shape of the splenic dulness is oval in the slant of the ribs.

In moderate *enlargement* the splenic dulness is increased in all directions; and on placing the hand deeply in the left flank, close under the ribs, the organ may be felt to descend upon it during inspiration. As the organ still enlarges it comes forwards and downwards, raising the apex-beat of the heart, occupying the region in front of the scapular line and below the level of the apex-beat, and projecting downwards beneath the costal margin into the abdomen. As the organ still further enlarges, the anterior margin curves forwards, forming nearly a right angle with the costal margin. It is usually sharply defined, and may extend forwards to the median line, and downwards to the pelvis. The posterior margin of the enlarged spleen is also, in such cases of great enlargement, to be felt thick and rounded immediately in front of the quadratus muscle. An enlarged spleen extending into the abdomen is superficial in its entire area; its anterior and posterior borders are well-defined; and it can usually be moved between the two hands forwards and backwards. The notch may be commonly felt. The surface may be quite even or nodulated. Sometimes on auscultation a bruit may be audible over an enlarged spleen. Friction-sound may also sometimes be heard. Certain alterations in the constitution of the blood and in the temperature of the body are intimately associated with diseases of the spleen, and the examination of these conditions forms an important item in their diagnosis.

Diminution in the size of the spleen cannot be accurately estimated, and is of little clinical moment.

Physical Examination of the Kidneys.—The kidneys, when of normal dimensions, cannot, as a rule, be felt, especially in fat people, or when the abdomen is enlarged. They lie one on either side near the spinal column, between the level of the spinous process of the eleventh dorsal and of the second lumbar vertebræ, and in the mid-line between these spinous processes and the outer margin of the flank. Imbedded in fat, they rest on the lumbar muscles. The right kidney is overlain in part by the liver, colon, and intestines; the left by the stomach, colon, and intestines.

In order to feel for the kidney, the patient should be placed in the position for abdominal examination. The observer, standing on the side opposite that of the kidney under examination, then places one hand along the mid-flank behind, immediately below the last rib; the other hand should rest upon the corresponding part of the abdomen in front, firmly depressing and manipulating deeply, so as to bring the site of the kidney between the phalangeal portions of the two hands. At the same time the patient should be made to inspire and expire deeply; and it is during the stage of moderately deep expiration that the organ will usually be felt.

Tenderness of the kidney, if present, may thus be estimated with certainty. Undue rigidity of the muscles on one side may be observed.

If the kidney be *uniformly enlarged* it simply extends downwards, and comes more readily under observation. In great enlargement of the kidney, as in cancerous tumour, or of its pelvis, as in pyelitis, the organ forms a tumour occupying the flank, and coming forwards from behind the colon towards the front of the abdomen. Such a tumour is more or less pyramidal or rounded in form, with a distinct band of resonance corresponding with the superior flexure of the colon extending across it. The tumour may be solid or fluctuating, according to its nature. Renal tumours are most common on the left side. The pelvis of the kidney, except when considerably dilated, does not come under palpation. *See* KIDNEYS, Diseases of.

Movable kidneys.—The mobility of the kidneys varies much, from mere laxness to complete dislocation. *See* KIDNEYS, Diseases of: 25. Kidney, Malpositions of.

The examination of the urine forms the most important part of the physical diagnosis of kidney-diseases. *See* URINE, Morbid Conditions of.

PHYSICAL EXAMINATION OF THE PANCREAS.—In thin subjects with retracted abdomen, the head of the pancreas may be felt as a small, somewhat angular, tumour to the right of the median line, above the level of the umbilicus, in the region, in fact, of the pylorus, with thickening of which it may readily be confounded.

Cancerous enlargement of the pancreas extends forwards, in or near the middle line, above the umbilicus, presenting a tumour difficult to diagnose. *See* PANCREAS, Diseases of.

PHYSICAL EXAMINATION OF OTHER ABDOMINAL VISCERA.—Diseases of the *stomach* and *intestines* yield their proper signs, requiring no separate description here. Tumours of the *omentum* have to be distinguished, by the method of exclusion, from affections of the solid organs of the abdomen.

The *pelvic organs*—uterus, and ovaries, and bladder, under certain conditions of enlargement—present themselves for diagnosis as abdominal tumours.

When distended, the *bladder* gives rise to a pyramidal area of dulness extending in the median line from the pubes, broadening upwards, towards or even beyond the umbilicus. The tumour is firm but elastic, on palpation tender, and is at once removed by successful catheterisation.

In pregnancy at the fourth month the *uterus* becomes perceptible to deep palpation in the pelvic basin in the pubic region. At and beyond the fifth month a tumour of growing dimensions extends from out of the pelvis towards and beyond the umbilicus. Dulness on percussion extends from the pubes over the whole front of the tumour, whilst above and in the flanks a resonant intestinal note is obtained. The relations of dulness and resonance are not appreciably changed by position. The tumour is elastic, and in the advanced stages obscurely fluctuating. On deep palpation, an irregular resisting lobulated mass is to be felt; and on keeping the hand steadily applied, undulating movements, or a distinct shock or jerking movement, may from time to time be felt. On applying the stethoscope with somewhat deep pressure, half-way between umbilicus and pubes and a little on one or other side, the rapid beat of the fœtal heart may be distinctly heard, closely resembling the tick of a watch under the pillow. On bringing the stethoscope nearer the inguinal region (usually on the right side), the soft low-pitched placental *souffle*, synchronous with the maternal pulse, is to be heard. Enlargement of the uterus from other causes, especially fibroid and fibro-cystic growths, may lead to abdominal tumours, which are diagnosed by combined vaginal and abdominal examination. *See* WOMB, Diseases of.

Ovarian tumours also present in the abdomen, extending upwards from one or other side of the pelvic region, and with a disposition as they extend to become central. They are most commonly cystic, and—especially in the later stages—sometimes present difficulties in diagnosis from pregnancy or peritoneal dropsy. *See* ABDOMEN, Diseases of; ABDOMINAL ANEURYSM; AORTA, Diseases of; OVARIES, Diseases of; and other appropriate headings.

R. DOUGLAS POWELL.

PHYSIOGNOMY (*φύσις*, nature; and *γνώμων*, an interpreter).

Definition. — Physiognomy originally meant the interpretation of the nature of an individual by the light of the indications afforded by his countenance, conformation, and movements; but the term is frequently used for the indications themselves.

Physiognomy in Diagnosis. In the early ages of medical science the doctrine of physiognomy formed an important part of all systematic teaching. In proportion as the means and practice of physical diagnosis have been developed, physiognomy, being insusceptible of exact treatment, has fallen into the background, and is seldom assigned a definite place among methods of investigation. Yet in every description of disease the indications yielded to inspection have their place; and practically it is no small part of the accomplishment of a skilful physician to be able to recognise readily in any sick person the outward signs which may be characteristic of his malady.

The authors who have treated systematically of physiognomy make it, in the first place, subservient to the definition of certain morbid temperaments, to which the name of *diatheses* has been given. When in any case the tendency belonging to a diathesis has gone on to the production of an actual diseased state, the word *cachexia* has been commonly adopted to express the fulfilment of the first physiognomical prophecy, with an extension of application to diseased states produced by accident, or without precedent sign of the existence of the corresponding diathesis. Among modern English authors on medicine, Dr. Laycock was conspicuous in allotting an important place to the 'physiognomical diagnosis of morbid constitutional states.'

Elements of Physiognomy. — Besides such larger groups of physiognomical indications, there are smaller groups, and even single features, which relate to particular systems of organs, or to individual parts, and which, in proportion to their limitation, have mostly a more precise meaning. Before enumerating some of these, it may be of advantage to review the elements of physiognomy. These are, in the main, four: (1) *tegumentary*—skin, with glands and blood-vessels, mucous membrane of mouth and throat; (2) *muscular*; (3) *skeletal*; (4) *attitudes* and *movements*, including those of speech.

The *skin* presents a large number of points for observation; for example, its colour, as regards pigmentation, and as regards vascularity; its texture, as regards softness or hardness, smoothness or roughness, thickness or fineness, toughness or flexibility, dryness or moisture; the development and distribution of glands and hairs; œdema; tumours, such as warts; and eruptions. Besides these, in the face, lines, furrows, and ridges mark the excessive or defective action of particular muscles, whether determined by habit or disease, causes which also determine the shape of the orifices and skin-prominence of the face.

As regards *muscular* variations there may be noted protective contractions, to which Mr. Darwin has drawn attention as part of the basis of the expression of the emotions, protective relaxation, reflex contractions, spasmodic contractions, and paralysis. With the conformation of the *bones*, which form the framework upon which the skin and muscles are moulded, must be associated the teeth, organs rich in information touching the health of the mucous membranes during childhood, and of the system at large throughout life.

Applications of Physiognomy.—Many of the correlations between physiognomy and disease are fully discussed in other parts of this work. A few illustrations of the use of the method may, however, be cited in this article.

The *skin*, alone, may yield indications suggestive, pathognomonic, or diagnostic, as the case may be. Of the first kind are the staining of jaundice, the contrasted tints of hectic, the alterations of the hair in various diseases; of the second kind are the eruptions of exanthematous fevers and syphilis; of the third kind is the observation of Sir Spencer Wells, in dealing with the diagnosis of ovarian and uterine tumours, that 'there is a facial expression common to women suffering from both classes of disease, associated with a very florid complexion when the tumour is uterine, whereas in the majority of ovarian cases the complexion is pallid.' In the mucous membrane of the mouth the blue line on the gums in chronic lead-poisoning, the spongy gums of mercurial poisoning and of scurvy, and the pigmentation of Addison's disease, are, approximately, instances of the three kinds of signs.

In the *muscles*, independently of the various evidences of paralysis, we may refer to the 'risus sardonicus'; to the tumid, expressionless upper lip of progressive muscular atrophy (Duchenne); to the fixed bent attitude of the head, and rigid, imperturbed features and unaltered articulation of paralysis agitans, as compared with the shaking head and scanning articulation of disseminated sclerosis, or the fatuous look which accompanies the irregular movements of chorea. The physiognomy in plague is said to be highly characteristic. *See* Plague.

The *bones* contribute also to our information. They present definite changes of form in rickets, the projecting under-jaw which in many women is associated with pelvic deformity, the enlargement of the cranium in hydrocephalus, and the hour-glass head and altered teeth of inherited syphilis.

As in the diatheses all the four systems co-operate to form a characteristic physiognomy, so in many actual diseases complex manifestations are abundantly presented. The changes observed in the face and neck in association with certain affections of the chest may be selected as illustrating well this kind of grouping. Thus in severe cases of chronic bronchitis, with emphysema, the skin is turgid, blue, purple, or livid, the lower lip especially being discoloured, enlarged, and everted; the veins, particularly in the neck, are full and prominent; the brows are knitted; the eyeballs projected, the eyelids swollen and partly contracted; the lower jaw, if not closed, is rigidly set in a way to give full effect to the action of the central muscles raising the sternum, which, with the sterno-cleido-mastoids, are prominent and strong; the head is bent forward, the shoulders raised, the nostrils expanded and thickened. The entire expression is one of strain and anxiety. If there be, as is often the case, tricuspid regurgitation, the veins of the neck may be seen filled during every pulsation of the heart.

In certain forms of advanced disease of the heart there is the same swelling and discoloration. But there is usually some icteric tinging of the skin and conjunctivæ, and much weaker signs of muscular strain, which in emphysema are brought about by the constant inspiratory effort. The face is generally calmer in expression, and the head rather thrown back than drawn forward.

When an aneurysm or intrathoracic growth presses on the structures in the upper part of the chest, the face often presents enormous venous turgidity, and the veins at the root of the neck are often permanently distended, and unaffected by the movements of respiration, sometimes on one side, sometimes on both. If there be pressure on the trachea or large bronchi, or if there be paralysis of the recurrent laryngeal nerve, many of the muscular strains already noticed may be present; if there be paralysing pressure on the sympathetic, the pupil on the same side will be comparatively contracted, all the tissues on the side more swollen, and the secretions increased. If with aneurysm there be aortic regurgitation, violent pulsation of all the arteries will usually be noticed, bringing into strong relief arteries generally quite unseen.

In these illustrations the appearances seen in the head and neck only are considered. If the modification of bodily conformation, movements, and attitudes which go to make up the full physiognomical picture were also detailed, a large addition, exceeding the limits of this article, would be involved. But even so much as is here portrayed will serve to remind us of the large amount of suggestive information which may be gleaned by the observer before proceeding to actual physical examination of the patient, and may stand for an example of the process which, under careful training and practice, is at last performed almost unconsciously by the experienced physician.

William M. Ord.

PHYSOMETRA (*φῦσα*, air; and *μήτρα*, the womb).—A condition in which a collection of gas or air is formed in the uterus. *See* Womb, Diseases of.

PHYTOSIS (*φυτόν*, a plant).—A generic term for plant-formation, applicable to epiphytic, phytiform, or parasitic diseases of the skin, of which there may be enumerated the following species: *Phytosis* or *tinea tonsurans*; *phytosis* or *tinea circinata*; *phytosis favosa* or *favus*; and *phytosis versicolor*. *See* Favus; Tinea Tonsurans; and Tinea Versicolor.

PIA MATER, Diseases of.—*See* Meninges, Cerebral, Inflammation of: 3. Leptomeningitis.

PIARHÆMIA (*πῖαρ*, fat; and *αἷμα*, blood).—A morbid condition of the blood, in which it contains free fat. *See* Blood, Morbid Conditions of.

PICA (*pica*, a magpie).—A perversion of appetite, characterised by a craving for various substances unfitted for or incapable of digestion. *See* Appetite, Disorders of.

PIETERMARITZBURG, in Natal. *See* Africa, South.

PIGEON-BREAST.—A deformity of the chest, in which the ribs are flattened laterally and the sternum thrust forward, so that the chest assumes somewhat the shape of the breast of a pigeon. *See* Chest, Deformities of.

PIGMENTARY DISEASES OF THE SKIN.—General Statements.—Derangement of the pigmentation of the skin may be in the direction either of excess or of deficiency, and either congenital or acquired. These defects usually occur separately, but may be associated together in the same individual, as in leucoderma and melanoderma.

The special affections of *excessive* pigmentation are Nævus pigmentosus, Lentigo, and Chloasma.

Those of *deficiency* are Albinism and Leucoderma.

Pathology.—Pigmentation of the skin may be derived either from the colouring-matter of the blood, extravasated or exuded into the tissues, and is then only an exaggeration of a normal process; or from matters introduced into the blood, as bile-pigment producing jaundice; or from without, as arsenic or nitrate of silver; or, again, there may be a local infiltration of the skin, as in tattooing, chrysarobin inunctions, &c. Except where due to local applications, the pigment is deposited chiefly in the rete mucosum, and almost entirely in the lower layers; it may also be seen in the upper layers of the corium in its passage from the vessels to the rete, to which it is conveyed probably by the branching connective-tissue cells; if these cells atrophy or are absent, the skin of the part is abnormally pale, but the untransferred pigment may be deposited in excess in the surrounding skin, as is seen in leucoderma, which is associated with melanoderma. But little is known of the pathological causes of general pigmentation, but disturbed innervation doubtless plays the chief part. Thus the bronzing of Addison's disease is, in all probability, produced by chronic inflammation of the abdominal sympathetic; while the general pigmentation which occasionally follows severe chills, and the disturbed pigment-distribution of leucoderma, which has in many cases followed closely on sunstroke, must also be regarded as nerve manifestations. Local pigmentation is in the majority of cases the direct consequence of acute or chronic hyperæmia, the blood or its colouring-matter escaping from the vessels and discolouring the tissues. This is especially common on the lower limbs, where the dependent position and frequency of varicose veins favour the exudation; the orange-coloured patches, for instance, seen on the leg being the direct consequence of capillary rupture.

Variations occur in colour, duration, and extent. In colour, pigmentation derived from the colouring-matter of the blood varies from a dull yellow or olive to brown or black. It is of a bright yellow or olive when due to bile, and a slate colour from nitrate of silver. It may be temporary as a sequel of skin-eruption and in jaundice, or permanent as in argyria. In extent, pigmentation may be general as in Addison's disease, in small spots as in lentigo, or in large patches as in chloasma.

Absence of pigment may also be general as in albinism, or partial as in leucoderma.

Ætiology.—Acquired pigmentation may be idiopathic or symptomatic.

Idiopathic pigmentations comprise those due to local causes, such as irritants, including blisters, sinapisms, friction, pressure, scratching, heat, or sun exposure.

Symptomatic pigmentations may be (1) *general*, as in Addison's disease, Graves's disease, leprosy, syphilis, malaria, cancer, tuberculosis, senile degeneration of the skin, argyria, and arsenical pigmentation. (2) *local*—(*a*) as a sequela of certain skin-eruptions, such as syphilides, lichen planus, some forms of urticaria; (*b*) an accompanying manifestation of certain skin-lesions, such as scleroderma, diffuse or circumscribed, and fibroma; (*c*) due to parasitic affections, as in tinea cruris, tinea versicolor, erythrasma, and the Pinta disease of Mexico. In these, however, the discoloration is on the skin, or at most only in the surface layers.

On the legs especially, if varicose veins are present, anything which produces hyperæmia is liable to stain the skin.

1. **Nævus Pigmentosus.**—Synon.: Pigmentary Mole; Fr. *Nævus Pigmentaire*; Ger. *Fleckenmal.*

Moles are congenital structures which may be mere collections of pigment (*nævus spilus* or *congenital lentigo*); or the surface may be uneven and warty (*nævus verrucosus*); or the pigment may be in soft tumours of fat and loose connective tissue (*nævus lipomatodes*); or the tumours may be covered with coarse hair (*nævus pilosus*). They vary infinitely in colour, number, size, and distribution, sometimes occupying a nerve-area. Later in life they sometimes become the seat of sarcoma or other malignant neoplasm.

Treatment. — Small tumours or hairy moles are best destroyed by electrolysis, both hair and tumour being removed by this method, each hair being separately attacked. Larger tumours, where not too large, and when their position renders it advisable, should be removed by the knife or caustics. In elderly people, any active change in a mole should be the signal for instant and complete removal.

2. **Lentigo.**—Synon.: Freckles; *Ephelides*; Fr. *Lentigo*; Ger. *Sommersprosse.*

This affection consists of small spots of pigment, from a pin's head to a split pea in area, and of a yellow, yellowish brown, or sepia tint. They occur chiefly on uncovered parts, namely, the face, neck, and back of the hands; less frequently on covered parts, chiefly the arms, back, and buttocks. They are usually in large numbers, more thickly aggregated in some parts than others, for example, on the nose and cheeks. Occasionally a few large pea-sized spots may be sparsely scattered about, with or without the smaller variety. Although seen at all ages, the ordinary freckles appear most commonly in the second decade of life, especially in fair or red-haired people, showing first in summer, when they are always most conspicuous, while in winter they may be scarcely noticeable. The sun is probably the exciting agent of these summer freckles, and some authors restrict the term 'ephelides' to them, reserving the term 'lentigo' for the spots which come in covered parts and are independent of season. Lentigines may be a symptomatic condition, as in xeroderma pigmentosum, and as one manifestation of senile degeneration of the skin. On the other hand, they are occasionally congenital, and are then classed with moles.

3. **Chloasma.** — Chloasma is a generic term for both patchy and diffuse pigmentation, but is chiefly used for the patchy form.

The patches are well defined, sometimes roundish or oval, but they may be of any shape or size, and any shade from fawn to brown, bronze, or black. When diffuse, the colour is always of deeper hue in some regions than others, namely, the axillæ, nipples, umbilicus, pubes, and genitalia. The causation has been discussed in the general ætiology of pigmentation. The most important variety is *chloasma uterinum* of women who are pregnant, or who suffer from chronic uterine irritation. Its most common positions are the linea alba, nipples, and forehead; but it may come in any part of the face. On the forehead it forms one or more irregular patches, but in other parts it is less defined. It usually fades slowly after parturition, but is occasionally persistent. A similar pigmentation of the face has been observed in abdominal tuberculosis, cirrhosis of the liver, constipation, and cancer of the stomach.

Diagnosis.—Chloasma may be distinguished from discolorations due to vegetable parasites by the latter being on rather than in the skin, except in the surface layers. If there is any doubt, scrapings of the epidermis, soaked in liquor potassæ and placed under the microscope, will show the fungous elements if the discoloration is due to a parasite.

Accidental or malingering pigmentation can be washed off either with soap and water or with weak chlorinated lime solution. Chromidrosis deposit can be readily removed with spirit of chloroform or ether.

Prognosis.—Time generally removes pigmentation due to previous eruptions and that due to pregnancy. The duration and continued activity of the cause are the chief factors in determining the likelihood of the removal of the discoloration.

Treatment.—This is not very satisfactory, either for lentigo or chloasma. Sometimes discutients are effectual, but in a large proportion of cases their action is only temporary. From a half to 5 grains of corrosive sublimate, but not more than 2 grains to begin with, may be added to a fluid ounce of almond emulsion, and this painted on several times a day; and if well borne the stronger solution may be used. Other well-approved applications are acetic acid and sulphur made into a paste, and laid on; citric acid (ʒss. to ℥j. of water); pure carbolic acid very carefully applied with a brush; or salicylic acid made into a paste with glycerine. These should all be used cautiously over a small surface at a time at first, as occasionally in strongly predisposed persons the pigmentation returns worse than before.

4. **Argyria.**—Argyria is the term applied to the staining produced by the long-continued administration of nitrate of silver, either internally as a remedy for epilepsy or other diseases, or as a topical application to the throat. The reduced metal is deposited in the rete and sweat-glands, and round the hair-roots. It is said that 450 grains is the minimum quantity taken internally which has produced the staining; but it is wise to be well within this limit, as, when once it has commenced to show itself, nothing will stop its further development or remove it afterwards. The parts exposed to light, the face, hands, and visible mucous membranes, are most strongly implicated. The colour is of a bluish-grey, slate, or leaden hue, or it may be almost black. Iodide of potassium in large doses has been recommended, but all treatment is unavailing.

5. **Arsenical Pigmentation.**—This is due to the deposition of the metal in the skin from prolonged administration of arsenious acid. It is general, but attacks most the parts where diffuse pigmentation is usually most marked. At first it may be recognisable by its sparing the central parts of the hair-follicles, so that on the abdomen there are whitish dots on a yellowish-brown ground, but at a later stage the discoloration is uniform. It may be accompanied by keratosis of the palms, soles, elbows, knees, knuckles, and web of the fingers. When psoriasis has been removed by the administration of arsenic, the site of the psoriasis patches may be the only parts pigmented. If the drug is stopped, the pigmentation usually fades in the course of time.

6. **Albinism.**—This disorder of pigmentation is described in a special article. *See* Albinism.

7. **Leucoderma.** — Synon.: *Vitiligo*; *Leucopathia*.

This disease is much more frequent in tropical than in temperate climates. It is a mixed condition of faulty pigment-distribution, but is named from its most conspicuous feature. It is notably symmetrical. Its first stage, though often overlooked, is an increase of pigment in certain regions; in this darker area, a white spot forms and enlarges, driving, so to speak, the pigment before it, so that the borders of the white part are convex, and those of the adjacent over-pigmented part concave. The dark part is sharply defined on the white side, while away from the white area it merges gradually into the normal skin. The number and extent of the white areas vary considerably, but the affection may in course of years affect the whole surface, the white part ever encroaching on the dark; or the excess of pigment may be absorbed. In either case, in some regions, or even over the whole surface, an apparent cure is produced in white races from want of contrast, but the part is really abnormally white, and will no longer tan in the sun.

Ætiology.—The affection is certainly more common in dark races, and is generally connected with sun exposure, some cases dating from sunstroke; but it has occurred after severe cold. The neurotic temperament and nerve-depressing influences appear to be favouring conditions. The pathology of the process has been discussed in the general statement.

Diagnosis.—Its striking symmetry, progressive course, and the combination of excess with deficiency of pigment, together with the absence of all symptoms other than the pigment anomaly, render the diagnosis of leucoderma easy. The last feature is important, as in India the disease has sometimes been called 'white leprosy.'

Prognosis.—The prospect of cure is bad; spontaneous arrest occurs; but apparent cure by the process previously described is the result to be most desired.

Treatment.—This is highly unsatisfactory. General tonic and invigorating treatment offers the best chance of arresting the progress of disease; and, of course, arsenic is recommended by some authors. White areas in a conspicuous position might be slightly stained with walnut-juice to render the contrast less striking.

H. Radcliffe Crocker.

PIGMENTATION, MORBID.—Definition.—A morbid process, consisting in the deposition of colouring matter in situations where it does not normally occur, or in excess in usual localities.

Description.—The abnormal deposition of pigment may take the form of an uniform staining of the tissues, as in icterus; or it may occur in patches, varying from mere specks up to areas of a very considerable size. The coloration may affect the skin (*see* Pigmentary Diseases of the Skin) or the mucous membrane, as in Addison's disease, where patches of pigmentation are frequently seen on the palate and inside of the cheeks, and occasionally on the surface of the intestine; or the pigment may be deposited in granular masses in the substance of organs, such as the liver, brain, spleen, kidneys, lymphatic glands, and medulla of bones. New-growths, of the epithelial and, more especially, of the connective-tissue type, may be the seat of extensive pigmentation, especially if the tissues with which they are connected be normally the repositories of colouring matter; but the change is by no means limited to such situations. Chronic inflammatory tissue—notably the peritoneal—is usually much pigmented, from a grey or slate colour to almost black.

Considerable variety is presented in colour. The various shades of black and brown are usually attributed to the existence of a substance called 'melanin,' though there is reason to believe that several different pigments are included under this term. In chemical composition melanin contains carbon, hydrogen, nitrogen, oxygen, and iron; in this latter respect resembling hæmatin. It is soluble in ether, alcohol, water, and acids; also in boiling caustic alkalis, thus distinguishing it from particles of carbon.

The bile-pigments are obviously the cause of icteric staining. The very exceptional and remarkable condition of *cyanoderma* is attributed to the presence of indigo. The excessive ingestion of lead is liable to be followed by a bluish line around the gums; of silver, by a peculiar coloration of the skin (argyria). Iron, mercury, and bismuth in the intestine are converted into black sulphides, and may form a dark precipitate on the mucous membrane.

Pathology.—Excepting when the colouring matters are obviously introduced from without, the morbid, like the normal pigments, are derived more or less directly from the hæmoglobin of the blood, occurring either as stainings of various tints, from decomposition of effused blood, or as the result of cell-activity, as is the case in melanosis. Their presence is associated with two very opposite conditions of nutrition, being sometimes an accompaniment of tissue-degeneration and diminished function, at other times connected with extremely active trophic changes. It is noticeable that the chlorophyll of plants and hæmoglobin of blood are amongst the earliest differentiated and most widely distributed proximate principles, intimately dependent upon which are the respiratory changes of plants and animals. The pigmentary layer of the retina, the visual purple, and the widespread occurrence of pigment in the nerve-centres, are among the most striking examples of the connexion of colouring matter with normal functional changes. Melanotic growths, which are usually of remarkable activity, the temporary brown patches on the skin (*melasma*) in the neighbourhood of painful spots in neuralgia and some uterine states, and the occasional sudden loss of colour in the hair from mental disturbance, are illustrations of morbid nutrition in the same direction. In the majority of cases where pigment is met with, some coincident blood-change is to be found. Thus in the class of malarial diseases, masses of black material are formed in the blood (*melanæmia*), from destruction of the red corpuscles during the pyrexial state, and are liable to be deposited, it is said, by the white corpuscles, in certain organs, especially the spleen. In Addison's disease, purpura, syphilis, and other diseases characterised by pigmentation, the red corpuscles are obviously affected. The deposition of pigment appears without doubt to be somehow under the control of the sympathetic centres.

Dr. Laycock observes: 'Fundamentally, the entire series of phenomena in which pigmentation is a leading characteristic may be regarded as having reference to the excretion of carbon after it has served its purpose in the economy; and, pathologically, the production of pigments may be taken as the expression of—(*a*) imperfect oxidation of carbon, so that it is not eliminated, as carbonic or lactic acids, &c.; (*b*) imperfect elimination of carbon proper; and (*c*) excessive production of carbon from highly carbonaceous foods. In all these there is a close analogy between the carbonaceous excreta as morbid pigments, and the nitrogenous excreta as morbid deposits of urates, &c.' However that may be, all diseases in which the red corpuscles are altered and their oxygen-carrying power diminished, tend to be associated with pigmentation, from imperfect oxidation of the carbon-waste.

A spurious pigmentation or blackish coloration by sulphide of iron is to be met with *post mortem*, or in gangrenous areas, from the union of sulphuretted hydrogen with the iron of the blood. W. H. ALLCHIN.

PILES.—A popular name for hæmorrhoids. *See* HÆMORRHOIDS.

PIMPLES.—A popular name for papules. *See* PAPULA.

PISA, in Central Italy.—A rather moist, mild, equable, calm, and relaxing climate. Mean temperature, winter, 44° F. East prevailing wind. *See* CLIMATE, Treatment of Disease by.

PITTING.—The formation of pits or hollow cicatrices in the skin, resulting from ulceration, as in small-pox; or from disorganisation of tissue and absorption of the papillary layer of the skin, as in syphilis and lupus. Also, the depression produced by pressure on an œdematous part.

PITUITOUS (*pituita*, phlegm; from root of *spuo*, I spit).—A term associated with phlegm or expectoration, when this is of the nature of thick and adhesive mucus. *See* EXPECTORATION; and SPUTUM, Examination of.

PITYRIASIS (πίτυρον, bran).—SYNON.: Furfur; Porrigo; Fr. *Pityriasis*; Ger. *Kleiengrind.*

DEFINITION.—A branny exfoliation of the skin; giving rise to scurfiness or scaliness of the epidermis.

ANATOMICAL CHARACTERS.—Pityriasis is a superficial chronic inflammation of the skin, without exudation or swelling, but especially characterised by disturbed nutrition of the epidermis and its desquamation in minute scales. In many cases it is a mild manifestation of eczema, and must be regarded as one of the forms of dry eczema.

DESCRIPTION.—The most common seat of pityriasis is the scalp—for example, *P. capitis*; and in that situation it may present several degrees of severity, ranging between the pityriasis with silvery scales of elderly persons (*xerasia*), or the mere accumulation of epidermic exuviæ in children and young persons, called 'dandruff,' and the more extensive desquamation, attended with chronic inflammation, of a declining eczema or even of psoriasis.

On the sensitive skin of children, particularly those of light complexion, pityriasis is apt to appear on the face in the form of small, circular, reddish discs, coated over with a fine furfur; and occasionally it is met with in patches on the body and limbs, always maintaining the same characters, namely, slight redness and pruritus, but a total absence of serous exudation.

The term 'pityriasis,' whilst strictly signifying an exfoliation of fine scales upon a skin more or less congested yet falling short of the activity of eczema, has also been applied to a furfuraceous state of the skin accompanying other morbid affections of this texture. Another form of exfoliation of the epidermis associated with a yellowish pigmentation of the skin, received from Willan the name of *pityriasis versicolor*; but as the pathological conditions of the latter are totally different from ordinary pityriasis, and are identical with parasitic diseases, this affection will be found treated of under the head of TINEA VERSICOLOR.

DIAGNOSIS.—The description just given of pityriasis will sufficiently distinguish it from other diseases; although, as will be perceived, it may be an accidental accompaniment of a variety of cutaneous affections, such as dry chronic eczema. Indeed, its idiopathic form is its rarest manifestation.

TREATMENT.—Our efforts in this direction should be aimed at the improvement of the nutritive function of the skin, and the relief of local inconvenience or suffering. The first indication is to be met by general tonics, and by the exhibition of small doses of some arsenical preparation; the second indication by the application of the red oxide of mercury ointment in a diluted form (one part to three), or the oxide of zinc ointment. The former remedy is the more suitable for the scalp or hairy regions of the body; the latter for the unprotected surface of the face and trunk. ERASMUS WILSON.

PITYRIASIS ROSEA.—SYNON.: *Pityriasis Circinata et Maculata*; *Herpes Tonsurans Maculosus* (Hebra).

DEFINITION.—An acute inflammatory eruption, characterised by the formation of pale red, delicately scaly, roundish, or oval patches and circles.

ÆTIOLOGY.—Pityriasis rosea is uncommon, about one in three hundred of all skin eruptions. It is more frequent in children, though it may be seen at all ages. It occasionally occurs in more than one member of a family, suggesting a possibility of contagion, but there is no definite proof that the complaint can be so transmitted.

DESCRIPTION.—There are two forms of the eruption, the *maculate* and the *circinate.*

Pityriasis rosea maculata consists of

roundish, oval, or irregular pale red patches, from a pin's head to a shilling in size, with well-defined borders, and the surface more or less covered with very fine delicate scales.

Pityriasis rosea circinata, as its name implies, occurs in circles. These commence as patches, and, as they enlarge, clear in the centre, which is left slightly pigmented, while the border is well defined and slightly scaly. When they meet other patches, gyrate areas are produced. In both forms, the eruption generally commences as a single patch, and after some days others form in the neighbourhood; the abdomen, chest, or side of the neck being the regions usually first affected. From one of these parts the eruption spreads, the old part usually clearing away, leaving slight pigmentation, while fresh patches develop, so that in the course of days or weeks the whole body-surface may become involved, and all stages of progression and retrogression may be simultaneously observed in different regions. There may be slight itching when the patient is warm. The disease tends to get well spontaneously, lasting from two weeks to two months, occasionally longer.

PATHOLOGY.—The pathology is unknown. The 'microsporon anomœon,' described by Vidal as a fungus (? micrococcus), has not been proved to be the cause of the affection.

DIAGNOSIS.—The pale red, slightly scaly, barely elevated patches or circles, covering a wide area, and undergoing spontaneous cure, are the most distinctive features of this disease. It is much less raised, and less scaly, than the early scaly or circinate syphilide; has no scaly crusts, but only delicate branny scales; and is not so red or so raised as psoriasis. It spreads too rapidly and widely for tinea circinata; and there is, of course, no trichophyton tonsurans fungus. It is not, like lichen circinatus or seborrhœa corporis, confined to the middle of the back and chest, and is never in papular circles; moreover, while that affection lasts for years if untreated, pityriasis rosea gets well in a few weeks or months.

TREATMENT.—Internal treatment is not required. A lotion consisting of liquor carbonis detergens, ʒij. to ℥viij. of water, is useful in allaying itching, and is perhaps curative. At all events, cases soon get well while using it. If the patient is seen when there are only one or two patches present, these may be painted with tincture of iodine.

H. RADCLIFFE CROCKER.

PITYRIASIS RUBRA (*πίτυρον*, bran; *ruber*, red).—SYNON.: *Dermatitis Exfoliativa*; *Eczema Foliaceum*; Fr. *Herpétides Exfoliatives*; *Erythrodermie Exfoliante*; Ger. *Hautkleie*.

DEFINITION.—An extensive and important natural group of skin-affections, in which there is universal, or almost universal, dermatitis; generally very chronic in its course; characterised by the severity of the congestion and the intense redness of the parts affected, and by the abundance of desquamation, either in the form of fine branny dust, or of large scales or sheets of epithelium.

The term is not applicable to a somewhat similar condition, which may be caused by the exanthemata (especially scarlatina, erysipelas, Rötheln and measles), or by certain drugs (for example, chloral hydrate, belladonna, quinine, copaiba, and phenazone).

ÆTIOLOGY.—The causes of pityriasis rubra are very obscure. It occurs more frequently in the male than in the female sex, in the proportion of three to two, or perhaps higher. It is most commonly met with between the ages of forty and sixty years, but has been observed in a child of four months, and in a man of ninety years. It is not hereditary. Nor is it contagious; but a condition indistinguishable from pityriasis rubra as regards its objective characters has lately prevailed in an epidemic form, especially in the infirmaries and workhouses of the west end of London. Gout, and still more rheumatism, strongly predispose to its occurrence, either as a primary dermatosis or as an epi-phenomenon of other skin diseases; and the same remark applies to chronic alcoholism and interstitial nephritis in a less degree. Its 'secondary' form may supervene upon psoriasis or—in diminishing grade of frequency—upon eczema, lichen ruber, erysipelas, seborrhœa, erythema multiforme, pityriasis rosea, or even artificial dermatitis, for example, from chrysarobin.

The most frequent immediate exciting cause of pityriasis rubra is a chill, while the subjects of it are frequently neurotic and intensely susceptible to cold, with other evidences of ill-balanced peripheral circulation. Severe nerve shock and mental strain seem mainly responsible for a certain number of cases. In a very remarkable example under the writer's observation, the condition showed itself immediately after an extremely prolonged cross-examination in the witness-box at the hands of an eminent, but notoriously harassing, counsel.

ANATOMICAL CHARACTERS.—These are in no sense characteristic. They include marked congestion and dilatation of the blood-vessels of the most superficial parts of the skin, and comparatively little of those of the deeper parts; separation of the upper two-thirds from the lower third of the horny layer; thinning of the Malpighian layer over the papillæ, with great increase in size and depth of the interpapillary processes; marked hypertrophy of the papillæ, with intense leucocytic infiltration of them, and of the upper layers of the corium. In a later stage the whole thickness of the skin is involved, and ultimately a process of sclerosis takes place, with formation of cicatricial tissue, pigmentation, and destruction of sebaceous and sweat glands.

Symptoms.—From the foregoing definition it will be manifest that a large number of maladies present the common characters attributed to pityriasis rubra, the synonym for which (*dermatitis exfoliativa*) is now in habitual use to connote the condition, both in this country and on the Continent.

Type I. *Secondary pityriasis rubra.—Generalised red and desquamative eruptions secondary to other dermatoses* (herpétides exfoliatives—Bazin).

The diseases upon which this condition may supervene have already been enumerated. In the case of eczema, discharge diminishes, and small, dry, whitish scales form in increasing numbers. The scaling of psoriasis becomes finer, while the margins of its patches usually become more and more ill defined, although in one case observed by the writer blebs formed round them. The bullæ of pemphigus become flaccid, and resemble the lesions of pemphigus foliaceus. Gradually from the primarily affected parts the erythrodermia spreads over the whole body-surface, which becomes covered with fine branny scales, the feet and soles being the parts most frequently spared. The nails become hypertrophied and claw-like, or may be shed and repeatedly re-formed. The general condition is usually maintained, the appetite and digestive functions being unimpaired; but occasionally marasmus sets in, albumen appears in the urine, severe diarrhœa or pneumonia supervenes, and the case terminates fatally. In the great majority of cases, however, spontaneous recovery ensues in from six to twelve months after the occurrence of an indefinite number of relapses. The primary skin-trouble often reappears, and each recurrence is prone to be followed by a generalised exfoliative dermatitis of gradually increasing severity.

Type II. *The relapsing, desquamative, scarlatiniform erythema* of Féréol represents the mildest form of primary exfoliative dermatitis. It is little known in this country, but the writer has seen at least one well-marked instance of it. It is of more frequent occurrence in children and young adults than the other types. Its onset is well defined, with pyrexia (102°–104°) and general malaise, sometimes even with sore-throat, and a desquamating, scarlatinal-looking tongue. The eruption does not usually make its appearance for two or three days. It consists of an intense, more or less uniform redness, sometimes with small purpuric spots, but without any infiltration; its commonest situation is the legs, from which it spreads over the whole body. After its persistence for three or four days, copious fine or coarse desquamation sets in, fever diminishes, and the redness begins to subside. At the end of a fortnight recovery is sometimes complete, but more generally repeated recrudescences prolong the duration of the disease over six weeks or two months. An accurate diagnosis in a first attack can only be a matter of surmise, but the subsequent course of the disease renders its nature indubitable. Relapses, presenting the characters of the first attack, invariably occur, and generally at regular seasonal intervals, most commonly in spring, when the return is usually attributable to a chill. With each relapse the severity of the disease tends to diminish, and finally perfect recovery generally takes place. It appears that sometimes the ingestion of certain drugs (especially mercurials) or the application of irritants (blisters, &c.) to the skin is responsible for the initial attack, which may be followed by relapses in the manner described. The disease is not infectious, and does not occur in epidemics; it is not accompanied by albuminuria, and loss of hair is very exceptional. A transverse groove on each nail is, however, generally left by each attack, while in the most severe cases the nails may be shed. This brings the disease into close relationship with—

Type III. *The primary universal exfoliative dermatitis* of Erasmus Wilson, which is a less rare and more severe affection than the foregoing. Its objective characters may, in exceptional instances, be perfectly copied by cases of secondary exfoliative dermatitis, but the differences in clinical history and in their *usual* course justify their differentiation. As a rule, the subject attacked is a healthy adult male. The onset is acute, with rigors or chills, or may be insidious and accompanied merely by 'malaise.' The temperature rises to 102° F. or higher; and until the eruption is on the wane it generally remains above the normal, with a marked evening rise. The eruption usually appears in the form of red erythematous patches, with fine desquamation, situated on the trunk, but it rapidly spreads, to become generalised over the whole body-surface. The skin is of an intense bright-red colour, but if exposed to cold often becomes of a dusky blue; in severe cases it is somewhat infiltrated, hard, and stretched. Soon the epidermis begins to exfoliate, and copious branny scales form and fall from the face, head, and neck; while large papery flakes are shed from the trunk, or remain attached by their centres, while overlapping like slates at their margins. Two or three pints of such scales may be shed in the twenty-four hours. The skin of the palms and soles is usually detached *en masse*, and the redness there does not show itself until after the first exfoliation. The amount of itching varies within wide limits; generally it is severe, and sometimes it precedes the rash, drawing the patient's attention in the first place to it. Sometimes, however, itching is conspicuous by its absence, and the subjective symptoms most commonly complained of are either tenderness or a sense of burning, while a feeling of cold is experienced by the patient as soon as he is exposed. Oozing from the flexures of the knees, elbows, axillæ, and thighs sometimes occurs, and is often no doubt attributable, in part at least, to rubbing or scratching of the part. In a few very exceptional cases, bullæ have been observed in these situations, allying the disease, according to some writers, with pemphigus foliaceus. The skin over the rest of the body remains intensely harsh, dry, and scaly, although from time to time copious sweating may occur. The scalp is extremely seborrhœic, while pustules, boils, and 'epidermic cones' surrounding lanugo hairs are of frequent occurrence. The mucous membranes become involved: coryza, conjunctivitis, superficial glossitis, stomatitis, and pharyngitis may be observed; while the occasional occurrence of vomiting and diarrhœa probably indicates implication of the gastric and intestinal mucous membranes. The shedding of nails and loss of hair early in the disease are characteristic of this type; they may occur as early as in the fourth week. In a certain number of cases the general condition remains remarkably good, but in others the appetite is lost, the patient emaciates, and alarming prostration sets in. The appearance of albumen in the urine, or the development of pulmonary troubles or of diarrhœa, may usher in a lethal termination (generally in the third or fourth month); but undoubtedly in the majority of cases ultimate recovery occurs in from six to twelve months, after repeated disappointing recrudescences. As a rule, the redness first diminishes, then the scaling, and the two subside gradually together. But in one very remarkable case observed by the writer, large circular areas of white, normal skin suddenly appeared in the midst of diseased skin, and in the course of a week almost entirely covered the surface. Among complications and sequelæ Brocq enumerates carbuncles, abscesses, phlegmons, deafness, iritis, joint-troubles, cardiac complications, partial paralyses, paraplegia, and mental affections.

Type IV. *The primary, universal, chronic pityriasis rubra* of Hebra is a rarer and more grave disorder than the preceding. Its onset is always gradual, and unaccompanied by fever; it is evidenced by the appearance of dry, scaly, red patches, generally on the trunk, which gradually extend, to become universal after a period of several months or, it may be, years. The colour is usually dusky, and the desquamation is always fine. There is little or no infiltration of the skin. Constant chilliness is complained of, but pruritus is seldom a troublesome symptom. Very gradually the skin becomes infiltrated, hard, brawny, and pigmented; then sclerosed, glossy, yellowish, and stretched over prominent bony points, or contracted round the orifices of the orbits and mouth (ectropion, eversion of lips). Slowly, also, but surely and without intermissions, the hair atrophies and falls out; and the nails become thin and crack, or much thickened and friable. Marasmus sets in after years, and the patient gradually sinks as the result of pulmonary tuberculosis, pneumonia, or diarrhœa. In the later stages ulceration and gangrene may hasten the fatal termination.

Pathology.—Of the intimate pathology of this group of diseases but little is known. Dr. Pye-Smith considers the dermatitis as primary; but there seem to be many valid reasons for considering the condition as essentially a vaso-motor and trophic neurosis, more probably of central than of peripheral origin. The co-existence of myelitis has been noted (Jamieson, Campbell, and Turner), and inflammatory changes in the peripheral nerves have been observed, but these are certainly not constant either in their occurrence, or in their nature when present.

Diagnosis.—This is usually easy; the history of the case, the universality of eruption, the intense redness and dryness of skin without marked infiltration, the absence of discharge, the characters of the desquamation and moderate amount of itching, combined with the grave general condition, all serve to distinguish pityriasis rubra from extensive psoriasis, eczema, or lichen planus. Pemphigus foliaceus may be very hard to eliminate from the diagnosis, but generally its bullæ may be distinguished with their foul-smelling contents; it also occurs more frequently in women than in men. Epidemic exfoliative dermatitis (Savill) most closely simulates this disease; indeed, there seems to be no criterion for differentiating them beyond the history of the presence of an epidemic of the former, and the discovery and constant presence in the blood of persons attacked by it of a diplococcus of supposed specific nature. Dr. Risien Russell, who confirmed Dr. Savill's discovery of this micro-organism, and further investigated it, failed to find it in two cases of pityriasis rubra under the writer's care during the prevalence of the epidemic disease, which were at first considered to be typical examples of it.

Prognosis. — The prognosis may be gathered from the study of any case in the light of the description of the various types given. Particular stress is to be laid upon the state of the appetite and digestion, and the presence or absence of albuminuria, pulmonary complications, and emaciation.

Treatment.—Treatment must be assiduous, and directed both to the local and general condition. The patient must be absolutely confined to bed, even in the mildest cases, and until recovery is complete, as the slightest chill is prone to cause relapse. He ought to lie between blankets, and on a spring-mattress or water-bed. The diet must be nutritious but simple, including milk, in as large quantity as possible, eggs, milk-puddings, strong meat-soups or jellies. Alcohol ought not to be prescribed, unless the prostrated condition of the patient demands it; and then sound wine is preferable to spirits, as causing less thirst and gastric disturbance. Cod-liver oil is sometimes of use when emaciation is marked. Iron appears sometimes to be detrimental, but quinine in an effervescing citrate of potassium mixture is certainly sometimes useful and grateful to the patient Diuretics, such as acetate of potassium with digitalis, are frequently employed and probably beneficial. The promotion of free diaphoresis by jaborandi or the subcutaneous injection of nitrate of pilocarpine has been advocated by Dr. Stephen Mackenzie and others. Linseed oil in large quantities both externally and internally has been lauded by Sherwell. The bowels must be carefully regulated, preferably with mineral waters and salines, the latter often profitably combined with the liquid extract of cascara sagrada. There is a general consensus of opinion that arsenic is worse than useless in the earlier stages, while few writers accord it anything but faint praise even in the later. The writer has also been disappointed with the effects of antimony, so highly praised by Jamieson. He has also noticed aggravation of the eruption after the administration of opium, chloral hydrate, belladonna, and cannabis indica, with a view to obtaining sleep.

Oily external applications are certainly the most beneficial. The calamine liniment recommended by Dr. Radcliffe Crocker is an admirable preparation. It is composed thus: Calamine 40 grains; oxide of zinc 2 drachms; olive oil and distilled water, each 1 fluid ounce. The patient may be swathed in rags soaked in this liniment, and slightly warmed if necessary. The pharmacopœial linimentum calcis is also useful, as is a lotion consisting of an ounce of glycerole of lead and glycerine in a pint of water, similarly employed. Pure vaseline is occasionally a valuable substitute.

Prolonged warm baths may be of service in diminishing itching, but are apt to be followed by increase of cutaneous hyperæmia. This risk is materially diminished by the addition of bran (6 lbs.), linseed (1 lb.), gelatine (3 lbs.), or potato starch (1 lb.) to the thirty-gallon bath. The further addition of two or three ounces of borax or bicarbonate of sodium is often advantageous.

Pityriasis Rubra Pilaris (Devergie-Richaud).—The recognition of this rare disease as a definite morbid 'entity' is mainly due to the writings of Dr. Ernest Besnier of Paris. At least one well-defined case has been observed in England by the late Dr. Hilton Fagge, and a model of it is preserved in Guy's Hospital Museum. Although its relationships are probably closer with psoriasis than with any of the forms of pityriasis rubra just described, the name which has been assigned to it justifies its position here, the more so as any form of exfoliative dermatitis may, during process of recovery, closely simulate it. The disease generally begins by desquamating patches on the palms and soles, or by a dry seborrhœa of the scalp, or by a fine scaliness of the face. Its onset is non-febrile, and young persons are often its subjects. Soon the characteristic lesions appear on the limbs or body, in the form of small brownish-red, firm, dry, conical papules surrounding atrophied hairs—'epidermic cones'—and sending little processes into the follicles; they are seldom larger than a millet-seed. Occasionally they become confluent, when they lose their characters, and form yellowish, slightly infiltrated, squamous patches, which may closely resemble psoriasis, especially about the knees and elbows. The primary lesions generally retain their characters on the backs of the first and second phalanges of the fingers and toes, and they are pathognomonic of the disease. Severe seborrhœa capitis is always present, but the hair does not fall. On the contrary, hypertrichosis of the affected parts has been noted in some cases. The nails become enormously hypertrophied and claw-like. The face assumes a peculiar powdered appearance, owing to the dry white scales lying on the reddened skin; and sometimes ectropion results from contraction. The general condition remains good.

Prognosis.—Recovery always takes place, but the duration of the disease is quite indefinite, and apparently uninfluenced by treatment.

Treatment.—Treatment may be conducted on the lines laid down for pityriasis rubra.

J. J. Pringle.

PITYRIASIS VERSICOLOR (*πίτυρον*, bran; and *versicolor*, of changing colour).—A synonym for tinea versicolor. *See* Tinea Versicolor.

PLACENTA, Diseases of.—Synon.: Fr. *Maladies du Placenta*; Ger. *Krankheiten des Mutterkuchens.*—The placenta being the sole medium of vital communication between the mother and fœtus, any deviation from its normal condition, by which its development may be arrested, and its physiological action impaired, must be of serious consequence. Nevertheless, the frequency or importance of placental disease is hardly yet sufficiently recognised.

The principal diseases to which the placenta is subject are: (1) Inflammation; (2) Congestion; (3) Hæmorrhage; (4) Myxoma fibrosum; (5) Vesicular degeneration; (6) Fatty degeneration; (7) Atrophy; (8) Hypertrophy; (9) Œdema; and (10) Calcareous deposits.

1. Placenta, Inflammation of.—Synon.: Placentitis.—Acute inflammation of the placenta is the cause of those morbid adhesions that may occasion the most serious dangers of parturition, namely, *post-partum* hæmorhage and inversion of the uterus. Moreover, it sometimes causes the death of the fœtus, by destroying the structural integrity of the placenta. The disease is probably generally syphilitic in its origin.

Symptoms. The symptoms of placentitis are so obscure that it is oftentimes undetected until after the birth of the child, when we find the placenta adherent. In many cases, however, this disease is attended by constitutional irritation or febrile disturbance of a remittent character. A very usual symptom of placentitis is the return of morning sickness in the later months of pregnancy, together with a persistent dull aching pain, or a sensation of weight and fulness, over the hypogastric or iliac regions. The placental souffle will also be found intensified in sound, or abnormal in some other respect.

Treatment.—The treatment most likely to prove useful in cases of placentitis is a mild alterative course of mercury conjoined with tonics, and followed by iodide of potassium. Severe local pain may be relieved by the use of phenazone or other analgesics. This treatment, if necessary, may be conjoined with leeching over the seat of the hypogastric or inguinal pain, should the application of oleate of mercury with morphine, or of some anodyne liniment, fail to give relief.

2. Placenta, Congestion of. — This condition is occasionally met with, and more especially after protracted labours, when its existence is recognised by the placenta being then found engorged with blood, hard and tumefied, its external surface of a deep purple colour, and covered with a raised network of tortuous and congested vessels. Acute congestion, from the sudden engorgement of the placental vessels, may also arise at any period of pregnancy, from general plethora, or the recession of some acute inflammatory disease. It may also be occasioned by the sudden check to the placental circulation from the death of the embryo.

The *diagnosis* between congestion and inflammation of the placenta is practically almost impossible. The *treatment* is the same in both cases.

3. Placenta, Hæmorrhage into.—Acute congestion of the placenta generally terminates by hæmorrhage into either the deciduous or cellular (maternal) portion; into the villous or vascular (fœtal) part of this organ; or in some cases into the cellular interspace between these, thus constituting what Cruveilhier described as 'apoplexy of the placenta.' Hæmorrhagic effusions of this kind are a frequent cause of miscarriage. Occasionally, especially amongst the too frequently ill-treated wives of the labouring classes, placental hæmorrhage is the result of external violence or shock. The effusion then generally takes place from the central external surface of the placenta, which is thus partially separated from the uterus; but if the effusion be limited to a few ounces, gestation may go on undisturbed.

4. Placental Myxoma Fibrosum.—Under this name a remarkable morbid transformation of the villi of the placenta has been described by Virchow, and later by Sir William Priestley, who has seen two specimens of this rare condition. According to the latter authority, it is quite different from the cellular or fibrous degeneration of the villi described by Ercolani and Robin, consisting of such enlargement of the stems and villi by fibroid hypertrophy, that they form in some cases distinct tumours in the placental structure. The fibroid change is more frequently connected with the later period of pregnancy, although indications of it are sometimes seen in the earlier months, and therefore it is described as a disease of the fully developed placenta. If the placenta is only partially affected, the child, though emaciated, may live; if the disease is more universal, the child dies.

5. Placenta, Vesicular Disease of. Myxoma of the placental chorionic villi, or, as it was formerly termed, hydatidinous disease of the placenta, or vesicular mole, consists in degeneration and abnormal proliferation of the placental villi of the chorion, usually following, although occasionally producing, the death of the fœtus. According to Spiegleberg, degeneration of certain lobes of the placenta in the midst of healthy ones, or partial myxoma occurring in different cotyledons, is also met with; and under such circumstances no injury need result to the fœtus. In the *Transactions of the Royal Academy of Medicine in Ireland*, the writer has related several cases of this comparatively rare disease. In most of these the hydatidiform mass was expelled from the uterus at the fifth month. In some instances, however, the vesicular mole has co-existed with a healthy fœtus to the end of the full term of gestation. *See* Mole; Molar Pregnancy.

Symptoms.—The symptoms of this disease can at first hardly be distinguished from those of ordinary pregnancy. If, however, in addition to the signs that usually denote the death of the fœtus *in utero*, the patient experiences occasional gushes of water, together with slight hæmorrhage from the uterus, lasting for a short time, and recurring at irregular intervals, we may suspect the existence of myxomatous disease in the placenta of a blighted fœtus.

The expulsion of these growths is generally attended by severe hæmorrhage.

TREATMENT.—In the way of treatment, nothing can be done to arrest the progress of the disease. But an attempt should always be made to prevent its recurrence by improving the general health of the patient by alteratives and ferruginous tonics, especially any of the milder saline chalybeate waters, such as Ems, Kissingen, or Schwalbach.

It has been recommended that we should bring on the expulsion of vesicular moles as soon as they are discovered. This, however, is inadvisable. Only a portion of the placenta may be affected; or, as the writer has seen, the birth of a healthy living child may be followed by the diseased placenta of a blighted twin conception. Hence, we should let nature take her course, for in due time the morbid growth will be surely expelled from the uterus, rather than by unnecessary interference run the risk of destroying a living fœtus.

6. **Placenta, Fatty Degeneration of.**—This is a common disease, so frequent, indeed, in its less marked forms as to have been regarded by Dr. Druitt as a normal condition at the end of pregnancy, and as being then preparatory to detachment at the time of delivery. It may be circumscribed or diffuse resulting from retrograde changes.

7. **Placenta, Atrophy of, or Placental Phthisis.**—Atrophy of the placenta is an occasional cause of the death of the fœtus between the sixth and ninth months of gestation. The uterine placental villi in such cases are arrested in their development, undergoing a retrograde metamorphosis into an opaque molecular substance, generally accompanied by fatty deposits in the terminal vessels of the fœtal portions of the blighted organ.

8. **Placenta, Hypertrophy of.**—This is a less frequent pathological condition than that last mentioned. We sometimes, however, find the placenta greatly enlarged without any apparent alteration in its structure, and in such cases the child, if alive, is usually diminutive and puny, being stunted not only by the blood having been diverted from its nutrition, but still more by the compression of the terminal umbilical vessels.

9. **Placenta, Œdema of.**—Effusion of serum is another occasional consequence of placentitis. In the cases of this kind that the writer has seen, abortion generally occurred, and the placental villi were enormously distended and bloodless, being filled with a serous fluid. In one instance, in addition to dropsy of the placenta, the umbilical cord was œdematous to an extraordinary extent.

10. **Placenta, Calcareous Deposits in.**—Calcareous deposits are frequently met with, more especially in cases of adherent placenta, being usually situated in the external or uterine surface, and in the decidual vessels. In some instances, however, the writer has found these deposits scattered throughout the whole substance of the afterbirth, as well as coating its fœtal surface. According to Priestley, they seem particularly prone to develop themselves in any adventitious deposit. The same writer has found them in placentæ of women unusually robust, being then probably the product of a gouty diathesis. Dr. Barnes, on the other hand, associates placental calcareous deposits rather with scrofula, tuberculosis, and poor living, and draws a parallel between such deposits in the placenta and those found in the tubercular lung.

TREATMENT.—The general treatment of placental disease must necessarily remain largely empirical and unsatisfactory, until the recognition and differential diagnosis during pregnancy of the various placental diseases referred to may be found more practicable. Nevertheless, there are some circumstances commonly connected with placental diseases that will perhaps serve to indicate the general principles of treatment. In the first place, the immediate or proximate cause of all placental disease may be assumed to consist in local inflammatory action, however occasioned. Secondly, their most frequent subjects are patients of strumous diathesis, or who have suffered from syphilitic disease. Thirdly, such placental lesions are specially prone to recurrence in successive pregnancies.

Bearing these facts in mind, the obstetrician, however unable he may be to arrest or even to diagnose existing placental disease, may at least be successful in the prevention of its recurrence by remedying the constitutional condition or cachexia, whether strumous or syphilitic, of its subjects. In the former instance, by attention to the general nutrition and hygienic surroundings of the patient, as well as by anti-strumous remedies, such as the various combinations of iodine and iron, cod-liver oil and malt preparations, and, above all, if possible, by change of air and the use of either natural chalybeates, such as Spa, Schwalbach, Ems, or Kissingen springs, or of the iodated mineral waters, namely, Kreuznach, Schinznach, or Woodhall Spa at their sources. In the still more numerous cases in which the origin of these obscure placental disorders is syphilitic, their treatment should obviously be governed by this consideration, the importance of which, however, is best proved in the prevention of their recurrence. In such cases a long-continued course of perchloride of mercury is efficient, administered in gr. $\frac{1}{24}$ doses in tincture of cinchona bark two or three times a day to both parents for some weeks, or even months, until slight but distinct mercurialisation has been produced, abstention *a coitu* being meanwhile enjoined.

Finally, amongst those methods of treatment to which reference has been already made, as being somewhat empirically applied to different forms of placental disease, there are two which demand notice in this connexion, the respective utility of each having been sufficiently established. Of these, the first is the administration of chlorate of potassium, which was suggested by the late Sir James Simpson in all cases in which the placenta is partially disabled by disease at any time of pregnancy, but is believed to be most useful in the latter half. The second measure referred to is in the induction of premature labour at a period compatible with the viability of the child, that is to say, after the seventh month, in cases in which in the patient's previous pregnancies the fœtus has perished after that period from placental disease.

THOMAS MORE MADDEN.

PLAGUE (πληγή, *plaga*, a stroke).—SYNON.: The Pest; Inguinal, Bubonic, Glandular, Oriental, Indian, Pali, and Levantine Plague; Oriental Typhus; Septic Pestilence; Fr. *la Peste*; Ger. *die Pest*.

DEFINITION.—A specific fever, attended by bubo of the inguinal or other glands, and occasionally by carbuncles.

HISTORY.—The term *plague* is used by the older historians in two senses: (1) in a general sense, as applicable to the prevalence of diseases accompanied by great mortality, irrespective of their nature; and (2) in a limited sense, as indicating the particular malady defined above. The earliest notice of the disease now designated *plague* is found in a work of Oribasius, the physician to the Emperor Julian (A.D. 361–363). He quotes from Rufus (Alexander) of Ephesus, a writer who lived in the reign of the Emperor Trajan (A.D. 98–117), a passage from which it would appear that plague had been known as an endemic, and occasionally as an epidemic, in Libya (North Africa), Egypt, and Syria, from the end of the third or beginning of the second century before Christ. The first appearance of plague in Europe is referred to the sixth century of the Christian era. In the reign of the Emperor Justinian (A.D. 527–565) the disease underwent a development previously unknown. According to contemporary historians, it broke out in Egypt, explosively, and presently spread thence to the neighbouring countries of Africa and Asia; invaded and extended over the whole of Europe; and became generally disseminated throughout the then known world, causing frightful mortality wherever it showed itself. From this period, it is inferred, plague became established in Europe, being sometimes more, sometimes less prevalent, for the 1300 years following—indeed, until the ninth lustrum of the present century. It must, however, be remembered that though numerous pestilences in Europe are recorded by mediæval chroniclers, there is no sufficient evidence, before the fourteenth century, that they were bubonic plague. The undoubted prevalence of this disease began after the black-death of the fourteenth century.

The great pestilence, most familiarly known as the *black-death*, which swept over the western hemisphere in the fourteenth century, causing an inconceivable mortality, and which has been designated *black plague*, although presenting several of the symptoms of bubonic plague, is held by some epidemiologists to have differed essentially from that disease. The *black-death*, according to these writers, was particularly characterised by a gangrenous inflammation of the respiratory organs, violent fixed pains in the chest, vomiting and spitting of blood, and a horribly offensive and pestiferous breath, which could be perceived at a considerable distance from the patient. Such symptoms distinguished, these writers think, the disease from bubonic plague. Moreover, it is noted that while bubonic plague had had its apparent source in Egypt seven centuries before, black-death, according to contemporary writers, had its origin in Cathay (Northern China), and issued thence to devastate the world. Writers who regard black-death as a different malady from plague, hold that the pestilential manifestation of the disease began and ended with the dreadful outbreak of the fourteenth century, and that the malady has long been extinct.

Other writers consider black-death to have been a modification of bubonic plague. But if this view be accepted, the extraordinary development and remarkable modification which the disease underwent in the fourteenth century stand quite alone in the history of the affection, and constitute phenomena which would have to be regarded as indicative of a secular evolution of morbid changes (*see* PERIODICITY IN DISEASE). This last-named view of the relation between black-death and bubonic plague is not without a present interest. For Hirsch and others believe that the *Máhámari* of Northern India—the *Pali*, or *Indian plague*, as the disease is also termed, which has several times prevailed as a local epidemic since the commencement of the present century, is a disease analogous to the *black-death* of the fourteenth century. [But this special analogy is not recognised by other epidemiologists, and Hirsch himself has considerably modified his views.] Probably these writers would now include the more recently known *Yunnan plague* in the same category.

In the fifteenth century the countries in which plague was habitually present, or recurred at intervals, included Northern Africa, Egypt, Western Arabia, Syria and Palestine, Asia Minor and Mesopotamia, Persia, probably India and China, and Europe generally. Throughout the sixteenth and seventeenth centuries there are almost continuous records, from year to year, of the presence of the disease, in greater or less activity, within this area of prevalence (Carl Martin, *Petermann's Mittheilungen*, Juli 1879). During the latter half of the seventeenth century a remarkable lessening of the area of prevalence of the disease began to take place. As regards Europe, in the course of the twenty years 1661–1681 plague disappeared from Italy, England, Western Germany, Switzerland, the Netherlands, and Spain. This lessening of area continued throughout the eighteenth century, the number of serious outbreaks of plague also diminishing, two only having occurred in that century—namely, (1) in 1703-13 (involving Turkey, Hungary, Russia, Poland, Austria, Bohemia, and Eastern Germany), and (2) in 1720-22 (Provence). At the close of the first third of the nineteenth century, the area of prevalence of the disease had shrunk to the easternmost part of the Turkish Empire in Europe; and in the year 1841 plague ceased on the Continent altogether.

While this change had been taking place in Europe, a corresponding change had been manifested in the prevalence of the disease in its habitats elsewhere. Before its complete cessation in Europe, plague would appear to have disappeared from Northern Africa (except Egypt), from Mesopotamia, and from Persia; the existence of the disease in Asia Minor, Syria, and Palestine came to an end in 1843; and in the year 1844, with the cessation of the malady in Egypt, plague seemed to have become wholly extinct, and Europe to have got rid of a terror which had harassed it for ages.

It is noteworthy that during the period of the progressive narrowing of the limits within which plague prevailed, and until its disappearance, the disease manifested no abatement of those characteristics, as well in respect to rapidity of course, to the nature of the symptoms, and to its fatality, which had made it the dread of Europe and the Levant. The outbreak of 1665 in London, which preceded the disappearance of the disease from England, and which is known as *The Great Plague of London*; also the outbreak of 1720 in Marseilles, which preceded the disappearance of the disease from France, have become historical from the fatality which accompanied them. Hardly, if at all, less terrible was the outbreak in Moscow in 1770, and the later outbreaks in Turkey, in Syria, and in Egypt. Even at the present day the traveller in Persia and Kurdistan comes upon communities the growth of which has been arrested, and the ruins of villages which have been depopulated, by the ravages of plague earlier in the century.

Notwithstanding the disappearance of plague from its last-frequented haunts, certain epidemiologists, and notably Gavin Milroy in this country, having regard to the long intervals which had occasionally been observed between recurring epidemics of the disease, doubted its cessation. Their doubts were presently confirmed by the re-appearance of the plague in the Levant. This happened in 1853 (nine years after the presumed cessation of the disease in Egypt) in the Assyr country, Western Arabia, on the eastern coast of the Red Sea, where a circumscribed outbreak occurred. Other local outbreaks followed at intervals in different places, in the order and countries here noted:—

1853, the Assyr district, Yemen, Western Arabia; 1858-59, province of Bengazi, Regency of Tripoli, North Africa; 1863, district of Maku, Persian Kurdistan; 1867, the marsh district on the right bank of the Euphrates, south and west of Hillah; 1870–71, Persian Kurdistan, in the district south-east of Lake Urumiah; 1871–73, Yunnan Province, Western China; 1873–74, the marsh district on the left bank of the Euphrates, south of Hillah and the position of ancient Babylon. This outbreak proved to be the beginning of a manifestation of the disease, which in the course of the years 1874-75, 1875-76, and 1876-77, showed itself over an area extending from Bagdad on the north to Suk-e-Sheyukh on the south, and from the banks of the Tigris and Shat-el-Hai on the east to the borders of the Syrian desert on the west. Hillah suffered from this outbreak in 1876 (recorded deaths 1,007), and Bagdad, both in 1876 (recorded deaths 2,611) and 1877 (recorded deaths 1,672). The outbreak of 1873–1874 on the Lower Euphrates was not the only appearance of plague at that period. Two other outbreaks occurred in 1874, one in the Assyr district, Western Arabia (the scene o the outbreak of 1853), and another in the province of Bengazi, Regency of Tripoli (the scene of the outbreak of 1858–59). In 1876, in addition to the then prevalence of the disease in the district south of Bagdad and on the Lower Euphrates, plague broke out in the Shuster-Dizful district, Khuzistan, south-eastern Persia; and before the close of the year it had shown itself also in two villages of northern Persia, situated about twenty-five leagues from the south-eastern angle of the Caspian Sea. The same year also there was an outbreak of *Máhámari* in the mountainous district of Kumaun, North-western India, which did not terminate until the following year. In 1877 an outbreak occurred at Resht, the capital of the province of Ghilan, Persia, and in the surrounding district. Ghilan lies at the south-west angle of the Caspian Sea. The same year cases of a fatal bubonic febrile malady occurred in the district of Baku, on the Caspian shore of Transcaucasia; and an outbreak of a non-fatal bubonic affection took place in Astrakhan and its vicinage, since recognised as a form of plague. At the beginning of 1878 plague was reported in the district of So-uj-Bulak, Persian Kurdistan; and in October the disease broke out at Vetlianka, a Cossack settlement on the Lower Volga, in the province of Astrakhan, Russia in Europe, and prevailed there and in the adjacent districts on both banks of the river, until February 1879, with the exception of an isolated case, or more than one, which was observed in the following month.

Since this outbreak, when, after thirty-seven years' absence, plague reappeared on European soil, several epidemics of the disease in its former seats have been recorded. An outbreak causing great mortality occurred on the Lower Euphrates in 1880-81. In 1884 the disease broke out on the Turco-Persian frontier, east of Bagdad, and, as usual, was attributed to an infection derived from Persian Kurdistan. The latter country suffered almost annual epidemics from 1881 to 1885; and, according to recent researches, has been hardly exempt for the last twenty or thirty years. This mountainous district appears to be an endemic seat of the disease; and, as some think, was the source whence the epidemics of Resht and the Caspian basin were derived. Khorassan (a district of Persia proper) suffered in 1877-78 and in 1881; Asterabad in 1886. In 1883-84 there was a doubtful report of a disease resembling plague in Candahar (Afghanistan). No epidemic of *Máhámari* has been recorded in India since 1877, but good authorities believe that the disease is not extinct. In 1879 the disease again showed itself in the Assyr district of Western Arabia; there were rumours of the same in 1887; and a very definite outbreak occurred in 1889. A doubtful epidemic was recently (April 1893) reported from Bengazi in Northern Africa.

Another undoubted seat of endemic plague is the Yunnan district in Southern China, and the seaport of Pakhoi on the Tongking gulf. It is evidently there a soil-disease, causing the death of animals such as rats, dogs, cattle, &c., as well as of men. In Yunnan it is confined to altitudes from 1,200 to 7,200 feet above the sea. Several epidemics since 1871 have been described in the *Reports* of the Imperial Chinese Customs, especially by Manson and Lowry. It shows apparently no tendency to spread into other districts, and foreigners are never affected.

It thus appears that there are at least four localities where plague is still endemic, and may break out at any time in an epidemic, namely: (1) Kurdistan, parts of Persia and the adjacent parts of Turkish Arabia; (2) the Assyr district of Arabia; (3) Bengazi; (4) Yunnan and Pakhoi. None of these, except the last, is without importance as threatening extension into other parts of the Turkish empire, or into the basin of the Mediterranean; and on the whole a certain increase in the activity of the disease since the middle of the century must be recognised.

Ætiology.—Plague is observed to be developed under two principal sets of conditions, namely: (*a*) certain *local states*, physical or social, or both, as the case may be, affecting communities; and (*b*) certain *relations between persons* sick of the disease and healthy persons; to these must be added (*c*) particular *seasonal influences*.

(*a*) The *local conditions* which favour the development of plague were made the subject of careful study by a Commission of the French Academy of Medicine, in 1844. The report of this Commission, prepared by Prus, sums up and represents the then existing knowledge on the subject. According to the Commission, plague was a product of Egypt (where it was held to be endemic), Syria, the two Turkeys (Turkey in Europe and Turkey in Asia), and many other countries of Asia, Africa, and Europe; and the conditions 'which determined and favoured' the development (birth) of the disease among communities there, were—dwelling upon alluvial and marshy soils, notably such as were found near the shores of the Mediterranean, and on the banks of certain great rivers, the Nile, the Euphrates, and the Danube being specified; a warm and humid atmosphere; low, badly ventilated, and crowded houses; great accumulations of putrefying animal and vegetable matters in the vicinity of dwellings; unwholesome and insufficient food; excessive physical and moral misery; and neglect of the laws of health, as well public as private.

The recent appearances of plague have served to correct some and to confirm others of these conclusions of the commission. Plague is no longer endemic in Egypt; but of late years, as already stated, it has broken out in several widely separated places of Africa and Asia. In these outbreaks (excluding from consideration for the present the outbreak in Astrakhan province) the disease appears to have been a local product determined by as yet entirely unknown conditions. The term 'spontaneous' is frequently applied to such developments of disease, but is best avoided as implying more than is warranted by our present knowledge. Again, the recent outbreaks have shown (and Tholozan has particularly dwelt on this subject) that plague is, perhaps, as much a disease of the highlands as of the lowlands. This is evidenced by its persistence in Kumaun, on the Himalayan mountains, and among the mountains in Western Arabia and in Yunnan. The outbreaks in Persian Kurdistan in 1870-71, and in the province of Bengazi in 1873-74, took place on elevated tablelands. The outbreaks also of 1853 and 1874 in Western Arabia took place among the highlands. But, if a less restricted topography must be assigned wherein plague may manifest itself as a local product, so to speak, the later prevalences of the disease confirm fully the conclusions of the Commission of 1844 regarding other conditions of development which are not peculiar to any country or locality. The outbreak of 1858–59 in the province of Bengazi followed upon four years' drought and failure of crops, at a time when the greater part of the flocks and herds had been destroyed from want of food, and by a fatal epizootic which prevailed among them, plague breaking out when the population was suffering most from famine, and when the physical and social misery resulting from destitution was greatest. The same was, in effect, the state of things when plague appeared in Maku, in Persian Kurdistan, in 1863; but here it is noted also that the infected district was pervaded with the putrid emanations from the unburied bodies of cattle which had died from murrain. The outbreak of 1867 on the Lower Euphrates was confined to marsh-villages on the right bank of the river; and that of 1873–74, in the same district (the beginning of the greater development of 1874–77), began in marsh-villages on the left bank of the river. The huts of the particular class of villages affected, writes W. H. Colvill, 'are on ground which is a foot or two lower than the surface of the water in spring; and the ground is so saturated with water, that the refuse of the village is neither absorbed nor can it be evaporated, for it acquires fresh moisture from the ground, and this refuse acquires the form of a bluish-black oily fluid which surrounds the huts and covers the paths, and stains the walls two feet from the ground; and, in fact, the village is in such a state of filth that it requires to be seen to be believed.' The outbreaks of 1867 and 1873–74 had been preceded, according to Colvill, by the only two great inundations of the Euphrates which had occurred since 1831, the year of the then latest outbreak of plague in Bagdad. The outbreak of 1870–71 among the highlands of Persian Kurdistan had been preceded by a fatal epizootic among sheep, and ergotism among the people. Writing of one of these mountain-villages—and the account serves for all—Castaldi says: 'Whatever is most afflicting in poverty, whatever is most revolting in filthiness, is accumulated, as if designedly, around these infected dens, in the interior of which live, or rather vegetate, from fifty to sixty men, women, and children. The cultivation of some plots of ground in the neighbourhood furnishes these unfortunates with insufficient nourishment.' The infected district escaped the famine which at this time prevailed in Persia, but it may be a question if the inhabitants escaped severe privation during the winter in which plague first appeared. The outbreak of 1874, in the province of Bengazi, North Africa, occurred among the nomadic tribes occupying the Cyrenaic plateau at a time when some of the favourite Arab camping-grounds had been converted into vast swamps from heavy and protracted rains, and when the people were reduced to the most abject misery and were suffering from an extremity of famine, the result of failure of their crops for three years in succession, consequent on drought. The outbreak of 1876–77 in the mountain-villages of Kumaun took place among communities who are described as occupying houses in which cattle, grain, and families are packed together under conditions of filth not unlike those observed in the mountain-villages of Kurdistan. Of the conditions under which plague was observed in the great towns, as in Bagdad and in Resht, as also on the Volga, they were states of filth, in and about dwellings, such as might be anticipated where no organised scavenging had ever existed, and of crowded and badly ventilated houses. But in Bagdad and the Mesopotamian towns generally, the most influential condition in promoting plague was, according to Colvill and Cabiadis, *poverty.* Cabiadis, indeed, styles the disease, *miseriæ morbus*, thus reproducing, in 1878, a name by which plague was designated by some in the 'Great Visitation' of London, 1665, namely, 'the *Poor's Plague.*' On the other hand, the communities which suffered on the Volga were comparatively prosperous; but, at the time of the appearance of the plague among them, they were living under almost indescribable conditions of filth accumulated about their houses, and from which the interiors were not free.

The local conditions which have been observed to be favourable to the development of plague since the reappearance of the disease in 1853, it will thus be seen, are similar to those which were observed before its disappearance from Europe and the Levant in 1844.

All these insanitary conditions may, however, be observed in many parts of the world where plague has never been heard of. Recent observations upon the origin of plague tend to show that in some at least of its endemic haunts, especially India and China, it is a soil-disease, the virus remaining from year to year, and occasionally under the influence of meteorological or unknown causes becomes epidemic among the population. One evidence is the mortality among animals, such as rats, living underground, often observed in India and China, and occasionally, though rarely, noted in the old European epidemics. Another is the slow progress of the disease, even through crowded cities, as in London in 1665 (*see* the observations of Boghurst, quoted in the article 'Plague,' *Encycl. Brit.*, and more fully in Dr. Creighton's valuable *History of Epidemic Diseases*). Dr. Creighton lays much stress upon cadaveric putrefaction as a factor in producing the disease; but this is not generally accepted. Tholozan has clearly shown that many epidemics in Persia and Arabia were self-limited, and spontaneously came to an end after spreading over a certain area. Thus the spread of plague from one place to another has a certain analogy to that of cholera, its vitality in a new locality depending upon an infection, perhaps of the soil, or at least of human habitations, more than on personal contagion. As in cholera, too, different epidemics seem to differ immensely in their diffusive power. (On this and other points, *see* Dr. Creighton's work.)

(*b*) That the kind of *relations maintained between persons* sick of plague and the healthy exercised an important influence upon the propagation of the disease, has been made clearly manifest in the recent outbreaks. The more closely and continuously the healthy were brought into association with the sick, the more certain were the former to suffer from the disease. Thus persons living in the same house with the patient were peculiarly liable to suffer, while those who were brought only occasionally into contact with him (as the physician) were rarely affected. And here, again, a difference was noted between the liability of the physicians and of the surgeons and their assistants to be attacked by the disease. The duties of the latter called for more frequent and protracted visits to the patients than the duties of the former, and they suffered to a greater extent. No doubt was entertained that the disease was, in ordinary phrase, *caught* from the sick by the healthy brought into association with them; but there was no certain evidence that actual *contact* with the sick person was necessary to the transmission, as the older doctrine of contagion maintained. On the contrary, the evidence indicated that the transmission was chiefly effected through the healthy breathing the same atmosphere as the sick—that is to say, the atmosphere surrounding the sick person. There would appear to be, in addition, evidence of transmission of the malady by the agency of *clothes and bedding* which had been used by the sick. The newer information obtained on this subject of the transmissibility of plague from those sick of the disease to the healthy, corresponds with the results obtained on the same subject by the Commission of the French Academy in 1844, and both point to a close analogy between the modes of transmission of plague and of typhus, and between the habits of the two infections. In plague, as in typhus, the liability of the healthy to contract the disease is mainly dependent on the constancy and intimacy of communication with the sick. In plague, as in typhus, the danger of infection appears to be principally proportionate to the fouling of the atmosphere surrounding the sick by the effluvium from his body and breath; and in like manner either infection would seem to be peculiarly easy of destruction by free dilution with air. Again, there seems to be no trustworthy evidence to show that the danger of the propagation of plague by *fomites* (as the older writers have it), that is to say, by articles carrying the infection of the disease—such as clothing and bedding—is greater in plague than in typhus. The condition for infection of articles of clothing and bedding was their very intimate use by, or association with, the sick. Evidence was entirely wanting of articles other than those mentioned, and under other conditions, being capable of communicating the disease to the healthy; nor was there anything to confirm the assumption that the long array of articles contained in quarantine-regulations regarding plague were capable of retaining and conveying the infection.

(*c*) Both the sets of conditions here noted as affecting the development of plague appear to be influenced by *seasonal* changes. In Mesopotamia the disease, during its prevalence there, rapidly declines, and becomes dormant, with the setting-in of the hot weather in June (beginning to fall when the temperature reaches 86° F., and ceasing abruptly at 113° F.), its activity re-awakening in winter, and gathering force with the advancing spring. Similar phenomena were observed in Egypt, whilst the disease prevailed in that country. In Constantinople, on the contrary, the disease was dormant during the colder months of the year and became active during the hotter. The same was true of this country when the disease existed here, as is particularly observed in the season of prevalence of the epidemics which have ravaged the metropolis. Here, as William Farr, Edward Smith, and, more recently, Buchan and Mitchell, have shown, from the records of mortality, September was the month of greatest prevalence, the disease rising throughout July and August, and falling throughout October and November. Farther north (in Moscow, for example) the disease has prevailed as severely in the depth of winter as in the height of summer.

Age.—Dr. Cabiadis noted the ages of 1,826 cases of plague observed at Hillah in 1876, with the following result:—

From 2 months to 9 years . .	277
,, 10 years to 19 ,, . .	617
,, 20 ,, 29 ,, . .	432
,, 30 ,, 39 ,, . .	292
,, 40 ,, 49 ,, . .	123
,, 50 ,, 59 ,, . .	52
,, 60 ,, 69 ,, . .	18
,, 70 ,, 79 ,, . .	11
,, 80 ,, 89 ,, . .	3
An old man of 113 (?) ,, . .	1
Total . . .	1,826

Incubation.—The recent outbreaks have not furnished much additional information on this subject, but, such as it is, it tends to confirm the conclusion of the Commission of the French Academy. This was to the effect that the disease had never shown itself among compromised persons after an isolation of eight days. L. Arnaud carefully studied the question in the outbreak of 1874, in the province of Bengazi, and from the facts he then collected concluded that the mean time of incubation of plague was five or six days, and that the maximum duration did not exceed eight days. Hirsch, from the information he obtained at Vetlianka, relating to the recent outbreak in the province of Astrakhan, concluded that the minimum period of incubation observed there was from two to three days, the maximum not exceeding eight days, and that the average might be set down at five days. He notes, however, that very short or very long periods of incubation were seldom observed.

Anatomical Characters.—The recent outbreaks of plague have added nothing to our knowledge of the anatomical characters of the disease. They occurred under circumstances where anatomical investigation was out of the question. The information existing on this subject was obtained almost solely at the time of the French expedition into Egypt at the close of the last century and the beginning of the present; during the outbreaks of plague in Bessarabia, 1825, and in Moldavia and Wallachia, 1828-29; and again in the outbreak of 1834-35 in Egypt. The morbid alterations noted were ecchymoses of the coverings of the nervous centres, of the pericardium, the omentum, and the peritoneum; enlargement and softening of the spleen; punctated extravasations of blood in the mucous membrane of the stomach; ecchymotic spots in the mucous membrane of the intestines; reddish-black injection of the mesenteric glands; extravasation of blood—sometimes considerable—into the cellular tissue about the kidneys, the kidneys themselves being tumefied and presenting extravasation of blood in their tissue and in their pelves. The most constant and characteristic changes were observed in the lymphatic glands. When buboes had been formed, the glands presented manifest signs of inflammatory action in various degrees, as did also at times the surrounding cellular tissue, which was, moreover, frequently the seat of bloody extravasations. The glands of the several cavities were more or less involved in or partook of the morbid action conspicuously observed in the buboes; and even where no buboes had formed, indications of considerable changes were found in the internal lymphatic glands. In some instances the affection of the glands would appear to have been general throughout the body; in others it would be limited to one or more of certain groups, in addition to the more superficial groups, as the bronchial, the mediastinal, the mesenteric, the lumbar, &c. The glands, as a rule, were found more or less enlarged, injected, and infiltrated with sanguineous fluid.

Symptoms.—These are summarised here wholly from the writings of recent observers: W. H. Colvill and Giovanni Cabiadis (as made known by E. D. Dickson) in regard to plague in Mesopotamia; Castaldi, in regard to plague in Mesopotamia, Persian Kurdistan, and Resht; L. Arnaud in regard to plague in Bengazi (*see* Blue Book, *Plague*, 1879); Döppner (official report); Hirsch (*Practitioner*, ii. 1879); and W. H. Colvill and Payne (official report) in regard to plague in the province of Astrakhan. This course is taken, first, because the disease, as they describe it, is that which the present generation is called upon to consider; and, secondly, because, generally speaking, the symptoms observed by them are similar to those described by the earlier writers on the subject.

Plague occurred in three forms in the recent outbreaks, namely, (1) an *abortive* or *larval*; (2) a *grave* (*plague*, as usually understood); and (3) a *fulminant* form.

1. **Abortive (larval) Plague.**—This form is characterised by the appearance of buboes in the groins, armpits, and neck, as a rule painless, and unaccompanied by feverishness. At times, but rarely, the manifestation of the buboes is preceded and accompanied by a general febrile disturbance of the system, so slight as not to preclude the patient from moving about (*ambulatory plague*). At times also a bubo suppurates; but more commonly these swellings disperse in about fourteen days. The buboes are clearly distinguishable from the chronic glandular swellings observed in persons of a scrofulous tendency, or affected with any special diathesis. Cases of abortive plague were recorded in the greater number of the recent outbreaks of the disease of which we have detailed accounts, and were particularly observed preceding and following the outbreak in Mesopotamia in 1873-77, and preceding the outbreak in the province of Astrakhan in 1878-79. It is questionable whether this form of the disease, unaccompanied by any marked febrile disturbance, is infectious.

2. **Plague in its usual form.**—The onset and progress of plague differ much in different cases, and at different periods of an epidemic. Most frequently, after a brief time of lassitude, aching in the limbs and loins (sometimes a very painful aching), and shiverings, a febrile state commences; and concurrently with this, or from the second to the fourth day of its duration, buboes appear in the groins, the armpits, or beneath the angle of the jaw. The febrile state is usually acute, and accompanied with much, often severe, headache, and delirium or stupor; the face being flushed; the eyes red and turbid; the skin hot; the tongue black, dry, and fissured, or coated as with cotton wool, or pointed at the tip, with red edges and thickly furred in the centre; the teeth and gums covered with sordes; and the

thirst intense. The swelling of the glands increases, and is accompanied by much, sometimes acute, pain; and if the patient have lived on, suppuration may take place about the seventh day, at which time, if not earlier, carbuncles or boils may appear. Of these symptoms, or groups of symptoms, it may be noted more particularly that the disease is sometimes ushered in by vertigo, or convulsive tremor, or a peculiar, absent, 'lost' state, when the patient, if he be seized from home, will be observed to make his way thither in a quasi-automatic fashion, with a strange staggering gait; or else, whilst going about his ordinary avocations, he is seen to become distracted, as if impressed with some indefinable fear, which prompts him, if away from his house, to rush wildly through the streets until he reaches it, and then throw himself on the bed in a state of extreme restlessness; while, in the gravest cases, the patient is attacked at the same period with vomiting of blood, and a high febrile state. Cabiadis describes cases ushered in by a *prolonged regular shake*, which persists from six hours to three days, the temperature of the body remaining nearly normal, and the patient not complaining of cold. This *shake* was invariably followed by coma, during which the patient sank rapidly. The pulse, in the febrile state, runs quickly up to 100–130; and the temperature of the body to 102-104°, and in the acutest cases to 107·6° F. The end of the febrile state is marked by a sudden fall of temperature, the thermometer descending sometimes as low as 93·2° F.; at the same time a profuse perspiration often occurs. Heat in the throat and in the epigastrium (in the latter, as of burning charcoal there) was a not infrequent complaint of the patients; and at times a sensation likened to being stabbed by a knife in the breast has occurred. Nausea and vomiting of bilious matters were not uncommon (Arnaud); and vomiting of coffee-ground-looking matter was frequent at the beginning of the outbreak of 1873-74 on the river Euphrates. Constipation is the rule in the acute stages of the disease. It is sometimes followed by diarrhœa, which has been regarded as a favourable sign. No noteworthy change appears to have been observed in the urine, either as to general appearance or quantity, unless it were mingled with blood; but Döppner describes its diminution and even suppression in severe cases at Vetlianka. *Hæmorrhages* were observed from the nose, the lungs, the stomach, the bowels, the vagina, and the urethra; and the cases in which they occurred all ended fatally. Occasionally the respiration is much hurried, but Arnaud states that such disturbances of the respiration as he witnessed in Bengazi were of nervous origin—a nervous dyspnœa preceding death. The prostration is extreme in some cases; and in a few instances in which this was observed, consciousness was maintained until just before the patient expired.

Of the *local signs*, the appearance of the *buboes* not infrequently precedes the symptoms of general disturbance. In some cases they are first observed within seven or eight hours after the febrile state has set in; in other and more numerous cases they show themselves on the second, third, and fourth days of the attack, and rarely on the fifth. When the buboes appear first they are sometimes accidentally discovered, the patient having no previous suspicion that he is affected; but more generally their appearance is preceded by pain in the glandular organs, at times sudden in accession, the patient exclaiming he has been stabbed in the groin, armpit, or elsewhere, as the case might be. The enlarged glands forming buboes are rarely numerous; and of a group only one is, as a rule, conspicuously enlarged, sometimes attaining a size equal to a turkey's egg or an orange, while the others are but little enlarged. The swelling at times is very rapid. Suppuration is not often observed in the fatal cases, and so it happened that suppuration came to be regarded by the inhabitants of the localities where plague prevailed as a favourable sign; while, on the other hand, 'flattening' or subsidence of the swollen glands in the early days of attack was held as indicative of a fatal result. *Boils* and *carbuncles* occur, but not very frequently. *Petechiæ* are often observed, most usually preceding a fatal issue; at times occurring comparatively early in the progress of the disease. Sometimes they are distributed generally over the body, at other times they are chiefly localised in the vicinity of the enlarged glands. They vary in size from the dimensions of a grain of millet to those of a lentil. They are at times so numerous that the skin assumes a livid hue, and the corpse has a blackened appearance after death. This appearance is so characteristic of the disease, says Cabiadis, that the malady might properly have been called, even in this day, *black-death*.

The plague has a special *physiognomy*, having nothing in common with either typhus or pernicious fever in any of its forms, or with relapsing fever. 'The eyes are retracted within the orbits, but not surrounded with the blue circle which is seen in cholera; the aspect is haggard, but without the fixity seen in typhous cases; the facial muscles are relaxed as other muscles of the patient are, and do not present the wrinkles and contractions observed in a patient attacked with typhus or cerebral maladies; the countenance of the plague-stricken expresses apathy' (Castaldi). 'On coming up to a patient suffering from an attack of pernicious fever, you are struck with the gravity of his case and the danger threatening his life. The very reverse of this meets your eye when you see for the first time a case of plague. Even the worst instances of this malady are apt to deceive an inexperienced physician, and make him fancy that the case is free from danger, when in reality the patient has only a few hours to live. The first instance of plague seen by Dr. Cabiadis did not seem to him to be one of an alarming nature. The patient looked stupefied, as if intoxicated, and did not answer readily the questions put to him. He vomited blood, and had a small bubo in the right axilla, but the pulse and temperature were normal. The patient died a few hours after Dr. Cabiadis' visit' (E. D. Dickson).

3. **Fulminant Plague.**—Cases to which this term is applied have been observed more particularly at the commencement of plague epidemics, but also during their course and towards their termination. These were cases which were struck down suddenly with illness and died in a few hours, without any of the characteristic indications of the disease—buboes and carbuncles, for example—having shown themselves. The conclusion that they were part of the prevailing epidemic—the infection having overwhelmed at once, as it were, the sufferers—appears justified by the prevalence, at the same time, of an intermediate class of cases, also very quickly ending in death, in which some traces of glandular swellings were observed, with profound disturbance of the nervous centres, convulsions or coma, and rapid formation of vibices and purpuric spots. The cases of the fulminant class which occurred at the beginning of the outbreak on the Lower Euphrates, 1873–74, were chiefly marked by vomiting of blood and setting in of a high febrile state concurrently. The natives had named these cases 'black-vomit' before the actual nature of the disease became apparent (Castaldi).

Máhámari (Pali or Indian plague); *Yunnan Plague.*—The recent descriptions of these forms of plague by Planck, Francis, Rocher, and Baber, do not present any such differences in the character of the disease above described as to call for a separate account.

The Plague on the Volga, 1878-79.—Only one account of this outbreak has come into the hands of the writers from the pen of an actual observer, and it merits a particular notice. It is contained in a report of Dr. Döppner, principal medical officer of the Cossack troops in the province of Astrakhan at the time, and is founded on personal observation of twenty-three cases seen by him when the outbreak was approaching its greatest intensity. His description of the symptoms presents them as forming two groups: (1) Violent headache (forehead and temples), pains in the limbs, slight shivering, followed by high fever, pulse from 100 to 120, sense of burning in the body and eyes, distension of the abdomen, and enlargement of the liver. These symptoms lasted two or three days, and were in favourable cases followed by perspiration and recovery with general debility; but in the greater number, after an interval of two or three days, the fever returned, accompanied by delirium, sleeplessness, restlessness, a temperature of 107·6° F., dryness of tongue, frequent involuntary dejections, urine scanty and reddish. Death usually occurred in the second paroxysm (sometimes, but rarely, after a third), preceded by convulsions and a general prostration of the vital powers. (2) In other cases the patient was attacked suddenly with palpitation of the heart, irregularity of pulse, vomiting, vertigo, oppression of the chest, spitting of clear blood, pallor, an apathetic expression, with dulled eyes and dilated pupils. The patient then remained for two or three hours in a state of extreme feebleness, followed by violent feverishness and delirium, suppression of the urine, and constipation. Maculæ appeared upon the body; it exhaled a peculiar odour, something like that of honey; and death supervened in a state of lethargy, with complete prostration of the vital powers.

In neither form of the disease, at this stage of the outbreak, were buboes a conspicuous symptom, and in the latter form they were rarely observed; but buboes (inguinal and other) had characterised a series of non-fatal cases of abortive plague which had preceded the cases described, and during the decline of the outbreak buboes were again observed. Death occurred in from twelve hours to three days. Decomposition of the body always set in rapidly.

Dr. Z. Petresco, of Bucharest, who, under instructions from the Roumanian Government, visited the seat of the plague on the Volga, and reached the infected locality early in February 1879, received accounts of the disease from physicians who had witnessed it at Vetlianka subsequent to the period of time to which Dr. Döppner refers (Nov. 17 (29) to Dec. 4 (16), 1878. He states that the predominant symptoms were intense headache, an acute febrile state (very rarely accompanied by delirium), and excessive prostration of vital force—these symptoms forming a 'triade séméiotique pathognomonique de la peste.' He also states that, at the beginning of the outbreak at Vetlianka, cerebral and lymphatico-glandular disturbances were chiefly noted, the latter manifested by submaxillary, axillary, and inguinal buboes; afterwards, at the height of the epidemic, graver indications of disorder of the nervous centres were observed, manifested especially by headache, vertigo, feverishness, and collapse, the cases at times ending fatally in twelve hours; lastly, during the decline of the epidemic, pulmonary disturbance predominated (hæmoptysis with symptoms of catarrhal pneumonia), inducing the medical men to diagnose the malady at this time as a croupous pneumonia, pneumotyphus, or malignant typhus.

Cabiadis and Colvill made an analysis of numerous cases of plague which came under their observation, from which the following particulars are taken in illustration of the foregoing symptoms, and as elucidating other questions.

Seats.—Of these 1,826 cases of Cabiadis' and of 402 cases of Colvill's, the following manifested themselves in the form of buboes and carbuncles :—

	Cabiadis' Cases	Colvill's Cases
Buboes—in the Groin . .	710	128
" " Axilla . .	466	109
" " Neck . .	98	19
" " Crural region	—	2
" in several places .	122	8
" not revealed . .	—	9
Carbuncles	36	9

Other Manifestations. — Cabiadis, with respect to the 1,826 cases mentioned above, gives the following numerical statement of the numbers in which noteworthy special symptoms were observed :—

Dependent on the nervous centres	Coma in . .	28
	Convulsive shake .	9
Dependent on the circulatory system.	Petechiæ . .	120
	Epistaxis . .	2
	Hæmoptysis . .	6
	Hæmatemesis .	27
	Sanguineous diarrhœa . . .	14
	Menorrhagia . .	2
Dependent on the assimilative organs.	Bilious vomiting .	32
	Bilious diarrhœa .	16
	Jaundice . .	2

Duration.—Colvill shows the duration of 534 fatal cases of plague as follows :—

Days after attack	Number of deaths
One day	126
Two days	80
Three "	105
Four "	76
Five "	60
Six "	26
Seven "	12
Eight "	14
Ten "	14
Twelve days	9
Sixteen "	1
Twenty "	11

Relapses and Second Attacks. — Arnaud notes both relapses and second attacks in his account of the Bengazi outbreak, 1873–74.

Mortality.—The mortality of plague appears to have differed much in different places and at different periods of an epidemic. Colvill states, of the outbreak of 1874–75 in Mesopotamia, that the mortality in the first half of the epidemic in a village was from 93 to 95 per cent. of those attacked, but that during the latter half of the epidemic the greater number of the attacked recovered. The mortality in Bagdad throughout the outbreak in 1876 was, he states, 55·7 per cent. of the attacks (cases 4,585, deaths 2,556). Arnaud gives the mortality during the outbreak in Bengazi, 1874, at 39 per cent. of the attacks (cases 533, deaths 208). According to Cabiadis, the mortality at Hillah in 1876 was 52·6 per cent. of the attacks (cases 1,826, deaths 961). Hirsch estimates the mortality at Vetlianka, on the Volga (Astrakhan), at 82 per cent. of the attacks (cases 439, deaths 358); and Döppner states that at one period of the outbreak there was a mortality of 100 per cent. (in other words, all who were then attacked died), and at another, and later period, of 43 per cent.

Diagnosis.—'No other idiopathic fever, attacking a multitude of persons at the same time, is characterised by glandular swellings, by carbuncles, and by those severe manifestations of the nervous, sanguineous, and biliary systems which declare themselves in an attack of plague' (Cabiadis, according to E. D. Dickson). As regards *pernicious fever*, with which the disease was confounded by some medical men in Mesopotamia, Cabiadis says no intermission has ever been observed in plague; no attack of plague has ever been cut short by the administration of sulphate of quinine; and the expression of countenance and general aspect of a plague-patient are strikingly different from those of a patient affected with pernicious fever. At Vetlianka, intermissions, according to Döppner, were observed.

Prognosis.—'Rapid suppuration of the buboes, even when accompanied with high fever, indicates a favourable termination; all cases complicated with nervous, hæmorrhagic, or bilious manifestations end fatally' (Cabiadis). Colvill is of opinion that the occurrence of diarrhœa in the course of plague, as seen in Mesopotamia, was a favourable sign.

Treatment. — (*a*) *Curative.* — The recent outbreaks of plague have thrown no positive light upon its curative treatment. In Bagdad and Hillah the plan of treatment mainly followed was the internal administration of carbolic acid or of quinine, and the use of leeches and mercurial frictions to the buboes before suppuration. In some instances this plan was thought to have done good, in others it was useless, if not detrimental. In regard to plague, as to other grave general maladies, except those arising from paludal poisoning, curative treatment is at present only possible on general principles, both as regards the systemic and the local symptoms. The practice would appear to be the same in respect to the general symptoms as would guide the physician in the treatment of typhus ; in respect to the local symptoms, such as would apply to ordinary phlegmon.—(β) *Hygienic.* In the present state of our knowledge, more importance is perhaps to be attached to the hygienic treatment of the disease than to the curative. Most important of all, perhaps, is the exposure of the patient to abundant, freely changing air; next is the use of cold or tepid sponging, as the temperature of the body and the state of the skin (as well as the sensations of the patient, if he be sensible) may seem to call for; together with the large administration of drinks (acid—? mineral, or other) to combat the thirst, the judicious use of liquid food, and especially of stimulants when the dropping of the pulse, the coolness of the skin, and the ataxic condition of the patient call for them.

Prevention.—The prevention of plague involves two sorts of considerations, the one relating to the removal of the conditions which favour the development of the disease; the other to the limitation of the spread of the disease, the malady existing. (*a*) The conditions favourable to the development of plague have been already enumerated, and include all those insanitary states of houses, their sites and surroundings, which form the subject of public-health administration; also those states of poverty which have to be dealt with, not only as an economic, but as a public-health question. Of these several conditions, the three which would seem most to call for special attention in this country, in view of impending plague, whether as regards private individuals or as regards local authorities representing communities, are *overcrowding*, *defective ventilation of houses*, and *impoverishment*. (*b*) In respect to the limitation of the disease, the malady being present, the first and most important consideration is the *isolation* of the patient under such circumstances of aëration as are stated above, as well in the interest of the patient himself as of the community; and the *disinfection* of articles of clothing, or bedding, used by him, and of the room he may have occupied. Local authorities have large powers enabling them to provide beforehand, in a mode available for the use of the whole community, hospitals for the isolation of cases of infectious diseases, such as plague, and apparatus and materials for disinfection; and many authorities have already exercised these powers. *See* Public Health.

But *plague* is the subject of special measures in this country, as in every country on the Continent and Mediterranean littoral, to wit, measures of *quarantine*. Quarantine aims at preventing both the introduction of the disease into a country, and its spread, if by accident it should happen to have been introduced, by the isolation for a longer or shorter period, not only of persons *sick* of plague, but, in addition, of *all healthy persons* who may have been exposed, directly or indirectly, to the infection of plague; also by the isolation and disinfection of articles, described under the quarantine law, as susceptible of conveying plague-infection, coming from an infected district. Experience has shown that measures of quarantine against infectious disease are futile, if not impracticable for this country, from the impossibility of closing all channels of introduction, in consequence of the activity and magnitude of our commerce. But quarantine is retained in regard to plague and yellow fever, and has occasionally to be made use of to meet the requirements of other nations, who, failing the adoption of this system here, would be likely to impose disabilities on our shipping with reference to the diseases named. Thus quarantine was revived in respect to plague, at the time of the recent alarm of the disease on the Continent. The doctrine of plague upon which the English Quarantine Act of 1825 is based, as well as the laws of foreign countries relating to the subject, is a traditional one, inconsistent in many respects with the later and more accurate observations which have been made on the mode of spread of the disease. *See* Quarantine.

Great importance has been attached in recent epidemics to the formation of sanitary 'cordons' by which the infected district was supposed to be strictly isolated. But the observations of Tholozan show that the results attributed to these, often very defective, lines of defence must have been due, in many cases, to other causes. In the epidemic of Vetlianka, the limitation of the plague could hardly have been due to the 'triple cordon,' since these arrangements were not completed till the epidemic was declining; but much more to the radical measures of disinfection and destruction which were adopted, and which very possibly prevented the recurrence or permanent acclimatisation of the disease.

J. Netten Radcliffe. J. F. Payne.

PLESSER, **PLESSOR** (πλήσσω, I strike).—A hammer-like instrument used in percussion, for striking the surface of the body, either directly or indirectly. *See* Physical Examination.

PLESSIMETER, **PLEXIMETER** (πλήσσω, I strike; and μέτρον, a measure).—A flat instrument used in mediate percussion, by being applied to the surface of the body to receive the stroke of the plessor. *See* Physical Examination.

PLETHORA (πλήθω, I fill).—Fulness of blood. A condition in which the vessels of the body generally, or of any part, are over-distended with blood. *See* Blood, Morbid Conditions of; and Circulation, Disorders of.

PLEURA, Diseases of.—The serous membrane which lines each cavity of the chest, and is so reflected as to cover the lung, is not infrequently the seat of disease. As in its anatomical and physiological relations, so also in its diseases, it presents analogies to the lining membrane of a joint. Its diseases may be of external or of internal causation. They may be considered under the following headings.

1. **Pleura, Injuries of.**—These may be caused in several ways: (1) by violent blows upon the chest—and in this case there is usually at the same time an injury to the lung-tissue, the effects of which to some extent overshadow the pleural lesion and its results; (2) by direct wounds with a knife or blunter instrument, or a bullet; and (3) by fractured ribs. In each case inflammation of the pleura may occur. With the surgical aspect of these cases we here have no concern, and the pleural consequences may be sufficiently gathered from the following paragraphs.

2. **Pleura, Inflammation of.**—SYNON.: Pleurisy; Fr. *Pleurésie*; Ger. *Pleuritis*.

DEFINITION.—Pleurisy is defined as an inflammation of the pleura, of whatever nature and extent. Clinically and pathologically, pleurisy differs only in its accidents from inflammation of serous membranes elsewhere, and is the most common of the serous inflammations.

ÆTIOLOGY.—The causes of pleurisy, if local, may be obvious enough; if general, not so obvious. Of local causes the chief are wounds or bruises of the chest-wall; fracture of the ribs; caries of the spine; escape of irritating matter into the pleural cavity, whether from the costal side, as in periostitis or osteitis, from the pulmonary side, as in phthisical excavation, from disease of the bronchial glands, or from the side of the abdomen, as in gall-stone, hydatid, renal stone, ulcers, subphrenic abscess, and the like. Foreign bodies, again, such as bones or coins from the œsophagus or larynx, have been known to find their way into the pleural cavity, and thus set up mischief. Acute pleurisy, the result of local causes, is usually more or less proportioned to these in its severity and duration; pleurisy of general or systemic causation, on the other hand, though less regular in its career than pneumonia, has yet a certain character of uniformity. The general or systemic causes of this form of pleurisy are very obscure, and none of them are accurately known. There are some grounds for suspecting that a chill alone may be a cause of acute pleurisy; but more probably we have to learn that chill must be associated with other factors. A rheumatic or gouty habit is suspected to be a disposing condition by many, and probably with good reason; in some cases again the influence of syphilis has been recognised. The depression of over-work or harass, the debility of previous illness, and the poison of malaria, are among the more common predisposing causes. Acute pleurisy again often occurs as a part, or as a complication, of other diseases. Thus it is rarely absent in acute pneumonia, and may run on, especially in children, to empyema, and in this the pneumococcus may be found; it occurs also, as cardiac valvulitis and pericarditis occur, in acute rheumatism, but less frequently. Acute pleurisy following scarlatina is probably dependent upon a rheumatic or nephritic sequel; if it arise otherwise in that malady the pleurisy is more often of the profuser kind, and tends to empyema from the outset. Pleurisy arises sometimes after influenza and after measles, when it is probably due to pneumonic irritation; and, with or without obvious pneumonia, after enteric fever; of several cases of the latter kind Eberth's bacillus has been found in the effusion. It is also a common consequence of disease of the kidneys in which hydrothorax may be simply dropsical or the product of pleuritis. In septicæmia and in pyæmia, again, a low pyogenic pleurisy often arises as like effusions arise in the joints, and may be equally or more latent; or it may be caused by the rupture of a pyæmic abscess of the lung into the pleural cavity. The origin of the pleurisy which may accompany puerperal and other septic peritonitis is explained by Recklinghausen's demonstration of lymph-canals between the diaphragm and the pleura; and its supervention in some cases of abscess of the liver may receive a like explanation, though in others the passage is direct by ulceration. Reversely, septic pleurisies spread themselves sometimes from the pleural to the peritoneal cavity. Acute pleurisy, when 'idiopathic,' is more often on the left side (three to two) and is rarely bilateral. When due to more specific causes, such as acute rheumatism or nephritis, it is often bilateral, though rarely of equal severity on the two sides. Acute pleurisy is common at all ages; it is recorded often within the first six months of life; in babies it is readily overlooked unless there be abundant effusion, and not rarely even then. In children the symptoms are often very latent, neither cough nor pain is manifest, or pain may be referred to the abdomen, and, on account of the great mobility of the parts, there is little definite displacement of viscera; yet pleurisy is really more common under one year than between the ages of two and five years. At the age of five it is frequent, but it reaches its maximum frequency in middle life (æt. 35-45). The younger the child the more readily the effusion becomes purulent, and in such cases the mischief may extend to the pericardium, but this is more common perhaps in older persons. Cases of simple inflammatory pleurisy have been recorded in persons beyond threescore years of age; but in aged persons it is rare, and presents little reaction or pain. The male sex is more often affected than the female, in the ratio of about seven to five; the difference may be due to the class of cases which owe their origin to weather; it does not appear, however, that pleurisy varies in prevalence with the change of the seasons. Pleurisy, under one form or other, is credited with about 2 per cent. of the deaths in England, and with about 1 per cent. of the deaths of patients in public hospitals.

Anatomical Characters.—The morbid anatomy of pleurisies differs but little from that of serous inflammations elsewhere. The costal membrane generally suffers the sooner and the more severely. The vessels become injected and even yield in places, giving rise to small irregular ecchymoses. Effusion of a sero-fibrinous and proliferative kind quickly infiltrates the tissue, and the natural gloss of the membrane gives place to opacity. The superficial epithelium also strips off, and papillæ appear, at first isolated, but soon communicating together by networks of vascular formation. At this point all may clear up, or effusion may escape from the surface. In dry pleurisy the products are chiefly new-tissue elements, without much interstitial effusion. In active cases the effusion is not very voluminous, but is usually highly albuminous and very rich in fibrin; and false-membrane, often of great thickness, forms upon the pleura, and sits tightly. Some of the loose or adherent gluey effusion degenerates, and is absorbed on resolution; some of it organises, and forms more permanent false-membrane or bands of connexion and adhesion. These contain blood-vessels, elastic fibre, lymph-channels, and even nerves (Virchow). Clots of fibrin float freely and abundantly in the effused serum, and contain a great abundance of imprisoned cells. In the fluid itself the cells are fewer, clear, granular or multinuclear. The more of these cells, the greater the fear of a purulent transformation, especially if streptococci be present. In pleuritic effusions, as in other inflammations of serous membranes, staphylococci are but rarely found. The coccus of pneumonia is found only, if at all, during the actual duration of the disease. There are also found abundant free nuclei and a quantity of red blood-corpuscles, varying with the vascularity of the new-growths. If the exudation be less actively inflammatory and more serous, it is usually more abundant, and may amount to 100-150 ounces: it is less disposed to form firm membranes or adhesions. This fluid is of a greenish straw-colour, like synovia, and is thin, with fibrinous coagula in it. It partially coagulates when exposed to the air, and is found to contain more degenerated cell-elements, and perhaps streptococci, and tends towards a sero-purulent character. Dr. Churton of Leeds has found cholesterine more than once as a product of these degenerations; calcareous matter has also been found, even in large masses. In scurvy, tuberculosis, carcinoma, and other cachexias, and even in rare cases of simple pleurisy, the effusion may be highly sanguineous, and blood may be found alike in the coagula, in the free and in the attached false-membranes. In cases of chronic arterial degeneration hæmorrhage may occur in the pleura from ruptured vessels.

When the contents of the pleura are purulent, much of the new membrane has broken up, though even here false-membranes are by no means absent, and fibrinous clots are at times discovered. In cases of large effusion the lung is found compressed, and often bound down by false-membranes extending from the walls of the cavity. In adults the lung is usually found in the vertebra-scapular space; it collapses primarily by its own elasticity and withdraws itself upwards, inwards, and backwards. It may be compressed one-quarter or even one-eighth of its normal volume; it is then flattened, leathery, bloodless and airless, and will sink in water. As the pressure subsides, the lung may, and generally does, recover more or less of its former volume. It is surprising how fully the lung may re-expand in spite of false-membranes, bands, and prolonged compression. Dr. S. West has shown how closely the opposite pleural surfaces tend to cohere even in spite of intrusive matters. Nevertheless, either complete or partial adhesions or bands of connective tissue generally remain indefinitely after acute pleurisy; and, happily, for the most part do no harm. If the lung fail to re-expand to any extent, the deficiency is made up by the inward pressure, partly of neighbouring soft parts, and partly of the chest-wall. Pleuritic adhesions are very commonly found after death from other diseases, their origin being unknown or forgotten. On the other hand, false-membranes and bands may become the seat of degenerative processes; and pus, cretified pus, and the like may be found in them, with or without secondary abscesses elsewhere. A pleural cavity which has thus suffered is more liable to subsequent inflammations. The compressed lung in like manner may become the seat of sclerosis, of degenerative changes, and even of necrosis; in empyema the contact of pus promotes ulcerative and septic changes in the lung, as it does likewise in the vertebræ, ribs, and other neighbouring parts. Thus the pus, finding for itself a passage in the direction of least resistance, pierces through lung or thorax, and establishes a pulmonary or costal fis-

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[1] 'Bradshaw Lecture': *Lancet*, August 20, 1887.

tula. Sometimes the pulmonary fistula is a simple one, and communicates at once by a free or a valvular opening with a bronchial tube, or may have so communicated by an opening afterwards closed; at other times the pus finds a less direct route, and either by a coarse filtration, or by way of many small ulcerating channels, it reaches the more open passages of the lung.

Subpleural ecchymoses, though often accompanying evidences of inflammation, are not always caused by pleurisy. They occur in deaths of children after broncho-pneumonia and diphtheria, but there is usually a patch of pleuritic inflammation upon and co-extensive with them. As the punctiform ecchymosis of Tardieu, they may also be found on the heart, pericardium, and thymus gland, and are not by any means peculiar to deaths by pleurisy: they are not uncommonly found in other deaths also, but are probably always associated with obstruction to the entrance of air into the lung.

In all cases the position of the heart and other viscera must be observed, and the chambers of the heart, the pulmonary veins, the inferior vena cava, and other vessels examined for clots. In empyema a careful examination of the body for secondary abscesses must be made, not forgetting the brain.

Chyle may be found as a pleural effusion, not a few such cases being on record. The nature of these cannot well be ascertained otherwise than by aspiration. Chylothorax may be associated with, and caused by, intrathoracic morbid growths.

CLINICAL CHARACTERS AND VARIETIES.—For convenience of discussion, pleurisy may be divided into six kinds, as follows: (α) *Dry*; (β) *Acute*; (γ) *Diaphragmatic*; (δ) *Quiet, with large effusion*; (ε) *Tubercular*; (ζ) *Fibroid*. Each of these requires separate consideration. Effusion, when present, may be serous or may be purulent, or a serous effusion may change into a purulent; but since antiseptic precautions in operative procedure have been perfected, this change is rarely witnessed.

(α) **Dry Pleurisy.**—This is so called because it is attended with no effusion, or with effusion so slight as to escape notice. Usually, if not always, it results in an adhesion of the opposite surfaces of the membrane. It may not be revealed by any sign or symptom during life. Adhesions, more or less extensive, due to this process, are very often found after death. Dry pleurisy may occur alone, or as a complication of irritative changes in neighbouring tissues, as in the lung or chest-wall. Pain or pyrexia, more or less fugitive, may accompany dry pleurisy; but in many cases, if present, they pass unnoticed. Should attention be drawn to the chest, friction may generally be detected—in the early stages. An obscure pain in the chest or loin, or a frequent teasing dry cough, may at times be traced by the close observer to a patch of dry pleurisy in some part of the chest. A friction-sound due to such a patch may be transient, or may be audible for many weeks. It is supposed that some of the pains in the chest which accompany phthisis are due to the intercurrence of dry pleurisy; probably, however, they are as frequently myalgic (cough) or neuralgic. Dry pleurisy, with its resulting adhesions, is rarely injurious. Indeed, it is rather a safeguard when any destructive process, such as phthisical ulceration, threatens to bore into the pleural cavity. If it fail, and morbid matters escape into the cavity, acute pleurisy and pneumothorax are the probable consequences. Dry pleurisy often ends in but slight thickening, the two pleural surfaces adhering without much increase of substance. In other cases the thickening may be considerable, but this probably would indicate some more persistent irritation, such as we find, for example, in those dense coverings which often surround the apex of a lung in chronic phthisis. The remoter consequences of dry pleurisy are for the most part without importance. In some instances it may limit the chest-movements, or, more rarely still, may so tie the parts as to cause abiding pains, described as dragging or tightening. Such pains are usually referred to the sub-axillary or sub-mammary regions, and may be really annoying. More often they do harm by ministering to needless fears. A generally adherent lung is usually small, and it may be more liable to undergo degeneration or tubercular infection. It is said that in rare cases hypertrophy of the heart has resulted from the embarrassment of its action by pleural bands. Dr. Bowditch tells the writer that he has seen this twice at least.

It is useless to prescribe treatment for a disease which escapes observation, or is but a secondary event in the course of more serious processes. Where dry pleurisy is found, and is doing harm by exciting cough or otherwise, the best practice is to place several light blisters in succession over the affected part, and to watch the patient closely in all respects.

(β) **Acute Pleurisy.**—Acute pleurisy, though less serious than chronic effusive pleurisy, is far more serious than dry pleurisy, and generally appears as an important illness. It sets in with fever, pain, embarrassment of the breathing and cough, sometimes catarrhal, usually reflex. These symptoms bear no certain proportion to each other. The fever has no very characteristic type, but is rather what is known as a symptomatic pyrexia. Speaking generally, there is not a sharp rigor of onset, as in pleuro-pneumonia, but there is often a succession of lesser chills. Nor are there any very definite stages of increment, but rather a daily fluctuation of remittent, more rarely of intermittent type, with evening rise, the elevations not often reaching and rarely exceeding 40° C. (104° F.) At first the blood-pressure is high, the pulse being small and hard; after the first onset the pressure falls, and the pulse becomes dicrotic. As the effusion reaches its height, the fever in acute pleurisy gradually recedes, unless the case approaches to the form (δ), when the effusion is indeterminate, and the fever may subside, may fluctuate, or may drift into hectic. The pain is often very characteristic, but at other times is variable, and even delusive. Most commonly it appears as a stitch in the side, about the level of the false ribs, which is intensified by inspiration and cough. The deep breath when partly drawn is cut short, as if with a stab, while the face of the patient is wrung with an expression of sudden distress. Such inspirations are, however, instinctively avoided, and may have to be called for by the physician, so that the face may speak rather of apprehended than of actual suffering; in either case the expression is a telling one to the practised observer. The fixed alæ nasi, which are dilated, but do not oscillate as in some other kinds of dyspnœa, the parted lips, the bright eye of fresh fever, the cheeks flushed but not congested as in pleuro-pneumonia, the preoccupied and apprehensive expression, the posture semi-erect, slightly bent forward and toward the affected side, the shallow breathing, the fixed chest, the hand on the side, the curt speech, the stifled cough, make up a clinical picture often seen, and easy of recognition. It is a curious fact that these symptoms of distress are generally more marked in a robust patient, or one previously healthy, than in the ailing, weakly, or cachectic. The pain, however, may wander from the lateral or ante-lateral aspect of the lower ribs, and appear in the hypochondrium, or even on the opposite side. At other times it may become more diffused, and play upon the brachial plexus, darting from the clavicular and scapular districts to the upper chest, shoulder, or arm. This is, perhaps, more common in the diaphragmatic variety (γ). In some bad cases, in which pus forms from the beginning or almost from the beginning, the pain is very distressing and prolonged, and the rigor very strong. Whatever be the treatment, we look for some relief of pain, cough, and conscious dyspnœa on the third or fourth day.[1] The respirations, however, may still range above the normal rate, from the mechanical interference of increasing effusion or of this increase combined with œdema of the open parts of the embarrassed lung, and perhaps of its overworked fellow. About the end of the week, be it more or less, the pleurisy has run its course, and the effusion has, in favourable cases, attained its maximum; the urinary, gastric, and other glands regain their normal activity; and convalescence, with absorption of the exudations, is to be looked for. Thus far, then, the disease is painful rather than dangerous, death in the first week of ordinary acute pleurisy being practically out of the question. Malignant cases of pleurisy, however, occur, in which the temperature may be 40° or 41° C. (104°, 105·4° F.), the pulse reach 140, the tongue become dry and brown, the prostration excessive, and the exudation run promptly to pus—pus which may be fœtid, although without obvious reason. Such cases are rare, except as complications of septic and other diseases, and they are generally fatal, even after free evacuation of pus by incision. An important instance of recovery from such a case has been reported by Drs. Gairdner and Buchanan.[1] By certain signs in the chest we know the height to which the fluid has flowed in the cavity, and we await its ebb. Usually, in a day or two, some fall is noted, and in favourable cases this ebb runs quickly at first, and afterwards more slowly as the products become denser. Some remnant is usually to be detected after the patient is about; and months, or even years, may elapse before the parts become normally clear. Indeed, the signs of an old pleurisy may be carried to the grave. Probable as is this favourable result in strong persons, yet it is not to be too lightly promised even to these. Too often when we are awaiting the ebb we find a new flood, the level of the fluid rises into the upper chest, and the patient, who hitherto has lain on the sound side to avoid pain, now turns on the affected side to give full play to the open lung. This flow may recur with or without renewed fever, but is generally attended with a proportionate increase of pulse-rate, and diminution of pulse in volume and tension. Coincident with the diminution of blood-pressure, which in its turn is due to the pulmonary obstruction, is a diminution of the urine, which, probably, had become more abundant as the fever ceased. That the changes, both of pulse and urine, depend upon the effusion is shown by the rapid recovery of both when fluid is artificially let out from the pleura; the pulse then falls in rate and increases in tone under the finger, and the urine soon becomes more abundant. A little albumen is sometimes present during the time of pulmonary obstruction (*see* ALBUMOSURIA). Under ordinary circumstances a renewed flow of urine may be indicative of pleural absorption, or the case may pass on into the form (δ), or into an empyema. Neither of the latter events is common, however, except as a consequence of neglect, the symptoms preceding these being generally of a quieter character. It is hard to tell when the full chest contains *serum* and when *pus*, and by direct observation alone it is usually impossible. Marked hectic may exist with serum, but if this be associated with increased temperature, tenderness or subcutaneous œdema of the affected side, change of countenance, loss of appetite, wasting of flesh, failure of strength, thrush, diarrhœa, or with any of them, and the more if there be any inherent constitutional frailty, a preceding acute specific fever, or a septic infection, we must fear that tubercle is present, or the fluid turning to pus. The discovery of streptococci in the fluid would indicate the latter event. In the later weeks or months of an acute pleurisy which has not ended in resolution, death may threaten and may not be averted. In some cases, as after scarlatina, or pneumonia, and especially in children, the effusion may be purulent from the beginning, and a fatal result may be feared even in the earlier days of the malady. Under ordinary circumstances, however, in healthy persons who have been carefully treated from the outset, and who have not been exposed to septic or malarious influences, we expect to have to deal with effusions moderate in quantity and stable in quality. The effusion in such cases rarely remains at its height more than two or three days; and in three weeks at farthest absorption should be tolerably complete. We must not therefore be too ready to tap in such cases. In other cases, fortunately rare, acute pleurisy, with remittent fever, continues for many weeks. Effusion in these cases may not be very rapid, but recurs gradually after the removal of moderate quantities; or it may not seem to need removal. The signs are simply those of acute pleurisy, but resolution does not take place, or is indefinitely deferred. Death may result in such cases, or the patient may slowly recover. After death may be found evidences only of active simple inflammation, partial or complete obliteration of the lung, and sero-fibrinous exudation. The other side, and the rest of the body, may be quite healthy. The name *relapsing pleurisy* might be given to these cases. When inflammation falls upon both pleuræ, it generally falls also upon the pericardium, and such cases are terribly dangerous. Even if moderate in degree in each, yet taken together the embarrassments of the patient become very grave, and death may imminently threaten. It is important to give relief by puncture as early as possible. The discovery of pneumococci in an exudation would, of course, indicate pneumonia also.

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[1] Writers are not yet agreed whether there be any local elevation of temperature in the affected side or not. Still less can it be said whether such local temperature runs any definite course of change.

[1] *Glasgow Med. Journ.*, Feb. 1883.

(γ) **Diaphragmatic Pleurisy.** — Diaphragmatic pleurisy is not essentially different from the preceding, but the symptoms are peculiar.[1] If the inflammation be, as it may be, exclusively diaphragmatic, and not costo-pulmonary, then the ordinary physical signs of pleurisy with effusion are either absent, or so ill-marked as to puzzle the inexperienced practitioner. In diaphragmatic pleurisy the patient may be taken as acutely as in ordinary pleurisy, or the fever may even be higher; but his distress is different, greater and more serious. The practitioner is surprised and perplexed to find a person, in whom he can discover no important organic defect, in an agony as it were mortal. The presence of pain shooting from the lower ribs of one side suggests pleurisy; but the ribs of both sides play with perhaps more than normal freedom, and no physical signs may be audible, unless it be that the practised ear may detect a want of breath-murmur at the base of one lung, and, after the first day or two, it may be, two fingerbreadths of dulness there. Still no friction may be heard, and it seems impossible at first sight to credit signs so slight with clinical phenomena so alarming. For the patient is as one having a clot in the heart, or a sudden perforation of the pleura, so terrible and so absorbing is the strife for inspirations which never satisfy, so keen the dread of any handling which may interfere with the one permanent need of sitting erect, and of keeping the upper respiratory muscles in full play. These inspirations may range from forty to fifty in the minute, or may even run with the seconds, except only when cut by a hiccup or a heaving of the stomach. To this are added the suffering of pain which shoots through the waist to the back, or darts round the shoulder-blade and collar into the shoulder, and a sense of a fatal grip. The fever may not be actually higher than in ordinary acute pleurisy, and the normal character of the heart-sounds gives great confidence to the physician; abdominal breathing, however, is lessened, and any pressure upwards upon the diaphragm is resented. All these things finally lead to the conclusion that acute inflammation has partially attacked and so far paralysed or inhibited the diaphragm, without extending far upon the pleura above; and the diagnosis is of course the easier if pleurisy be discovered elsewhere in the chest. A patient thus attacked seems to be in no little danger, but recovery may be anticipated if the mischief come not from below. Fortunately the malady is far less common than ordinary pleurisy, and indeed may be called rare. As stated above, however, inflammation of the diaphragm may complicate ordinary pleurisy,

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[1] Wintrich is indisposed to admit that the symptoms of diaphragmatic pleurisy are so characteristic as herein described. Diaphragmatic pleurisy may exist without setting up such marked and special symptoms, but the present writer speaks of his own experience.

and introduce both the pains in the brachial plexus and the excessive and paroxysmal dyspnœa. An empyema or other effusion lying between the diaphragm and the pleura may be out of the reach of direct diagnosis, unless the needle be used, and may have a latent commencement.

(δ) **Quiet Pleurisy with Effusion.**—This form of pleurisy is commonly said to be the sequel of acute pleurisy; but if we except a few cases in which pleurisy, at first sthenic, afterwards follows the asthenic tendencies of the patient, and those in which acute pleurisy has been treated with neglect, we shall find that in the large majority of the remainder this form begins not sharply but quietly, and indeed is often unnoticed until the chest is laden with fluid. If the patient suffered pain it was too slight or too indefinite to ensure attention; the low fever, unmeasured by the thermometer, escaped observation; the chest, slowly invaded, accommodated itself to circumstances until the fluid had nearly filled the cavity; and even then the patient may be brought to the doctor only by a sense of dyspnœa on ascending hills or stairs. A quick eye may detect in him an expansion of the alæ nasi; or, indeed, may see that the patient—almost unknown to himself—is breathing at double, or nearly double, the normal rate; or, again, a sensitive patient and a vigilant physician may fully perceive the remittent—almost intermittent—fever, the indefinite pain and the encroaching effusion, and may lessen the evil by timely interference. As a rule, where effusion is large the patient lies on the affected side, thereby escaping the pressure of the fluid upon the mediastinum, and enabling the sound lung to have free play. This decubitus is not, however, invariable, and is avoided if the affected side be painful. With pyogenic change in the effusion the patient may turn off the affected side, as this change is sometimes accompanied by a renewal of tenderness to pressure. When the effusion has come on very gradually, the patient may be able even to lie on either side indifferently. Occasionally a large pleural effusion may cause some difficulty of swallowing. Let the reader then remember that pleurisy running to large serous effusion not only may be, but very often is quiet; and not only may be, but not uncommonly is overlooked until matters come to an extremity. Even if the effusion be purulent, its accumulation may be equally rapid or equally silent; being silent when it is the further change of a serous effusion, being silent and rapid when it comes as pus almost, or quite, from the outset, as in septic and infectious diseases, and in children. If acute pleurisy drift into chronic pleurisy, the fever, which may have vanished for a time, lights up again fitfully at times, and fresh brushes of inflammation take place in the pleura and in the new membranes. With this there are also renewed outpourings of serum, and these sometimes increase so rapidly as to put the patient in imminent danger of death by syncope. The fever in these stages is often hectic in character, so that the presence of hectic alone does not prove the effusion to be purulent. Quiet effusive pleurisy is very uncertain in duration. Should the effusion be not excessive, and remain serous, months may elapse—nay, even years—before it is absorbed; and the absorption may be gradual, or may be deferred for awhile, and then completed more quickly. It is needless to say that even so favourable a result as this cannot do away with the injury which the chest must suffer from being waterlogged for so long a time. Very frequently, however, the effusion is sero-purulent or purulent; and if left to itself finds an exit gradually by many little ulcerated spots through the filtering lung, and so is gradually expectorated; or, by an opening into a bronchial tube, rushes with a sudden and copious discharge into the mouth. The expectoration in the former case is usually profuse, inoffensive, and muco-purulent; in the latter, the gush of pus, often stinking, is sometimes so great and so sudden as to swamp the lungs and threaten or even produce suffocation, especially if it occur during sleep. In either case we have usually to deal with a subsequent pyopneumothorax, which, if left to itself, may ultimately heal, but will probably end in death by slow hectic and marasmus. The issue is more promising if the pus find its way outwards between the ribs, and this it may do by a direct opening, usually in the fifth space towards the front, or a sinuous opening; or it may gather between the ribs and skin, forming there a large superficial abscess—'*empyema necessitatis*,' the tension of which varies with respiration and increases with cough, and this of course more or less readily as the communication is more or less direct. These changes in tension aid us in distinguishing such issues of the pleural cavity from local abscesses of the chest-walls. The chest, however, is imperfectly emptied; septic poisoning is but partially prevented; and a lingering illness must be cut short by operation. Again, the pus may find its way into the opposite pleura, thus doubling the empyema, and even such cases have recovered; or into the pericardial or peritoneal cavities, though such terrible events are fortunately rare; or it may burrow between the tissues and appear at distant places, and thus may mimic psoas or other sinuous abscess. A cure of empyema by reabsorption is said to be possible, but the possibility must be a bare one, except in the case of small encysted collections.

In some cases the fluid may rise in twenty-four hours from the angle of the scapula to the clavicle—an obliteration of breathing space far more terrible in its rapidity than a more gradual one to which the system slowly adapts itself. Largely effusive pleurisies have no definite course, for absorption is difficult, and so far as it occurs is too often compensated by renewed febrile movements, with renewed effusions. The lower character of the exudations, their lack of vessels, and the compression of those which exist, hinder such absorption as may be possible in weakly persons. Thus the fluid either is or becomes purulent, and makes for itself an outlet.

(ε) **Tubercular Pleurisy.** — In considering the relations of pleurisy to tubercle we have to deal with four classes of cases: (1) Those in which one or more attacks of pleurisy, not apparently itself tubercular, have preceded phthisis. (2) Those in which tubercle may arise in the exudations of a pleurisy thitherto simply inflammatory. (3) Those in which pleurisies spring up here and there in the course of pulmonary phthisis. (4) Those in which the pleurisy is tubercular in its origin and development.

These states will be best considered reversely, beginning with the last. True tubercular pleurisy is not uncommon, but, apart from tubercle in other parts, rarely destroys life directly, and, being a part of general tuberculosis, is not therefore found alone upon the *post-mortem* table. Tubercle, however, sometimes betrays its presence in the pleura before it manifests itself elsewhere, so that the occurrence of pleurisy without definite cause in a delicate person should always excite suspicion, and this the more if patches of inflammation spring up here and there in the membranes of the two sides without much resulting effusion. The fluxion of tubercles is generally insufficient to produce much effusion, though of course many sero-fibrinous or even sero-purulent pleurisies are of tubercular causation, direct or indirect; the fact of recovery does not necessarily prove the non-tubercular nature of the case. No great difficulty arises in deciding upon the nature of those intercurrent pleurisies which are coincident with, and so often caused by, pulmonary phthisis in the neighbourhood. These very commonly are not tubercular in a strict sense. More difficulty will be found in foreseeing or detecting tubercle in a pleurisy apparently simple. Tuberculous pleurisies of this second class are not uncommonly met with in practice, and followed to the *post-mortem* table. A pleurisy, severe or not, but seemingly of simple nature, appears to progress towards recovery, or perhaps, indeed, to reach recovery. The temperature, however, if it has fallen, fitfully rises again and the pulse quickens, yet without much evidence of empyema or of any returning effusion. After a longer or shorter interval a patch of pleurisy on the other side, or a sign of mischief at the apex of a lung, may betray the character of the relapse. These cases end as more or less generalised tuberculosis, and in the pleura or the old false-membranes are found the caseous or softened residue of the first crop. Most difficult of forecast are the pleurisies of the first class, which, however painful or profuse, end in recovery which seems complete. The patient, who has returned to the labours and delights of life, begins, however, to be hectic and to cough shortly and drily; signs of phthisis are detected in the lung; and the end comes in the too familiar way. The tubercle bacillus is very rarely found in the products of pleural paracentesis; indeed, the absence of any micro-organisms whatever in a purulent exudation may even suggest tubercle. For some reason or other tubercular effusions are often malodorous. The reactions of a patient to tuberculin might in a case of difficulty aid the diagnosis. The physician must regard with positive anxiety all pleurisies, however frank they may seem, or however happy in their resolution, which arise in delicate subjects, or in the members of families tainted with consumption.

(ζ) **Fibroid Pleurisy.**—Sometimes as a primary affection, but more often as an ultimate consequence of ordinary or of latent pleurisy, the membrane slowly thickens, and, allying itself with a like irritation of the connective elements of the lung, increases at the expense of the proper tissue of the lung; then, gradually contracting after its kind, it stifles and destroys a great part of that organ. Fibroid pleurisy generally begins at the base of the lung, and the pulmonary membrane may increase until it may form a dense leathery covering of even one-third of an inch in thickness. The disease is very chronic, and as the irritative overgrowth of the connective elements slowly advances into the lung, and is chiefly important as affecting the lung, little more need be said about it in this place. Fortunately the affection is rare, and it has not therefore received the attention it deserves. It enters into the class known at present as the chronic non-bacillary fibroid phthisis described by the late Sir Andrew Clark. Cough and dyspnœa, abiding dulness on percussion, lack of expansion, symptoms of pulmonary irritation and bronchiectasis, all following a known attack of pleurisy, should excite suspicion of such a fibroid hyperplasia. The causes of this abiding irritation are very obscure; the abuse of alcohol seems to be among them.

Hæmorrhagic Exudation.—Pleurisy may be attended with other peculiar features of not sufficient importance to justify its division into further varieties. For instance, it may be attended with *hæmorrhagic exudation*—that is, with exudation mixed with more or less blood, the loss of which may be exhausting, as is often seen in empyemas. These cases, though sometimes very acute, are usually chronic; and the hæmorrhage depends, as we have said, on bleeding of the new vascular tissues, which, moreover, may be due to some further abnormal state of the patient, such as scurvy, carcinoma, arterio-sclerosis, or tubercle. It seems probable that hæmorrhages do not suppurate unless micro-organisms gain access to them, and tend to do well if other conditions are favourable. A small quantity of blood may give to a body of serum a very sanguineous hue, but its specific gravity would remain low. A serous may quickly follow a hæmorrhagic effusion after paracentesis.

Pyopneumothorax. — This is a term applied to that condition in which, on perforation into or from some open channel, air finds entrance into a cavity, which is or becomes empyematous. At the same time pus is evacuated. The lung may in a measure expand, or in neglected cases may be irrecoverable; the chest-wall falls in more or less, according to the rigidity of the ribs in the individual. Dulness now gives way to clearer and lower notes, except in such dependent parts as may still be occupied by effusion; and the pitch will vary according to the thickness and density of the false membranes within, and to the degree of pulmonary expansion. If the fistula be moderate in size, little or no blowing sound will be heard; pus may indeed be spit up from an empyematous cavity, without the access of air to the cavity, the opening being in such cases valvular or quasi-valvular. Three additional auscultatory signs may also be obtained, which are alike in nature, but are distinguishable as *succussion*, *metallic tinkling*, and *bell sound*. *See* Lung, Perforation of; and section 3. Pleura, Air in.

Physical Signs.—These are to be detected by the usual methods. Throughout the stages of pleurisy *inspection* will tell us that the movements of the affected side are lessened either by the warning of pain indirectly, or directly by effusion which stops the play of the lung. This diminution of movement is often to be noted also in the abdomen on the same side, especially in diaphragmatic pleurisy. If the effusion greatly increase, the chest may or may not be seen to bulge beyond its true lines; the intercostal spaces are usually, but not always, flattened up to the level of the ribs, and the form of the affected moiety of the chest becomes more cylindrical, as is best shown by the cyrtometer. The diaphragm may be so thrust down and forward as to cause a fulness in the epigastrium; in large effusions there may be bulging even of the supraclavicular space; and the outline of the affected side measured in the transverse submammary line will usually measure more than on the healthy side. Half an inch is an important difference, seeing that in a young adult the other and healthy side in overwork expands about half an inch or more beyond the normal, and will fall again as the compressed lung expands after paracentesis. In recent effusions the skin is often obviously stretched. Œdema of the skin on the affected side is occasionally present, and, though not decisive of pus, is less common in serous effusions. It is confined to the affected side, but sometimes extends far beyond the chest-wall. The state of the veins of the neck must also be noted, and of those upon the chest. Much enlargement of these would suggest intrathoracic tumour rather than fluid, as in like manner would inequality of the pupils, or other evidence of solid pressure within. Clubbing of the fingers may often be seen in old cases of pleuritic effusion not necessarily phthisical, and the feature recedes if the patient advances towards recovery. The presence or absence of a heart-beat, and its position if present, must be noted. If fluid be in the left chest, a diffused pulsation in a tumid epigastrium often replaces the proper apex-beat, or the heart-beat may be felt or heard towards the right breast; if in the right chest, this beat may be detected towards or upon the left axillary line. In some cases of limited but complete dulness in the anterior and inferior region of the left chest, it may be difficult to decide between fluid and pleuro-diaphragmatic adhesions. In the latter case tapping might be attended with some risk of perforating the diaphragm. M. Jaccoud says the distinction may be made in some cases of adhesion by observing traction upon the lower ribs and spaces in forced breathing, so that the spaces are drawn in on inspiration, and the ribs drawn towards the median line. But puncture in so dangerous a situation would rarely be desired. In some rare cases of empyema the whole of the affected side so pulsates as to simulate a large aneurysm, a phenomenon which has not yet received a satisfactory explanation (*see* Diagnosis). Finally, in large effusions there is often some prominence in the hypochondrium of the same side; the nipple drifts farther from the sternum, and the shoulder-blade is thrust somewhat out and away from the spine. All these displacements and changes of shape are of course more readily brought about in young subjects, and in women more readily than in men. In children, also, on account of the elasticity of the parts, we find proportionately less visceral displacement. The female diaphragm is more readily depressed than the male, and the right side of it more readily than the left. In neglected cases absorptive and atrophic changes tend to bring about a retraction of the affected side; the thoracic and intercostal muscles waste; and the ribs fall together with corresponding flexure of the spine, and great elevation of the heart or liver. Such a deformity may, indeed, be permanent if the lung be obliterated; happily this is not generally the case.

Palpation will help us to find the heart's beat; and to ascertain whether the liver or the spleen be displaced, and so forth. By the hand we may sometimes detect the creaking of friction; and we may verify the imperfect expansion of the side or abdomen, the levelling of the intercostal spaces up to the ribs, and possibly fluctuation in the former. The most distinctive sign to the hand, however, is the loss of the vocal thrill, which is arrested by fluid effusion. This is normally more distinct over the lower two-thirds of the chest. Here effusions usually first accumulate, and loss of this thrill is almost pathognomonic of them; for it occurs besides only with those intrathoracic growths which by their size or position close the bronchial tubes, or in certain rare cases of very severe pneumonia with blocking of the tubes. Unfortunately, sometimes, when most wanted, the voice fails to awaken a thrill in normal parts. Sometimes the limits of the thrill may give a gauge of the height of the effusion. Above the limits of the effusion or near the spine the thrill is often more distinct than it is over the corresponding part of the sound side, and it is said to be present at times, or even increased when, after re-absorption or withdrawal, but a very thin layer of fluid lies between the lung and the chest-wall.[1] In such a case dulness would of course be still present. It must be remembered, if collapsed lung lie between the hand and fluid, that the vocal fremitus is none the less diminished.

Percussion of course reveals to us a higher or duller note over the whole extent of the fluid. But it cannot always tell us the amount of fluid present, as the level of this depends on the state of the lung and of intrathoracic tension and displacement. Moreover, during absorption, dulness depending upon thick false-membranes cannot be easily distinguished from that due to fluid. Such membranes may diminish vocal fremitus also. When fluid is present in quantity the note struck is dull, as if struck upon the thigh, and the stricken finger receives a peculiar sense of dead opposition, owing to the loss of resilience or vibration in the chest-wall. Extreme degrees of consolidation, however, may rival fluid in these characters. On the other hand, in effusion the level of the dulness may perhaps vary with the position of the patient, if its quantity be moderate, and it be unconfined by adhesions. Gravitation, however, helps us less in pleuritic effusions than in pleural and other dropsies, as in the former case the fluid is more liable to be sacculated, and may often be suspended by adhesion above the base line of the cavity. If the fluid be not sacculated it must sway no doubt more or less, but practically we can rarely follow its changes of position. If the pleura seem full of fluid, but the lung be not much compressed, direct percussion by the finger-tips will give a very dull note and a sense of resistance, while stronger mediate percussion will bring out a note of somewhat lower pitch. Usually the level of the fluid is a little lower in front than laterally and behind, as the lung, if free from much adhesion, shrinks, by its own elasticity in the first instance, upwards, inwards, and backwards, so that it may be detected by a clearer percussion-sound on the corresponding side of the four or five upper dorsal vertebræ.[1] In acute pleurisy the fluid rarely rises above the third rib in front; but in quiet effusive pleurisy the whole moiety of the chest may become very dull upwards and across to the opposite parasternal line, and there may be dulness and actual bulging in the supraclavicular space. When the chest contains a good deal of fluid, but is not full, percussion over certain areas may actually give a low or tympanitic percussion-note. These tympanitic areas may be of three kinds—(1) where a thin layer of fluid lies over expanded lung; (2) where distended air-cells compensate cells closed in another part;[2] (3) where, the chest being full of fluid and the lung collapsed, percussion in the neighbourhood of the trachea and large bronchi causes vibration therein. Tympany, when present, is nearly always immediately under the clavicle. If the tympany be due to the third cause, it may have something of the cracked-pot quality. In some cases the tympany is decreased on inspiration and increased on expiration. The detection of tympany under the clavicle may mislead the unwary into a belief that the healthy side is morbidly dull; but on the other hand it is an invaluable help to the physician who takes it as a hint to look for mischief below: in rare cases this may be extensive consolidation without fluid. Dulness due to a displaced liver may be distinguished by the removal of its boundaries on inspiration, and by its anterior rather than posterior disposition. In mere hydrothorax the lung generally rises more readily, and the diaphragm and other parts can usually be made to move in respiration.

Auscultation, before any dulness appears, usually reveals the respiration at the part to be defective in quantity, rhythm, or quality; and there a friction-sound may be audible. Defective inspiration at the outset is due to arrest of that act; afterwards it is due to the false-membranes and effusion which favour collapse of the lung, hinder conduction of sound, and ultimately silence it. A friction-sound, if ever generated, may be fugitive and escape the observer, or the embarrassed chest-movements may fail to give it distinctness. When present it appears at the outset, and disappears as effusion separates the surfaces; it may reappear as the fluid is absorbed. The friction of outset may last but a few hours, and except in dry pleurisy is rarely abiding; returning friction, however, may continue for a longer time, even for weeks. In those cases in which the surfaces do not separate, and friction continues for many days without a break, we have to deal most frequently with the drier pleurisies, or those of some cachexias or of septicæmia. It is not uncommon to find a friction-sound abiding so long as the patient can be kept under observation; these quasi-permanent rubs seem often to be without much practical importance. Diminished breathing and friction, if effusion gather, are followed by intermediate phenomena due to thin layers of fluid. These are bronchial breathing, bronchophony, and ægophony. Ægophony is nearly always heard near the root of the lung under the scapula; it has the character of a bleat, and when once heard is not easily forgotten. Its presence is pathognomonic of fluid;[1] but it is so often absent that it is of little practical value. As fluid increases, these phenomena give place to silence; and as fluid gathers first at the bottom we often find silence at the base; bronchial resonance amounting, it may be, to ægophony at mid-lung; and either defective or compensatory breathing at the apex. We may also meet with curious inverse changes in the physical signs, notwithstanding an increase of fluid, if at first this be spread over a partially expanded lung, and afterwards accumulate below it as the lung collapses, or as intrathoracic pressure tells on the other side. Thus dulness may actually recede with an increase of fluid, or on the other hand may rise upwards as with a diminution of fluid the re-inflated lung descends. For these and other reasons it is very difficult to gauge the ebb of intrathoracic effusions, or accurately to ascertain their behaviour after tapping. In children, bronchial breathing and bronchophony often, but not always, persist throughout. Dr. Bowditch used to say that he was occasionally greatly embarrassed in deciding about re-accumulations. 'At times after the effusion has been withdrawn the chest remains as flat as ever, and often it never clears up in the lower part of the affected side; but if it remains in this state without producing untoward symptoms, I have not tapped again, though a tentative aspiration could do no harm.' In cases where the lung is unbound, gauging is of course the more easy. When the chest is quite full of fluid, there may be no response to ear or hand; but even in such cases a faint but distinct respiratory *souffle* is occasionally audible almost down to the base. Moreover, breathing more or less tubular, and some resonance on percussion, are generally to be heard over the root of the lung in the vertebra-scapular space. As air re-enters the lung, respiration is at first defective, and accompanied by *râles* which are probably due to degrees of œdema; sometimes this œdema is severe and persistent, and abundant *râles* with watery expectoration last for many days. This is not uncommon after paracentesis. Respiration then improves gradually, and reinforces itself as the lung expands and clears. The pneumonia of children being often lobular, the discovery in them of bronchial breathing and bronchophony is suggestive of fluid, though lobar consolidation is of course not uncommon in them. In the other lung there is usually a slight general lowering of the percussion-note and compensatory breathing; if the effusion be large enough to compress the opposite lung, the percussion-note may be very markedly lowered. The gradual formation of a pulmonary fistula may in some cases be revealed some days or hours before evacuation, by the presence of liquid *râles* in the upper third of the affected side.

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[1] This has been noted by Dr. Griffith of Leeds (*Med. Chron.* 1889), who also says, 'The first sign to become normal is, as a rule, the vocal fremitus;' and further 'that this often becomes greater than normal' Speaking generally, the writer believes that Dr. Griffith is right.

[1] Broadbent, *Lancet*, May 1884.

[2] Dr. Bristowe attributes skodaic resonance to a diminution in the area of the chest-wall which vibrates.

For *bruit d'airain* (bell-sound) and other curiosities, *see* Physical Examination.

Diagnosis.—The difficulties of diagnosis in pleurisy belong chiefly to the earliest and to the latest stages of the malady. In the earliest stage the pleurisy may be latent, and so beyond the possibility of diagnosis; or a pain may be felt, and, setting aside other causes, this pain may be due to pleurisy or to pleurodynia. The pain is often referred to the loin or abdomen, thus leading to suspicion of mischief elsewhere. In the previous history a catching of cold, and the arthritic diathesis, would tell equally in favour of either view; while prolonged anæmia and leucorrhœa would lead us to think of the latter. Unfortunately a comparison of local temperature in the two sides seems untrustworthy, but the presence of fever would make us strongly suspicious of pleurisy. It must not be supposed that diagnosis in this early stage is unimportant. Few errors are more common than the attribution of pleuritic pains to pleurodynia; the pain disappears as an effusion slowly accumulates, and mischief and peril, perhaps hardly remediable, may be the consequences. The careful observer will listen anxiously to the chest day by day, or more than daily, until a friction-sound be audible;

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[1] Several modifications of pectoriloquy have been relied upon by Baccelli and other writers as means of distinguishing between pus and serum in the pleura. Dr. Bowditch informed the writer many years ago that the signs in question do not bear out the value which has been claimed for them; the phenomena probably vary, not with the density of the effusion, but with states of the lung.

and this once heard, further mistake is impossible. Fever of course may be present with pleurodynia, and an immediate diagnosis would then be impossible, unless something characteristic in the stitch and start on deep inspiration betray the real state of things. Neuralgic and inflammatory diseases of the walls of the chest are not likely to give rise to any permanent misunderstanding. It is said that a pericardial may be mistaken for a pleuritic friction-sound, but the distinction can rarely be difficult, except where a localised pleurisy affecting a patch overlying the pericardium may gain a cardiac rhythm. A difficulty is more likely to arise in distinguishing between a pericardial and a localised pleuritic effusion. Still this can hardly be insuperable. In rheumatic fever, scarlatina, and some other diseases pericardial may accompany or ensue upon pleuritic effusion, and when the latter is on the left side, and is abundant, the limit between the two may be beyond definition. The practical lesson is to remember the likelihood of pericardial effusion, and not to overlook it if it come.

In the later stages of pleurisy, when effusion is abundant, its diagnosis may occasionally be very difficult. Under ordinary circumstances complete and extensive dulness, with loss of all elasticity in the chest-wall, of respiratory sound, and of vocal thrill, make diagnosis easy; and if there be resonance below the clavicle, its high-pitched character is very characteristic of fluid below. But there may be no such resonance, and the voice may fail, or fail to set up thoracic thrill. Moreover, vocal thrill and respiratory murmurs may vanish likewise in intrathoracic tumours. Thus the diagnosis between exudations, pulmonary consolidations, intrathoracic growths, and combinations of fluid with either, is sometimes difficult. In acute pneumonia the course of the fever, the expectoration, and other symptoms, may help us to a decision. In pleurisy with moderate effusion the limits of posterior dulness may be changed by a few forcible inspirations, such changes being probably due to a re-expansion of collapsed lung. Moreover, a moderate effusion thus limiting the recoil of one lung may, in the absence of adhesions, permit the heart to be dragged over by the opposite lung. Consolidated lung cannot, of course, be thus modified. In both there may be tubular characters of respiration, which are more easily distinguished in print than at times they may be in the patient. If ægophonic we decide upon fluid, but if bronchophonic we have to distinguish as well as we can between the 'sniffling and metallic' bronchophony of consolidation, and the duller and more diffused bronchial sound of pleuritic effusion. If perchance the dulness and breath-sounds should vary with the position of the patient, fluid is clearly manifest. Limited effusions, such as an encysted empyema, not large enough to bulge the intercostal spaces, if they do not displace the heart, as most of them do, are at times physically indistinguishable from a like extent of chronic consolidation, or of abscess in the lower lobe of the lung. Such effusions, though usually basic, are by no means always so. Retained by adhesions, they may occupy the upper and anterior region, any part of the middle region, or strips, or irregular districts in any direction; or, again, they may be interlobar—a hard puzzle. It may be said, in general terms, that a permanent *very dull* area remaining after an acute pleurisy or pleuro-pneumonia most probably corresponds to an encysted empyema, but not always. In such cases fever may be entirely absent, and, unless clubbed fingers tell the tale, there may be little to suggest the nature of the disease. Obsolescence may result; still such a collection of pus is very likely to work mischief sooner or later — years later, it may be: the patient rarely escapes with impunity at last. The difficulties of distinguishing the more bulky effusions from pulmonary consolidations are not often great. In the former the intercostal spaces may be bulged, and the moiety of the chest enlarged; but these signs may also occur in some rare cases of caseous pneumonia. On the other hand, it but very rarely happens that consolidation reduces the lung to silence, though this also may be the case; in such a case the bulk of the half-chest would in all probability be lessened, but so, on the other hand, may it be in a chronic pleurisy. The fact is, many chronic cases can only be diagnosed by the needle; and it should be noted that, even with the needle, more than one puncture or two should be made before deciding against fluid. Practically speaking, however, as Dr. Wilks has said, 'chronic basal pneumonias,' unless of subphrenic origin, are so called in error, being pleuritic effusions almost always. Between intrathoracic tumours and large pleuritic effusions a difficulty is found only in those cases in which the tumour occupies a moiety of the chest; this, however, is not very uncommon, especially in cases of aneurysm. If fluid effusion accompany tumour, there may be subtympanitic resonance under the clavicle. In favour of fluid alone are the absence of enlarged veins; the equality of hydrostatic displacement of organs, and the absence of signs of localised pressure—of retarded arterial wave, of inequality of pupils, of peculiar sputa, and of enlarged superficial glands.[1]

A curious pulsation, of uncertain explanation, is sometimes seen in left-sided empyema, or any effusion, if tense enough, and very rarely also in pneumonia (Graves) alone. In the case of effusion, indeed, the lung must be indurated and must be tied down to the structures about the heart. This pulsation must not be mistaken for an aneurysmal throb. If fluctuation be certainly felt in the intercostal spaces, the disease, in part at any rate, is a fluid effusion. Sometimes a gastric, hepatic, biliary, renal, or other subphrenic abscess, making its way by a sinus, occupies also some part of the pleural cavity or excavates an adherent lung. Such an abscess usually extends rapidly, but it may encyst itself, and remain latent or quiescent for months or years; or it may excite an effusive pleurisy in the remainder of the cavity, so that two effusions co-exist in one pleura. Thus, serum may be withdrawn from one part of a pleural cavity, and a collection of pus may remain encysted in another, a collection very difficult of discovery even when suspected. From it of course pulmonary fistulæ may take their origin, and pus from the same central source—whatever the origin, for instance, hepatic or perihepatic abscess, renal stone, appendicitis, caries of bone, and so forth—may in part issue from the urethra or rectum, and in part issue from the mouth. When such pyogenic cysts contain air, but not by way of the lung, it may be supposed that they have originated in some perforative disease of stomach or bowel; such cases often simulate pyopneumothorax. In these cases, however, there will be little evidence of retracted heart or increased intrathoracic tension, and the affected area will rarely approach the apex. Dulness from disease below the diaphragm, but encroaching on the thoracic space, can often be displaced downwards by a deep inspiration. It is stated that in puncture, combined with the use of a manometer, when the cannula is in a cavity beneath the diaphragm, inspiration is attended with an increase and expiration with a decrease of pressure, being the reverse of that which occurs when the cannula lies in the pleura. In peripleuritic abscess tension is of course low, there is no pressure on neighbouring organs, percussion dulness is less profound, free expansion of the lung can probably be detected, and the axillary glands may be enlarged. It is said (Bartels) that pus from cellular abscesses is of higher specific gravity (1040) than from large cavities (1028-1030). The formation of pus at the bases of both pleural cavities is very suggestive of a subdiaphragmatic origin, and, what would be worse, of the presence of pus perhaps in the mediastinum also. Pleural effusions arising by direct absorption from puerperal and like forms of peritonitis are usually themselves also septic. In respect of diagnosis between serous, sero-purulent, and purulent effusions, it is better to say flatly that without the needle no definite diagnosis can be made. Even in the case of limited recent basal effusions it is better that the physician should understand that he has no positive grounds for assuming that there is not empyema. On the other hand, the signs, such as œdema of the skin, said to be indicative of pus are by no means trustworthy. The chest-wall, again, may be retracted over pus as over serum.

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[1] Dysphagia may, of course, occur in these and in many other conditions; often, for instance, in pericardial effusion, occasionally in pneumonia, and so forth. 'Cancer-cells' are found occasionally in pleuritic effusions, but their absence has no negative value.

A hæmorrhage into the pleura can be distinguished from a serous or purulent effusion only by a careful survey of all the history and symptoms; the direct physical signs help us but little. Large pulmonary cavities may be taken for encysted empyema with fistulous opening into a bronchus; and here again, as a pulmonary fistula rarely gives rise to tubular breathing, unless the opening be very large, or communicate with a secondary cavity, diagnosis by the direct signs alone might be impossible. The history of the case and the state of the other lung would be important factors in decision. In another class of cases the distinction between chronic phthisis and pleurisy may be difficult—in those, that is, in which there is some old dulness and retraction of a part of the side, with weak respiration and indefinite *râles*, and more or less fever. The absence of bacilli and lung-tissue in the expectoration, and the health of the other side, help to exclude phthisis. Fibroid phthisis, however, is not even thus excluded, and is usually pleuritic in origin. Hepatic hydatids may rise up to the third rib, and in children, enlargement of the spleen, with extension upwards and backwards, has occasionally simulated effusion at the base of the left lung. Finally, the intense distress and orthopnœa of very painful pleurisies—of diaphragmatic pleurisy more especially—may simulate cardiac thrombosis. The state of the pulse alone usually suffices to lessen the fears of the physician.

Prognosis.—The prognosis of simple pleurisy, apart from tubercle or malignant disease, is generally favourable, unless the degree or kind of effusion in the chest endanger life. In children the prognosis is especially good, although in them the effusion is usually pus. If not always favourable, it is because simple inflammatory pleurisies seem sometimes to originate a process of chronic fibrosis, which thence invades the lung. Happily such instances are rare, and in an individual case the chance of such an event almost vanishes. In ordinary inflammatory pleurisies, then, prognosis is favourable; in cases of effusion, where the effusion is moderate, it is favourable; where the effusion is large, it is the less favourable the greater the quantity and the slower the absorption. Signs of hyperæmia and œdema in the working lung must be anxiously watched, especially if an empty radial artery, scanty urine, and other evidences of venous stasis be added. When the chest is full, prognosis is unfavourable apart from operation. In severe and rapid cases the other lung becomes œdematous and congested, bloody and frothy sputa may appear, carbonic-acid poisoning become evident in the blue lips and lethargic brain, the pulse slip away, the heart fail, and the extremities grow chill; or, again, dislocation of the heart and arrest of the pulmonary circulation may cause fatal syncope by asystole or thrombosis. It is said that death may suddenly occur by failure of the respiratory centre even in cases of small effusion; but probably thrombosis of some kind is the ordinary cause of such deaths. Operation, however, raises the hope of recovery greatly—so much so as to put the chances largely in favour of rapid recovery in good subjects. The earlier the relief, the less the damage to the parts and the better the hope of rapid amendment. In bad subjects prognosis will be the less favourable the more potent the adverse conditions; and in pleurisies secondary to other diseases the prognosis will depend but partially upon this one element in the case. In old people operation is still useful, but especial care must be taken to draw off the fluid very slowly, and to watch the circulation. The conditions in them unfavourable to operation are still more unfavourable to absorption. In empyema the prognosis is graver; unless operation be performed death is very probable, either by syncope before the matter escapes, or by exhaustion, chronic septicæmia, or secondary abscesses, during a long period of incomplete drainage of the chest. If operation be submitted to, the prognosis is favourable, save in the worst cases; on the whole, the earlier the operation is performed, after it is fairly indicated, the better the prognosis. Among the deferred dangers are amyloid disease—not a common event, but possible in cases of necrosed rib or other bone, or of long and exhausting drain; and phthisis or more general tuberculosis, happily rare, prevented, it may be, by the density of the false-membranes. The presence of albumen in the urine does not by any means preclude complete recovery, nor forbid prompt operation. The precise bearing of age and sex upon prognosis cannot as yet be decided. Experience indicates that it is more hopeful in cases under ten years of age and above twenty years. Dr. Bowditch says that full pregnancy is no bar to thoracentesis. The influence of diathesis on the progress of local diseases must be estimated in all cases on general principles.

As regards duration, an ordinary case of inflammatory pleurisy will last from ten days to a month, according to the degree of effusion and the rate of re-absorption. Chronic cases with large effusions may last any length of time, rarely less than three months. If tapped, the fluid may not return, or may not return after a second tapping; in such a case recovery will be more rapid. Empyemas, opened under the most favourable conditions, have often been months and even years before final closure; antiseptic operations and dressings have, however, much shortened the average duration. If left to itself, an empyema usually opens through the lung or externally. In the latter case the issue is most commonly about the fifth interspace anteriorly, but may appear elsewhere. Drainage in such cases is very incomplete, and although some relief is attained, the patient nevertheless drags on with a permanent fistulous discharge, it may be for years; recovery without operation is scarcely to be hoped for. Of double empyema many cases have recovered, especially in children.

It must not be forgotten that simple pleurisies may be the forerunners of phthisis. The occurrence or repetition of a pleurisy in a young person of delicate habit or origin is always an alarming thing, and the more so if not due to obvious causes. The experienced physician will call to mind many cases in which a pleurisy, to all appearance wholly recovered from at the time, was followed before many months had passed by definite signs of phthisis. A decided attack of pleurisy, occurring in the course of pulmonary phthisis, always means or makes mischief, even if quickly got under.

Hæmorrhagic effusions, if kept aseptic, often do well; their gravity depends chiefly upon the antecedents in the case. Of secondary foci, which may arise from suppuration within the chest, abscess of the brain is the most calamitous, and, unfortunately, not the most uncommon.

Treatment.—1. *Medicinal.*—Dry pleurisy requires little or no treatment. In some cases, indeed, it may cause distress, as in chronic phthisis; and, if so, may be relieved by spongiopiline and laudanum, or by any similar soothing measures. In the cases in which a troublesome cough is caused by a patch of chronic dry pleurisy, the cough and pleurisy alike may be removed by the application of blisters. In acute pleurisy, however, much depends upon active treatment at the outset; in few maladies is early attention better rewarded, and in few is neglect more surely punished. Our great aim in the beginning is to diminish the pain, the inflammation, the fever, and the tendency to excessive exudation. With or without treatment, as we have seen, the pain usually passes off in forty-eight hours, or thereabouts; nevertheless it is very acute while it lasts. In sharp cases, occurring in healthy persons, we may put on six to twelve leeches according to the age, sex, or condition of the patient, and these may bleed freely into a large poultice. This measure, if adopted at the very outset, diminishes the pain, the fever, the exudation, and the duration of the case. When the bleeding has ceased, the chest should be firmly bandaged, and so soon as the state of the leech-bites will allow of it the affected side should be as firmly strapped. This, by giving rest to the part, will favour resolution and resorption. Constant respiration, on the other hand, favours effusion, as exercise favours it in inflammation of a joint. If called to a case after the first brunt is over—say after a lapse of forty hours—it is better to omit the leeching, in order that the strapping may be applied at once. It must be carried out on the plan laid down by Dr. F. Roberts, of University College Hospital, which is described in the article Rest, Therapeutics of. Dr. Roberts applies the strapping in all cases from the outset. The writer's experience is in favour of early leeching in suitable cases; it may be possible to combine the two remedies, but this at the outset is far from easy, as a large poultice is almost an essential part of the leeching. Some physicians recommend that an attempt be made to subdue the local inflammation by the application of ice-bags, but the results of this method are not very satisfactory. It is said, however, to give great local relief. In addition to local measures, such medicines as the following are required: A combination of compound ipecacuanha powder gr. v, and antimonial powder gr. iij, may be given every six or eight hours, for two or three days. In diaphragmatic and in other cases in which pain is a marked feature, the subcutaneous use of morphine is also to be recommended, in doses of one-eighth to one-fourth of a grain, or possibly more. The fever is rarely severe or protracted enough to require such vigorous antipyretics as quinine, nor is aconite a very safe remedy. It is better to give, in addition to the powder, either full doses of solution of acetate of ammonium (ʒij–ʒiv for an adult), covered with a little milk, or ten grains of salicylate of sodium, every four hours; the latter drug is better avoided in tubercular cases, but it seems to have some power to promote absorption of fluid effusion. An alkaline effervescent may be freely used also as a drink. Thus vascular tension is lessened, and activity of the skin and kidneys promoted. In the earlier stages free purgation should be avoided, but it is well to call gently upon the alvine excretion by the use of mercurials and salines. All solids must be withdrawn from the dietary, and stimulants, as a rule, forbidden. The alkaline effervescent or a cream of tartar drink, with acetate of ammonium mixture, are to be continued after the powders are withdrawn, so as to keep up free excretion; for the same purpose, and also to lessen chest movements, the patient must be kept closely to bed. For some days after the subsidence of the fever the appetite for highly nitrogenous diet must be held in check, and it is desirable at this stage to lessen the amount of fluid in the dietary. Thus it is to be hoped that, as the patient's general condition improves, the effusion in the chest may likewise fall. If this be not the case blisters are to be applied, which, if not pushed to full vesication, may be repeated frequently; or the chest may be kept continuously under the effects of iodine, though this method is less successful than the blisters. At the same time, or soon after, a pill may be administered twice daily, containing a grain each of digitalis (fresh leaf) and blue pill. A grain of squill may be added, but squill has some tendency to disorder the stomach. The use of both blisters and mercury must, of course, be avoided if the kidneys be not sound, and mercury should be avoided in any case where a phthisical tendency is suspected. Iodine may be applied externally. When a brief and gentle eliminative course of this kind is ended, it is well at once to turn to the full tonic treatment, with such drugs as iron and quinine. Less active effusions in delicate and anæmic subjects may need iron and bitters, cod-liver oil, and liberal diet from a very early stage, and such cases are common. At the same time such measures are not to be used while the more acute stages are present—a precaution too often forgotten; for even in phthisis a sharp intercurrent pleurisy must often be treated by salines, and possibly a leech or two at first.

These measures will generally succeed in reducing not only an acute effusion of moderate extent, but also many effusions of a more obstinate kind. If, however, the case resist the means prescribed, the effusion will probably increase, and may need operative interference, as is so commonly the case in latent pleurisy. As a general rule, if an effusion rises much above the angle of the scapula, and abides in this quantity or more for two or three weeks in spite of adequate treatment, it must be drawn off, whether the patient be embarrassed by it or not.[1] In cases in which treatment by medicines has not been fairly tried, when the patient is in comparative ease, the effusion is not above the spine of the scapula behind nor above the mamma before, is not rising fast, and the neighbouring organs are not seriously displaced, operations may give place to medicinal treatment for two or three weeks longer. The writer, however, would advise the withdrawal even of a pint of fluid which had lain in the cavity for a month, as its continued presence promotes collapse of the lung, and tends to destroy the absorbent power of the pleura and of its granulations.

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[1] In the revision of this article these words are left as formerly written. The writer is well aware that of late recourse has been had earlier and more frequently to paracentesis; but his own experience leads him still to counsel delay so long as the patient is in no distress. Under ordinary circumstances serous effusions advance to a moderate limit, and then slowly recede.

It is needless to add that, if there be effusion in both pleural cavities, the amount in both must be considered as one quantity. Before speaking of operation, however, it is well to say that two more methods remain—the so-called 'thirst cure,' which has some good effect in the treatment of serous effusion; and the jaborandi cure. The first method consists in the withdrawal of fluid from the diet, which should be as dry as possible, and consist of lean cold meat, stale bread, and the like. All fluids are forbidden, except half a pint on the third day, and a pint on the seventh and eighth days. The effusion is said under this method to decrease daily; the method, however, is more painful than tapping, and could not be borne by all patients without injury. The second plan consists in the promotion of profuse sweating, by means of jaborandi. Excellent results are said to have followed this method. The drug may be administered as a liquid extract, ʒj being given every three hours; or one-third grain of nitrate of pilocarpine may be injected subcutaneously, and repeated as the results may indicate. If medicinal and dietetic means fail to remove a moderate effusion, if the fluid be rising fast, or if it already occupy the whole or a great part of the pleural cavity, the cavity must be tapped. There should be no hesitation in tapping instantly any chest which is dull up to the clavicle, or which presents but a small tympanitic space under the clavicle. The operation of removing fluid from the chest by tapping (paracentesis thoracis) seems to have been practised in early times, but did not become familiar to us until the last quarter of the present century.

2. *Operative.*—It may be a matter of doubt whether the fluid contents of the chest be serous, sero-purulent, or purulent. To ascertain this an exploring syringe may be passed through the wall of the chest, and a specimen of the fluid drawn off. In this way information is obtained as to the nature of the fluid, and its accessibility. Should the tap be dry, it can be repeated at another spot more readily, and with less sense of failure, than a greater operation. The precise place of operation must, of course, be chosen with great care; but, happily, there is plenty of margin for error; in an encysted empyema with thickened walls four or five punctures may be needed before pus be reached, and the negative result must not be accepted without projecting any drop or fragment which may be within or about the needle upon a slide, and examining it under a microscope. If the issue be serous, the complete emptying of the cavity is not necessary, and not always desirable. In cases of multilocular pleuritic effusion the emptying of one cavity only is of course an incomplete measure. Such cases are unsatisfactory at best, and can only be tested by repeated puncture.

If there be no special reason to the contrary, the chest is to be tapped on the lateral or posterior aspect, as there is thus less danger of interference with other organs. Reasons to the contrary may present themselves in the case of adhesions tying the lung or diaphragm to the side or back of the cavity, of lateral displacement of the heart in left-side effusions, of deformities in the individual, and so forth. The pointing of an empyema forward, however well-marked, is no indication for an anterior opening, as this pointing will recede when a posterior opening has been made; nor is the faintly audible sound of respiration over the back of the affected side a reason for declining to operate posteriorly, for such faint sounds are often conveyed to the ear when the cavity is full of fluid. Let a minute scrutiny then be made of the lateral and posterior aspects of the chest. Let any bulging of intercostal spaces be looked for, as at such a spot false-membranes are probably scanty or thin; and let the ribs be minutely examined, in order to ascertain that there is room enough between them for the insertion of a finger into the cavity, if this prove to be needful; or that, in any case, resection of a rib may, if possible, be avoided. The eighth space in a line with the angle of the scapula or a little outside is the best position in ordinary cases. If it should appear, however, that the fluid is so limited or encysted that it does not gravitate to the bottom of the cavity, or that it has a more anterior seat, a tentative puncture must be made at the dullest spot, regard being had, of course, to the position of neighbouring organs.

After careful disinfection both of the skin and of instruments, the needle must now be thrust quickly through the tissues into the cavity, the operator being careful to take the mid space, and thus to avoid the periosteum of either rib, and the intercostal artery. There is no objection to freezing the skin beforehand, but if the edge of the cannula present no ridge upon the trocar the stab is not very painful. If the fluid drawn be clearly serous, and the patient be a child, or the syringe capacious, it may be well, if time press not, to wait a day or two to see whether this small draught will set up absorption of the rest. Many such cases are on record. As a rule, however, it will be needful to proceed to a further evacuation of the cavity. For this a special instrument will be needed.

We cannot enter into an account of the many instruments sold for paracentesis thoracis; almost any one of them is satisfactory. They all consist in a fine trocar or perforated lance-headed needle, with an exhausting apparatus attached thereto.[1] Pumps of various makes are adapted to the trocars, by which the pressure of the atmosphere or the choking by clots may be counteracted. These pumps are rather cumbrous, and they are liable to be worked at an excessive pressure. The best exhaust in ordinary cases is a column of the fluid itself, which can be set higher or lower, as the run of the fluid seems to indicate. This column is formed by attaching a long indiarubber tube, at least four feet long, of small calibre but of substance thick enough to prevent collapse, to the collar of the cannula, and its height is varied by elevation or subsidence of the basin of water in which its distal end is placed. This tube has, of course, the action of a siphon, and by it alone, in the vast majority of cases, we can overcome the resistance. The diameter of the tube should be small, or the fine cannulas now in use for paracentesis will not feed it; moreover, the slower the issue of the fluid the better. It is well to attach the tube to a short branch of the cannula issuing at a small angle from the side of the latter, and containing a stopcock; in such an instrument the trocar works like a piston in the cannula, and can only be withdrawn to a point immediately beyond the opening of the lateral channel. The advantage of this arrangement is that we have in the tap a ready and convenient way of commanding the flow, and on stoppage of the cannula the trocar can at once be so pushed up as to clear it. If there be no piston-trocar the cannula has to be cleared by wires —a fidgety process, and too often inefficient. It may be better indeed under such circumstances to close the wound and re-introduce it elsewhere; thus less pain and annoyance is felt in the end, and a better result obtained. A disadvantage is that such an instrument is not very easily purified, and as inflammatory serous effusions are certainly liable to turn into pus if septic elements be admitted to them in the smallest quantity, the instruments used must be scrupulously disinfected and air excluded. If the distal end of the delivery tube be placed in water, and the tube be emptied by running the finger down it, any bubbling after the expulsion of any residual air will almost certainly point to wound of the lung. The tap should be turned when the patient is quiet and at the beginning of his expiration. The fluid will run at first in a steady stream, afterwards in gushes corresponding to the expirations. When the fluid ceases to run, or coughing grows troublesome, the tube may be withdrawn; for if the fluid be serous the presence of a remnant, or more than a remnant, of the effusion in the cavity is of no disadvantage; if it be sero-purulent the cavity is certain to refill, and if it be laudable pus it will in all probability refill. On the other hand, when the lung expands imperfectly, to exercise strong suction upon the mediastinum or on the abnormally vascular pleura is to run the risk of doing harm. The patient must either sit up, or take a semi-recumbent position towards the sound side, with the shoulders raised upon pillows. If there be any tendency to syncope, an erect position will aggravate it, and a recumbent position is unfavourable to operation and to escape of fluid. The patient must be closely watched, and the stopcock turned in case of severe coughing, which may be very tiresome and attended by profuse watery excretion—probably the consequence of pulmonary œdema intensified by the siphonage. The least sign of faintness will of course call for the same precaution, but, happily, this is rarely seen. Cases are reported in which sudden death has occurred during paracentesis, or about the time of it; but cases of sudden death are not uncommon in pleuritic effusion, whether punctured or not.

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[1] The hollow needles sometimes used have many drawbacks. They may prick the lung and cause cough or even let air into the pleural cavity, which, if not septic, may prevent expansion of the lung.

It may be desirable, if there be no indication to the contrary, to inject one fifth of a grain of morphine beneath the skin after the operation, in order to relieve any irritation either by cough or otherwise, and to secure subsequent rest. The stopcock of the instrument will, of course, be shut when the cannula is withdrawn, and the puncture promptly closed on withdrawal by the finger. It is well to keep the finger in apposition for a few minutes, and then to apply a simple antiseptic lint-pad with short strips of plaster. In some favourable cases no second tapping is needed, and the heart tends to recover its position on the completion of the operation, moving three inches perhaps in the course of it. In two cases in which the writer noted reduplication of the second cardiac sound before tapping, the sign ceased at once on the emptying of the cavity. In other cases, even of serous effusion, the severity of the pleurisy may have so fettered the lung that the re-adjustment of the parts is much more gradual, and the space of the effusion is re-occupied but slowly by the unfolding lung, and the yielding of the chest-wall and mediastinum. In this respect there is not much difference between serous and purulent formations, save, of course, that neglected cases are more likely to have become purulent. A rapid return to the normal of the physical signs is a very good omen, and in cases promptly dealt with is now happily a common experience. In cases which recover more slowly we get less help from the physical signs, the conditions within the chest being in a more stable state of perversion. In pleuro-pneumonia the lung may not be able to expand in case of paracentesis for the pleurisy, so that only some ten ounces or so may be obtainable by falling in of the ribs. It is rather the rule than the exception for some dulness to remain below the scapula, and this alone is no indication for repeating the operation. In the majority of cases, however, the cavity refills, and aspiration may have to be more than once repeated. It is proper, therefore, to warn the patient beforehand of what may be in store for him. The injection of a solution of chloride of sodium ($\frac{3}{4}$ per cent.) has been said to promote re-absorption and avert re-tapping. The same end is said to be attained also by the introduction of sterilised air after removal of all the fluid possible. These methods, however, have not yet proved their claim to acceptance.

If there be any subsequent pain or elevation of temperature, these, under ordinary circumstances, will prove to be transient. If the rise of temperature continue after the first day or two, the formation of pus is to be feared. This event, moreover, is not infrequently attended with a reawakening of pain. In a case of extreme illness it may be desirable to draw off a certain quantity of a purulent effusion by ordinary tapping before proceeding to any further operation, as in this way any danger due to the sudden emptying of the whole cavity by the radical operation is avoided. Moreover, in young children aspiration might possibly suffice. As soon as possible, however, in all adult cases, the pus must be evacuated by free incision. But in all ordinary cases incision must be practised at once on the discovery of pus in the pleura. An anæsthetic must be used, and the operation deliberately performed. Chloroform in these cases seems to put less strain upon the limited breathing powers than ether; it need not be pushed far. If for any reason general anæsthesia be undesirable, it may be obtained locally by one of the sprays having this power, or by pressing against the part a lump of ice previously dipped in salt. If the patient be of spare body, let the opening be taken a little outside and below the angle of the scapula—say, in the eighth interspace, which site is above the line of an adherent or drawn-up diaphragm; if he be stout and muscular, a more lateral operation may be preferred, though drainage is more continuous and thorough by a posterior opening, and the ribs are there less liable to fall together. A scalpel is first thrust straight through the chest-wall on the upper margin of a rib, a grooved director is inserted alongside of the scalpel, and the incision is enlarged with a curved probe-pointed bistoury to the size of an inch or an inch and a half. Some surgeons recommend that incision be carried so far as the pleura only, and the latter forced open by dressing forceps.

It is, we repeat, of the greatest possible importance that all the instruments in use be disinfected, and the whole operation and dressings carried out on the antiseptic method. From the time of the operation the temperature should fall rapidly to the normal; if it rise again, the rise will be almost surely due to occlusion of the opening. To prevent this we insert a short, stiff drainage-tube. False-membranes as thick as wash-leather may oppose themselves at first, and the tube therefore should be proportionately large; but these soon break down into curdy shreds, and the tube may be then reduced in diameter. Injections of a simple or antiseptic character into the cavity of empyema are, in the writer's opinion, to be avoided. They are rarely of use, they often increase irritation, and are sometimes attended with distressing or alarming general symptoms.[1] The great secret is to secure free and complete drainage; if this be attained the cavity will purify itself. This is as true of closing cavities as of freshly opened cavities; for to inject sinuses, in the hope of procuring adhesion and closure, rarely succeeds and often does harm. In like manner, to probe the opening of an empyema is generally a mistake. If the opening discharge for a long period, it may be well once for all to ascertain the length and direction of the sinus; but it is better to enlarge the opening if necessary, or even to make another, than to fret the part by repeated explorations. Resection of a portion of a rib has been recommended by some surgeons, even as a part of the ordinary operation. If a neglected empyema have shrunk or discharged spontaneously, if the ribs have come into contact, or if, after opening, the continuance of the discharge seem to depend on rigidity of the chest-wall and carnification of lung, then resection of considerable portions of several ribs on Estlander's method may carefully be considered by the surgeon. But the practice of resection in ordinary cases is unnecessary and meddlesome.

In the exudations of tuberculous or carcinomatous disease, operation may be justifiable by the temporary relief given to the sufferer; paracentesis must, however, be preferred to incision as long as possible, as the incision is not likely to close. If after the removal of a collection of pus, and the establishment of really free drainage, the discharge become more offensive and the fever remain, the disease is probably tubercular and the forecast of the worst. It will be remembered, however, that the pus may not all be included in one cavity or in cavities which communicate. It is needless to say that each separate cavity will need its own operative relief.

Sometimes empyemas have been treated by repeated aspirations, instead of by incision and continuous drainage. It is hopeless to attempt the cure of a sero-purulent discharge by this method, but a collection of laudable pus once removed by the aspirator has in rare cases failed to return. The chance of success by this method, even in young children, is too slight to be looked for with any confidence, and the repetition of these aspirations does not prevent the gradual condensation of the lung, nor the formation of a pulmonary fistula. There is no difference in method between the performances of these operations in childhood and in age, but in childhood recovery is generally more rapid and sure. Nor is there any difference of method in operating upon a case in which a pulmonary or other ill-placed fistula has already formed; nor is the performance of the operation much the less urgent in such cases, even if the bronchial opening be free and not valvular. In rare cases it may be possible to drain a pyopericardium through the pleural opening.[1] In cases of double empyema a day or two should, if possible, be allowed to intervene between the two operations, especially in children; there is no small risk of collapse or of pulmonary œdema in doing both operations together.

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[1] Jeanselme has collected forty-five such cases in *Rev. de Méd.*, July 1892.

It is desirable that after each or any removal of fluid from the chest the re-expansion be assisted by respiratory gymnastics. The best method of obtaining this end is by graduated exercise; by the inhalation of compressed air; or by residence at high elevations. Massage and faradism will be found necessary under such circumstances.

Means have been proposed by which the entrance of air into an empyematous cavity under drainage might be prevented, and the lung thus helped to expand under inspiration. The need of absolute freedom in draining and dressing, however, must discourage the use of all complex apparatus; and if the operation be performed early and antiseptically, it is marvellous how well the lung will recover itself.

3. Pleura, Air in.—Synon.: Pneumothorax; Fr. *Pneumothorax*; Ger. *Luftbrust*.

Definition.—Pneumothorax, as its name imports, is the state in which the pleural cavity, normally vacuous, or rather non-existent as a space, contains air or other gas without intermixture of liquid. If air or gas be present together with pus, blood, or a watery fluid, we give to the resulting state the compound names, *Pyopneumothorax*, *Hæmatopneumothorax*, and *Hydropneumothorax* respectively. The gaseous contents in these cases may precede the entry of the fluid or succeed it, and in the latter case it may perhaps be developed as a product of decomposition. These conditions, though not wholly unknown to the predecessors of Laennec, nevertheless were first adequately distinguished and clinically demonstrated by him.

Ætiology.—Pneumothorax is a commoner event than would be supposed, were we to confine our attention to cases which are recorded under this name. It is often an incident in the course of other diseases, and of none more often than phthisis. Pneumothorax sometimes, but rarely, appears as a primary event, and disappears again without further complication; more usually it occurs as one result of wounds of the chest, of purulent pleuritis, of phthisis, or of some rarer disease, such as ulceration of the œsophagus, stomach, or gall-ducts, carcinoma, and the like, which effect an opening into the cavity. If air be mechanically admitted to the pleural cavity, decomposition of other contents may add to the volume of that which was admitted. Even in those few cases in which pneumothorax seems 'idiopathic'—in which, that is, we find pneumothorax to be the first, the sole, and the last morbid state—we are almost bound to assume that this state is, in fact, secondary, and due to some perforation the cause and place of which escape our search. That such cases do occur is unquestionable; the most frequent cause being a strain, noticed or unnoticed at the moment. One such case, in the writer's experience, was due to a strain at the oar, another to a strain during gymnastics, a third to some unknown cause. All three subjects were vigorous men, and soon recovered on expectant treatment. In passing to the cases of more obvious causation, those due to wounds of the chest are the first to meet us, and need not detain us. That any wound perforating the wall of the chest and the pleura may permit air to be drawn by suction into the pleural cavity is obvious.

Of the same kind, but of reverse origin, is the pneumothorax which in empyema often but not necessarily follows perforation of the lung with ejection of the pus upwards, or less often perforation of the chest-wall by ulceration outwards. In these cases of pyopneumothorax we have to deal, of course, with the presence both of pus and of air in the pleura. Pneumothorax is not infrequently met with as a complication of phthisis pulmonalis. It occurs for the most part in the later stages of the disease, and often escapes observation; less frequently it is met with in the earlier stages, and is then betrayed at once by its symptoms. Its occurrence may be aided or not by such a strain as a fit of coughing. That pneumothorax is not a mere uniform result of ulcerative processes in the lung is due, of course, to the anticipation of a breach of surface by previous adhesive inflammation. In phthisis, happily, the perforation as a rule is minute, and the quantity of matter escaping into the cavity small—so small as to be generally inadequate to produce the physical signs of fluid contents. In other cases the escape may be more abundant, or a more abundant effusion comes from the pleura itself, as a consequence of the resulting irritation. We then have to deal with an obvious hydro-pneumothorax, or pyopneumothorax. The opening by which air escapes into the pleural cavity may be, and often is, valvular, so that its entry during inspiration may not be balanced by its exit. In this way air may accumulate under pressure. If, as in empyema, the lung be already collapsed, this pressure is the less distressing; if the lung be wholly or in part open, the pressure adds to the degree of the sudden embarrassment due to rapid collapse of lung, and to encroachment upon the surrounding parts, including the opposite lung. Air thus entering the pleural cavity is often purified from septic elements by its filtration through the lung, unless it pass through cavities and alveoli already charged with septic matters. In puncturing the chest-wall with a fine trocar, in cases of serous effusion, the lung is sometimes wounded, and air escapes into the pleura. The accident is an untoward one; but the air which thus escapes into the pleura is so cleansed by its passage through a healthy lung that, as a rule, it sets up no putrefaction, and is itself quickly absorbed. The puncture heals too rapidly to permit of any continuous transpiration, but the quantity suddenly admitted may add a good deal to the suffocative distress of the patient. A similar state of things is not uncommonly seen in the practice of the surgeon, when an injury which breaks a rib also drives its broken point or points through the costal and pulmonary pleuræ.

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[1] *Cf.* Sir W. Savory, *Med. Chir. Trans.* vol. lxvi. p. 235; and Mr. Godlee, *Brit. Med. Journ.* Oct. 15, 1892, p. 830.

It is said that in emphysema the bursting of dilated lobules may set up pneumothorax, and we may wonder that this event should be so rare. Perforation into the pleural cavity by ulcerative, cancerous, or other destructive changes, either in the lung itself or such neighbouring organs as the œsophagus, the stomach, the bowel or connected ducts, is not very rare in cases of malignant disease; and the entry of air, food, or other foreign matters into the pleura sets up suffocative and inflammatory symptoms, which add greatly to the miseries of the last days of life. There are, no doubt, other kinds of disease by which air may find its way into the pleural cavity; but the above description, with little or no essential difference, will apply to all.

Anatomical Characters. — Under this head we have little to say in respect of pneumothorax, and we have not here to deal with the further appearances of hydrothorax or empyema. A patient would rarely die of simple pneumothorax; for if death be mainly due to this, yet unless it occurred within the first few days it is probable that some degree of inflammation would follow the disturbance. In the vast majority of cases, of course, the pneumothorax is secondary to some other disease, and any fluid or other matters found with the air in the chest may be due, not to the mere admission of septic air into the cavity, but to the admission of decomposing elements into it. As concerns the presence of air alone, we have only to say that in most cases—especially in the cases in which air has reached the pleura by a valvular opening—the affected side of the chest may be visibly distended. In such a chest the pressure of the contained air may well be not negative only but positive, and on puncture the imprisoned air may escape with a hissing noise; if the air be contained under high pressure, the out-rush may be very strong —strong enough to blow out a candle. This air is usually deoxidised, and rich in carbonic acid; if there be decomposing matters in the cavity, it is likely also to contain sulphuretted hydrogen. Neighbouring parts will be found more or less dislocated directly as the degree of compression of the contained air, and inversely as the amount of adhesion limiting its extent. Bilateral pneumothorax of great extent is, of course, incompatible with life; if on necropsy it be found double, we may be sure that, on one side at any rate, it came on at the moment of death.

Symptoms.—The symptoms of pneumothorax are of course the more distinct the less the symptoms of the primary malady. In those rare cases in which pneumothorax comes on apparently as a primary disease—that is, in which the mode of entrance of air into the pleural cavity is most obscure—we find the chief symptoms to be dyspnœa and a sense of faintness, pain being a less uniform symptom, and present only when the entrance of air is followed by irritation and inflammation from the fluid or solid matters which accompany the gaseous. Aseptic air alone does not set up inflammation, nor much irritation. Fever, in like manner, depends not upon the entrance of air, but of the irritating matters which accompany it, and excite inflammation. It may, like the pain, be considerable; it may not be present at all; or, again, it may be lost in the fever of the primary malady, or show itself but as a slight exacerbation of that fever. The dyspnœa, in part mechanical, in part probably reflex, is necessarily attended by increase of pulse-rate; the two events being but different aspects of the same machinery. The degree of these accelerations, as has been hinted, depends upon the amount of previous accommodation in the chest, and upon the quantity, if any, of fluid and solid concurring with the gaseous escape. The escape of air with irritating matters suddenly into the pleural cavity of a person suffering but little from a phthisical ulceration, or of one surprised by an accident in the midst of health, will cause dyspnœa almost suffocative in degree, faintness, great acceleration of the pulse, and intense pain. If the affair be more serious there may also be symptoms of collapse, including a fall of temperature, cold extremities, ashen face, colliquative sweats, and chill breath. On the other hand, in pneumothorax occurring towards the end of phthisis, when a pulmonary ulcer breaks into the pleura widely adherent about a lung already half-obliterated, an attack of chest-pain may follow a bad fit of coughing, and be often put down, like the dyspnœa and the pulse-rate, to the fatigues and distress of a restless night. The patient's general condition may not be very markedly altered in such cases, and the pneumothorax is often overlooked. Cough and expectoration of course assume no proportions in simple pneumothorax; but if pneumothorax be established on the bursting of an empyema into a bronchus, it is obvious that cough and expectoration will be the most prominent of the symptoms. It is well to remind the reader that emphysema of the skin may result from the breach which causes the pneumothorax, or on the other hand may be present without pneumothorax, even in cases of fractured rib, and in cases of interlobular emphysema passing to the neck by way of the mediastinal tissue.

The *physical signs* are as follows: The affected side, in well-marked cases, may be enlarged in girth and of a rounder form. It is, moreover, still in respiration, the half of the chest being fixed (probably in the inspiratory position), or only dragged a little by the efforts of the accessory muscles. Air, like fluid, may press down the diaphragm, thrust the mediastinum aside, and change the place of the heart. The lung of the affected side will tend, of course, to recede to the point of the equilibrium of elasticity. In other cases, as in pyopneumothorax with retraction, the affected side often falls in so as to be of less girth than the sound side. Vocal fremitus must be absent if the lung be wholly collapsed, or far removed from the wall of the chest; if the lung be adherent in part to the chest-wall, vocal fremitus may be proportionally perceptible, and it may be possible to ascertain by other methods how far, if at all, the lung is adherent. Decubitus is usually on the affected side.

Percussion gives us great assistance in the detection of pneumothorax, the sound being tympanitic everywhere where lung is not, by adhesion or repression, kept in contact with the chest-wall, and often extending beyond the normal boundaries of the affected side. There is something about the loud, low-pitched, and extensive, if not definitely tympanitic, vibrations of the stricken chest in pneumothorax which is very characteristic. On the other hand, it is said that if the pleura be tightly distended by air under high pressure the percussion note may rise to positive dulness; the presence of fluid will dull the percussion considerably or altogether, in districts which will vary with the quantity of fluid and the position of the patient. In pyopneumothorax, with a bronchial fistula, the sharp line between hyper-resonance and dulness may be changed after a profuse expectoration. By percussion with palpation the dislocation of neighbouring parts and organs may be ascertained. The auscultatory phenomena of pneumothorax are curious, and were known even to Hippocrates. If we confine ourselves to pneumothorax pure and simple, auscultation is generally almost negative; in rare cases we may detect by a blowing (amphoric) sound the entrance and exit of air by a free opening, but in such cases fluid is always present as well; a few resonant *râles* may also be heard, especially near the shoulder-blade. The voice-sounds also and the cough may be more or less amphoric. Vesicular breathing is never heard. In pneumothorax, there is often present the peculiar phenomenon called the *metallic ring*. After death this metallic echo is always to be obtained, but during life the increased tension of the gas at the higher temperature may prevent it. In addition to this a very clear cracked-pot sound may be heard in some cases of pyopneumothorax with a wide fistula. The metallic tinkle of succussion, which was known to Hippocrates, consists in the echo of splashing or dripping fluid in the air-containing pleural cavity; and indeed other sounds generated inside the patient, such as the heart-beat, cough, &c., may take this metallic consonance from the chest-cavity, and may betray pneumothorax or illustrate it. In the same case, at different times, such sounds may be heard, or may be inaudible—variations which are, perhaps, due either to mechanical conditions dependent upon adhesions, the formation of false-membranes, the shape of the cavity, or the tension of the contained gases. *See* PHYSICAL EXAMINATION.

DIAGNOSIS.—The diagnosis of pneumothorax by the signs and symptoms above named is not difficult, if its occurrence be sudden, and the patient not too ill to forbid examination. If the presence of adhesions prevent the development of these symptoms, the case may be more obscure, but by so much the less serious. As, on the one hand, in an enormous moist cavity it is conceivable that metallic and succussion sounds may be heard, so, on the other hand, pyopneumothorax, restricted by adhesions to small dimensions, might simulate a cavity. Indeed, diagnosis might be impossible in such cases, but, speaking generally, the dulness and retraction of the chest-wall over a cavity would assist the diagnosis. Distension of the stomach, with elevation of the diaphragm, or diaphragmatic hernia, could scarcely be mistaken for pneumothorax by anyone who fairly took into consideration all the facts and history of the case. As empyema, especially in children, may lead to purulent pericarditis, so may pyopneumothorax by perforative process have pyopneumopericardium added to it. Emphysema of the lungs gives rise to tympany sometimes as great as of pneumothorax. Emphysema, however, is always two-sided, and rarely dissociated from sibilus or other sign of open bronchial tubes. In cases of pyo- or sero-pneumothorax there may be great difficulty in determining the quantities of fluid and of gas respectively in the cavity; so much as three quarts of fluid may coexist with a great deal of resonance above it. Tapping alone could decide the matter, and in such a case would probably be indicated.

Prognosis.—This obviously depends so largely upon the causes and concomitants of the pneumothorax, that any general directions are impossible. The tendency of air in the pleura is to absorption. The prognosis of chest-wounds, of phthisis, of empyema, contains differences too wide for formulation. It is asserted that pneumothorax, by the sudden oppression of the lung through the indrawn air, may cause rapid and even sudden death.

Treatment.—The treatment of pneumothorax in like manner must depend greatly upon the nature of the primary malady. In pyopneumothorax from empyema operation is the first necessity in a patient of sound constitution. Whether, in any given case of phthisis, pyopneumothorax should be dealt with by operation may become a question—a question usually, but by no means always, to be decided in the negative. Still, cases do occur in which the volume or character of the effusion, and the chronicity of the lung-disease, may outweigh the risks of operating; aspiration should be tried alone in the first instance. In wounds of the chest-wall, or of the pulmonary pleura, the puncture rarely closes so soon as to imprison the air in a state of higher tension than the atmosphere. Such a thing may occur, however, especially with valvular openings, and the displacement of organs and respiratory distress may indicate that relief is urgently needed. If it be, a fine trocar may be inserted into the chest, and by means of a tube air may be permitted to escape through water or under antiseptic dressings until equilibrium is re-established. The hypodermic use of morphine is as valuable in soothing the pain and distress of pneumothorax as of like suffering elsewhere.

4. **Pleura, Dropsy of.** — Synon.: Hydrothorax; Fr. *Hydrothorax*; Ger. *Brustwassersucht*.

Definition.—As the word implies, this is the term given to simple aqueous effusions into the thoracic cavity.

Description.—Hydrothorax is not to be classed with the effects of inflammation, but with dropsies elsewhere, and is the companion in many cases of ascites and anasarca. In other cases it exists alone, but is rarely confined to one side of the thorax, and perhaps never exists as a sole malady. We may say generally that it is liable to arise under the following circumstances: when the whole circulation is so impeded that venous pressure is increased—as, for instance, in disease of the mitral valve or its orifice; when venous arrest is due to some local causes, as, for instance, to the pressure of localised swellings upon veins, or to venous thrombosis; when the bronchial glands are enlarged; when in renal disease the removal of water from the system is checked; or, finally, when the quality of the whole blood is so deteriorated by disease, or the circulation is so changed by cold, or other such general influence, that its serum tends to exude passively from the vessels. In the first and third cases we should expect to find dropsy in both pleural cavities, in the second case the transudation might be limited to one of them. On the other hand, it is to be remarked that such transudations rarely stand at the same height in the two cavities, and indeed the contents of one of them is often so small in volume that the hydrothorax may seem to be unilateral. As a matter of experience, hydrothorax is chiefly seen in diseases of the heart and kidneys, in scarlet fever without renal affection, in septic and other diseases of the blood, and in the cancerous and other cachexias, whether there be local disease of the pleura or not.

Diagnosis. — The diagnosis of hydrothorax and its measure are easy, except in a few cases where the effusions are restrained by adhesions. The lung moves more readily than in pleuritic effusion, the diaphragm often retains its normal relations, the line of dulness does often shift (while in inflammatory effusion it practically does not), and vesicular breathing may not be absent.

Treatment.—Hydrothorax in the majority of cases is not formidable in itself, and (being not uncommonly an event of the last days or hours of life) is perhaps only noticed at the necropsy. Diuretics and hydragogue purgatives act more readily in hydrothorax than in inflammatory serous effusions. Still, if it increase so far as to harass the breathing or to add to the dangers of the disease, the fluid should be drawn away by a fine trocar without any fear of purulent change. It is well, however, to prevent the entrance of air into the chest, lest the fluid have in any degree an inflammatory nature, as it may well have, for instance, in scarlatina or nephritis. The operation may be repeated a great number of times if re-accumulations make it necessary. The fluid, if wholly non-inflammatory, appears as a greenish or yellowish transparent water; it contains no clots nor does it coagulate in the vessel; it may not contain corpuscular elements. It contains albumen, and its specific gravity is about 1008°. The presence of a corpuscular precipitate, any turbidity of the fluid or tendency to coagulation, will at once suggest a degree of pleuritis. In heart-disease with much venous stasis or much arterial degeneration, the effusion is not rarely tinged with blood.

5. **Pleura, Hæmorrhage into.** — Synon.: *Hæmothorax.*—Bloodstained effusions may occur, as we have said, even in simple pleurisy, but more commonly in such conditions as scurvy, tubercle, cancers, and the like. A purely sanguineous effusion is generally the result of wounds of the chest or its viscera; but it may also arise from within, as from rupture of the heart or of an aneurysm, or from a bleeding cancer. The means of examination or treatment of such cases, in so far as these are possible, may be gathered from the preceding sections. Hæmorrhage into the pleura from direct extravasation may be left awhile, on the chance of re-absorption. If this does not seem on the way, a tentative puncture may be made. If the issue be ichorous the patient will probably become febrile, and the major operation be needed sooner or later.

6. **Pleura, Morbid Growths in.**— The pleura enjoys no complete freedom from the invasion of sarcomatous or carcinomatous growths; but growths of the former class are very rare, except as intrusions from neighbouring parts. Cancer is found less rarely. The frequency of mammary cancer, and the neighbourhood of the pleura to the breasts, increases the danger of secondary mischief in the former part. Pleural mischief is, indeed, a common consequence of mammary cancer, and may be the fatal conclusion of a case. It occurs after or before operations of excision. From the cancer in the wall of the chest simple inflammation often extends to the pleura, and produces the usual results. In other cases the cancerous growth is itself propagated to the costal pleura, and spreads from thence. The cancer is usually seen in the form of small flattened or rounded elevations, rich in blood-vessels. If septic matters escape into the pleural cavity its effusions may soon become putrid. It is said that a rapid degeneration of cells, either cancerous or tubercular, may give rise to a quantity of fat-droplets so great that a layer of fat may be seen to stand on the top of the serosity withdrawn by tapping. Blood, too, easily issues from highly vascular formations—whether cancerous, tubercular, or simply inflammatory; and may be seen in the fluids after withdrawal.

There is little to be said of the symptoms and signs of such cases that will not be found under the more general heads of Lungs, Morbid Growths in; Mediastinum, Diseases of; and 2. Pleura, Inflammation of. The diagnosis of cancerous or other such masses from their own effusions or from simple effusions, let it be frankly repeated, is sometimes impossible without the needle. The prognosis in such cases will not depend upon the pleuritic changes alone; and the only remark to be made on their treatment is that paracentesis, in the secondary effusions, is not wholly to be declined. Some such patients have obtained from repeated puncture not only a prolongation of life, but also great relief of suffering.

Hydatid of Pleura.—Hydatid is rarely met with in England either in pleura or lung, and in either place occurs rather as a secondary than as a primary event. The most common source of thoracic hydatid is the liver, whence it tends to invade rather the right side of the chest, and may rise nearly to the clavicle. In some cases, when the cyst is comparatively small and unbroken, its nature may be suspected from its position and outline.

In other cases, and especially when the cyst has ruptured into the pleural cavity, physical diagnosis can give no distinctive evidence, and we have to make what we can out of the history and other circumstances of the case.

In view of operative interference, it may in a few cases be needful and possible to distinguish hydatid of the pleura from hydatid of the lung, but this is a question rather for discussion in connexion with pulmonary diseases. Pain would suggest pleural relations, and if a small cyst lie deep in the lung tubular breathing might be audible in the partially compressed overlying lung-tissue. When a hydatid cyst breaks into the pleural cavity, its treatment falls under the ordinary rules of pleuritic effusion, but aspiration alone will rarely suffice for a cure.

T. Clifford Allbutt.[1]

PLEURODYNIA (πλευρά, the side; and ὀδύνη, pain).—Synon.: Intercostal Myalgia; Fr. *Pleurodynie*; Ger. *Seitenschmerz.* A name for muscular rheumatism or cramp affecting the chest-wall. *See* Chest-Walls, Morbid Conditions of; Cramp; and Rheumatism, Muscular.

PLEURO - PNEUMONIA. — This compound word signifies a combination of inflammation of the pleura and of the lung itself. In all cases of acute pneumonia there is a certain degree of pleurisy corresponding to the inflamed lung; but it is of little or no practical significance, there being only some exudation on the pleural surfaces. Pleuro-pneumonia implies that the two morbid conditions are actually associated in various degrees, giving rise to their respective pathological changes, and each thus influencing the symptoms and physical signs. Individual cases, therefore, present many diversities, in accordance with the different ways and degrees in which the two diseases are combined. It may happen that they are associated from the first; or one may supervene during the progress of the other, in this way modifying its course, and not uncommonly rendering the diagnosis more or less obscure and difficult. Obviously the exact conditions present in the chest under such circumstances can only be positively determined by adequate physical examination; and it must be remembered that the pleuritic and pulmonary conditions will each tend to modify the signs produced by the other. No general rules can be laid down as to prognosis or treatment, but every case must be regarded on its own merits, in accordance with the principles laid down in the articles which treat of pneumonia and pleurisy respectively. *See* LUNGS, Inflammation of; and PLEURA, Diseases of.

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FREDERICK T. ROBERTS.

PLEUROTHOTONOS (πλευρόθεν, laterally; and *τόνος*, tension).—A form of tetanic spasm, in which the body is bent towards one side. *See* TETANUS.

PLOMBIÈRES, in France.—Thermal waters, with some soda, silicate, and arsenic. *See* MINERAL WATERS.

PNEUMATOCELE (πνεύμων, the lung; and κήλη, a tumour).—Hernia of the lung. *See* LUNGS, Malpositions of.

PNEUMOGASTRIC NERVE, Diseases of.—SYNON.: Fr. *Maladies du Nerf Pneumogastrique*; Ger. *Krankheiten des Vagus.*—Of all the cranial nerves, the pneumogastric has the most extensive distribution, supplying the pharynx, larynx, lungs, heart, œsophagus, and stomach, and even, in part, the intestines and the spleen. In some of the so-called functional diseases of the organs which it supplies its action is conspicuously deranged. The symptoms of its disease are thus very extensive, and it will be well first to describe them generally, and afterwards to consider in detail those which merit separate description.

Some of the functions of the vagus depend upon fibres of the spinal accessory which join it, but it is convenient to consider these in this article.

The pneumogastric, it will be remembered, arises from the side of the medulla, between the glosso-pharyngeal above, and the spinal accessory below, and to the outer side of the hypoglossal. The fibres of origin come from a tract of grey matter which is continuous below with the nucleus of the spinal accessory, and above lies (in the calamus scriptorius) between the hypoglossal and internal auditory nuclei, while to the outer side of its upper extremity, and more deeply seated, is the nucleus of the glosso-pharyngeal. The trunk of the nerve, after receiving fibres from the spinal accessory, and giving off some small branches (of which the most important is one to the external ear), passes down the neck, behind, and in the same sheath with, the carotid artery; enters the thorax on the right side, over the subclavian artery, and, on the left, between the subclavian and the carotid; passes through the thorax beside the œsophagus; and ends in branches to the stomach, spleen, and intestines. The most important branches are the pharyngeal, which, with the glosso-pharyngeal, form the plexus of the same name; the superior laryngeal; the recurrent laryngeal, which passes back, the left around the arch of the aorta, the right around the subclavian artery; branches to the œsophagus; pulmonary branches which, by means of the pulmonary plexus, supply the lung; and branches which form the cardiac plexus for the heart.

ÆTIOLOGY.—The deep position of the pneumogastric and its branches preserves it from some forms of damage, although its extensive course renders it liable to suffer from many causes. The nucleus in the medulla may be damaged by local softening, hæmorrhage, or slow degeneration; but in all these cases other adjacent nuclei suffer (*see* LABIO-GLOSSO-LARYNGEAL PARALYSIS). The nerve, at its origin from the medulla, may be compressed by thickening of the meninges, growths from the meninges or bones, or aneurysm of the vertebral artery. Affections of the nerve due to syphilis are almost always the result of meningeal disease in this situation. Other adjacent nerves commonly suffer at the same time. The trunk of the nerve is sometimes, but rarely, implicated in punctured or gunshot wounds; incised and lacerated wounds damaging it are usually immediately fatal from lesion of the large blood-vessels to which it is contiguous. In surgical operations the trunk and branches of the nerve are occasionally injured. The trunk has been tied in ligature of the carotid, and divided in the removal of deep-seated tumours. In such operations in the lower part of the neck it is often difficult also to avoid injury to the recurrent laryngeal. In excision of an enlarged thyroid both recurrent laryngeals have been repeatedly excised, from the time of Galen down to the present. Sarcomatous and other tumours, and enlarged glands, may compress or involve the nerve in almost any part of its course; and interference with its function especially occurs from such disease in regions limited by rigid structures, as in the upper part of the neck, near the skull, and in the upper part of the thorax. Aneurysms may compress the nerve or its branches; and the recurrent laryngeals suffer from this cause with especial frequency, because they pass round large blood-vessels. The left suffers much more frequently than the right, because the arch of the aorta is more frequently affected by aneurysm than the subclavian. An enlarged thyroid may compress the recurrent laryngeal nerves, and symptoms due to such compression may vary with the varying size of the tumour. The nerve is, in rare cases, the seat of neuromata. Neuritis of the trunk of the nerve, due to cold, is supposed to be an occasional cause of symptoms, but such cases are extremely rare. It is probably sometimes involved in very severe and grave cases of multiple neuritis, including that due to diphtheria and to beriberi.

Symptoms.—It must be remembered that the vagus nerve, besides containing motor fibres for the pharynx and larynx, is the chief afferent nerve for the respiratory centre. It contains accelerating and inhibitory fibres for this centre, but the former preponderate, so that experimental division of the nerve in an animal renders the respirations less frequent, but deeper, while stimulation of the divided (central) end quickens the respiration, and may even arrest it in tetanic standstill. The inhibitory fibres are contained chiefly in the superior laryngeal nerve, and their stimulation arrests the respiration in muscular relaxation. The vagus is the inhibitory nerve of the heart; slight stimulation increasing the diastolic periods, and stronger stimulation arresting the action of that organ. On division of the nerve the cardiac contractions are accelerated. It has been said to contain trophic fibres for the heart and lungs. The pneumogastric is an afferent nerve for the vaso-motor centre, the action of which is lowered by its stimulation, so that the arteries throughout the body are relaxed. It is the motor and sensory nerve for the œsophagus; the sensory nerve for the stomach; and partly also the motor nerve for the stomach and intestines.

Symptoms due to paralysis of the vagus are more frequently met with than those which result from its irritation. Occasionally both are combined. Laryngeal spasm and vomiting are the irritative symptoms most commonly met with, but occasionally cardiac inhibition occurs. Czermak, for instance, was able to arrest his heart for a few beats at will, by pressing a small tumour of the neck against his pneumogastric. Concato had a patient in whom a similar inhibition could be caused by pressure on the right nerve. The increased frequency of pulse which corresponds to paralysis of the nerve has been several times noted, and has occasionally been associated with diminished frequency of respiration, although the laryngeal paralysis, also resulting, has often obscured the effect on the respiratory movements. Roux tied the trunk of the vagus with the left carotid; instantly respiration was arrested, but the pulse was also retarded. The ligature was immediately relaxed, but the patient died in half an hour. Robert also tied the nerve with the carotid; the patient, who was conscious, immediately called out, 'I am suffocated!' and his voice became hoarse. He recovered, but the hoarseness continued for six months. A good example of interference with the functions of the vagus has been recorded by Guttmann. A lad, after diphtheria, presented paralysis of the palate and of one sternomastoid. His respiration quickly became reduced to twelve per minute, and very laboured, while his pulse rose to 120, and he died in a few hours. In many other cases a similar change in the pulse and respiration has been noted, and even a pulse-rate of 160–200. In the face of these observations, and of experiments on animals, it is not easy to understand a fact, said to have been observed by Billroth, who excised half an inch of one pneumogastric, which was implicated in a tumour, without any resulting symptoms.

The important central relations of the vagus, above alluded to, cause its derangement to form part of many so-called functional disorders of the central nervous system. Its nucleus forms part of, or is connected with, the respiratory centre, which is conspicuously disturbed in hydrophobia and some other diseases. The phenomena of 'Cheyne-Stokes breathing,' or 'respiration of ascending and descending rhythm,' are probably the result of lowered action of the respiratory or pneumogastric centre (*see* Respiration, Disorders of). This symptom is met with in cerebral hæmorrhage, uræmia, meningitis, and in some cardiac diseases. The central connexions of the vagus, in the hemispheres, extend to, or are connected with, those parts which are concerned in emotion, and it is probably through the agency of this nerve that the heart's action is affected in excitement and fear. In many epileptic fits the central representations of the nerve are the parts through which the consciousness is first affected, and hence the so-called 'epigastric aura,' which may seem to ascend to the throat.

A similar disturbance is in all probability the cause of the globus hystericus and of the laryngeal spasm, which are conspicuous in some epileptic and hysteroid seizures. The nerve is closely connected with the centre or nerves for equilibration, so that severe vertigo, on whatever dependent, is often followed by vomiting. The pneumogastric nucleus is contiguous to the internal auditory nucleus, and part of the auditory nerve, that which comes from the semicircular canals (the space-nerve of Cyon), is known to be concerned in equilibration. In the vertigo which results from disease of this nerve, or of the canals (labyrinthine or auditory vertigo), vomiting is very common, and the nausea and retching of sea-sickness are probably due to the deranged action of the semicircular canals, in consequence of the motion of the endo-lymph disturbing their nerve-endings, which in turn affect the pneumogastric centre. It is possible that the connexion of the vagus with the equilibrial nerves is by means of the cerebellum, disease of which so constantly causes vomiting, although this connexion has not yet been traced. Conversely, gastric disturbance of the vagus is often accompanied by vertigo, especially when combined with pre-existing imperfect action of the auditory nerve.

1. **Pharyngeal Branches.** — The branches of the pneumogastric which enter the pharyngeal plexus supply the constrictors of the pharynx and the soft palate. Some have asserted that all the pharyngeal branches are derived from the spinal accessory. The branches to the soft palate are derived from the spinal accessory. When one vocal cord is paralysed from disease of the roots of the spinal accessory, the levator palati on the same side is, as a rule, also paralysed, and very often there is palsy of that side of the tongue from damage to the adjacent roots of the hypoglossal nerve. *See* Palate, Paralysis of.

(1) *Paralysis.* — Ætiology. — The most common cause of paralysis of the pharynx is disease of the origin of the nerve in the medulla; such disease commonly also involves adjacent nuclei (*see* Labio-glosso-laryngeal Paralysis). Paralysis may, however, result from meningeal disease outside the medulla, from disease of the bones of the base of the skull, but scarcely ever from disease outside the skull. It occasionally forms part of diphtheritic paralysis.

Symptoms.—The chief symptom is difficulty in swallowing. Food lodges in the pharynx about the epiglottis, and small particles and liquids may enter the larynx. If the paralysis is limited to the superior constrictor, liquids may, it is said, be forced up into the nose by the contraction of the middle constrictor; but it is doubtful whether this occurs unless the palate also is paralysed. The affection of one nerve causes only slight trouble in deglutition, no doubt because of the circular arrangement of the muscular fibres.

Diagnosis. — The only conditions with which paralysis of the pharynx can be confounded are spasm and organic disease. The writer once saw an elderly man with distinct pharyngeal paralysis, who had been sent to an eminent surgeon because the difficulty in swallowing was supposed to indicate cancer of the throat. A careful examination is usually sufficient for the distinction.

(2) *Spasm.*—Spasm of the pharynx may be recognised by its paroxysmal character, and is almost always part of 'functional' nervous disease. It forms part of the spasm of hydrophobia; and occurs in hysteria, and in some other allied states. Individuals are sometimes met with who are unable to take food except when alone, so great is the amount of pharyngeal spasm which results from the emotion induced by the presence of other people. Other emotional states may have a like effect; in fear and intense grief swallowing may be impossible, partly from this cause.

2. **Laryngeal Branches.**—It will be remembered that, of the two laryngeal nerves, the superior is the sensory nerve for the larynx, and also supplies motor power to the crico-thyroid muscle, which is the tensor of the cords; while the recurrent laryngeal is purely motor, and supplies the other muscles. The motor fibres of both are derived from the spinal accessory. Of the muscles, the most important in regard to paralysis are the chief abductor, the posterior crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage backwards, and so moves the processus vocalis outwards); the chief adductor, the lateral crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage outwards, and thus the processus vocalis inwards); and the arytænoideus (which approximates the two arytenoid cartilages). Other muscles, acting at the same time, increase the power of closure.

(1) *Paralysis.*—Only paralysis of the abductors and adductors need be discussed in this article. That of the tensors and laxors of the vocal cords, although very important among laryngeal diseases, is always the result of local conditions, not of lesions of the pneumogastric nerve.

Ætiology.—Almost all diseases of the nerve-trunk affect the fibres to the larynx, the only exception being the diseases of the trunk below the origin of the recurrent laryngeal. Syphilitic and other intracranial disease, injuries, and pressure by tumours, all have this consequence; and the motor paralysis is, necessarily, almost as complete in disease of the recurrent laryngeal as in that of any part of the trunk of the pneumogastric. In multiple neuritis, especially that due to diphtheria and toxic influences other than alcohol, the larynx is also sometimes paralysed. Disease affecting the fibres of origin of the spinal accessory at the medulla, or its trunk in the neck, or the recurrent nerve, usually causes paralysis on one side only, but unilateral palsy is rare from general causes, such as those that give rise to polyneuritis. Disease of the nucleus of the nerve is usually bilateral. Another occasional cause of bilateral paralysis is the implication of both recurrents in growths in the upper part of the thorax.

Symptoms.—In complete *unilateral* paralysis the affected vocal cord is usually in half-abduction, in the position assumed after death. Although there is loss of all movement, that of adduction is the obtrusive defect. In phonation, the unaffected cord moves up to or beyond the middle line, while the paralysed cord remains motionless; and the movements outwards in inspiration and inwards in expiration, are performed only by the healthy cord. The voice, under these circumstances, may be hoarse, or it may be little altered, the healthy cord being moved beyond the middle line into sufficient proximity to the other to permit phonation. Complete approximation, such as is necessary for a cough, is impossible; and in the attempt to cough the patient only succeeds in driving air quickly through the open glottis, and no sudden explosive cough is possible. Sometimes, in complete unilateral paralysis, the affected cord is not in semi-abduction, but is nearly up to the middle line. It is in the position for phonation, and so there is no defective approximation in uttering vowel-sounds; but when phonation is over, and especially during inspiration, the healthy cord is abducted, while the paralysed cord remains motionless. Thus the loss of abduction is the conspicuous defect. On what the difference in the position of the paralysed cord depends, whether it is in abduction or in adduction, is not quite certain. The position of adduction is seen especially in paralysis of the recurrent nerve. One explanation is that the position of abduction is the early state, and that after a time, in some cases, adduction results from unopposed muscular contracture (Riegel), but it is probable that the key to the problem lies in the greater power of the adductors, which causes adduction to result from electrical stimulation of the recurrent laryngeal, and a defect, equally distributed, will have far more relative influence on the more feeble abductors. When the cord is in the position of adduction, the voice is high-pitched. At rest there is no dyspnœa, but on exertion the unabducted cord interferes with the entrance of sufficient air, and respiration becomes stridulous and short; but there is rarely, if ever, sufficient dyspnœa to render tracheotomy necessary.

Bilateral paralysis is much less common. It may be due to central disease; to diphtheria; to multiple neuritis; to pressure on both recurrent laryngeal nerves from tumours in the upper part of the thorax; or to the injury of these nerves in the excision of enlarged thyroid. Two remarkable cases have been recorded (Baümler, Johnson), in which pressure on one recurrent laryngeal and vagus has caused paralysis of both vocal cords, in one case equally, in the other less on the side opposite to the tumour than on the same side. Sir George Johnson suggests that the mechanism is probably an inhibition of the central nucleus on both sides, by the pressure of the afferent fibres in the vagus. In bilateral paralysis the same difference in the position of the cords is met with as in unilateral paralysis. Sometimes they are apart, in half-abduction, and sometimes approximated in adduction. In each case they are motionless. In the first instance the absence of the adduction for phonation is more conspicuous than the want of respiratory movement, and leads to the condition being designated *paralysis of the adductors*; in the latter the absence of the normal abduction on inspiration attracts chief attention, and there is said to be *paralysis of the abductors*. It is probable that the explanation above given applies to these cases also. The difference between the two in their symptoms is very great. When the vocal cords are in abduction, phonation is almost, or quite, impossible, and there is no closure of the glottis in cough. There may be no dyspnœa except during very active exercise. When, however, the cords are near the middle line, the patient's condition is very different. He is able to speak, but only in a high, stridulous voice. The most urgent symptoms arise from the absence of the normal respiratory movements. Instead of being abducted in inspiration, the pressure of the air brings the cords closer together, while the current, in expiration, separates them. This inspiratory approximation of the cords constitutes a source of the gravest danger. When the patient is at rest enough air may enter to prevent dyspnœa, but exertion brings on stridor and intense difficulty of breathing. The least swelling of the cords occludes the glottis entirely. This condition is one of great rarity, and is most commonly due to central disease, especially of degenerative nature.

Slight impairment of adduction of the cords is a very common and much less grave affection, met with in general weakness, hysteria, and local inflammatory diseases. It has been termed 'phonic paralysis,' because in the slight effort of speaking the cords are not approximated, while in the stronger effort of the cough they are brought together perfectly. It does not result from nerve-lesions.

Anæsthesia of the larynx may result from disease of the superior laryngeal nerve, but is extremely rare from this cause. Lessened sensibility, bilateral in character, is not uncommon in central disease of the medulla.

(2) *Spasm.*—The common form of spasm of the laryngeal muscles is that of the adductors. The muscles which close the glottis are far more powerful than those which open it, hence any irritation of the nerves—direct, central, or reflex—causes closure. For this closure, since it plays an important part in many physiological processes, a central mechanism is provided, which is readily excited by various means.

In cough, for instance, it may be stimulated, not only from the special afferent nerves of the throat, larynx, and lungs, but also by those of the stomach, and even, it is believed, by the branch of the vagus which goes to the external auditory meatus. Spasmodic cough may result from the simple irritability of the centre, as in hysteria; and a peculiar barking cough is occasionally the result of masturbation in boys. In whooping cough, again, the glottis, after being closed, is imperfectly relaxed, so that a sound accompanies the next inspiration. Simple laryngeal spasm, without implication of the expiratory muscles (laryngismus stridulus), occurs in children, in whom, in consequence of the constitutional condition known as rickets, the central nervous system is in a state of undue irritability. In this the vaso-motor centre seems to participate; a child, on some exciting cause, as a start, a reflex impression, or on none, suddenly turns pale, is unable to get its breath for a few seconds, and then, the spasm relaxing, air is drawn through the slowly opening glottis with a crowing noise. Quite similar attacks may occur in adults. They may be accompanied by distinct convulsive action elsewhere. In the paroxysms of epilepsy a similar combination is seen; the epileptic cry is the result of laryngeal spasm. Hydrophobia also is attended with a paroxysmal closure of the glottis.

Since the closure of the glottis is the physiological effect of irritation of the afferent laryngeal nerves, it is not surprising that spasm accompanies a large number of laryngeal diseases, varying in its prominence according to the irritative nature of the disease, and the irritability of the reflex mechanism; and, since the latter is most intense in children, we have in them a condition in which the slightest local catarrh gives rise to spasm. The attacks tend to occur especially at night, when the reflex centres, released by sleep from the control of the higher, are in their most active state. Spasm may occur, not merely from irritation of the laryngeal nerve, but from that of the vagus below, or by compression by tumour, the afferent nerves from the lungs being sufficient to generate it. Reflex spasm is always bilateral in character. Direct spasm by irritation of the recurrent laryngeal usually involves only one vocal cord; but in a few cases spasm so excited has been bilateral. This result can only be explained either by assuming the irritation of some afferent fibres, or by ascribing it to the spasm of the arytænoideus, which is a bilateral muscle (Krishaber).

A very rare condition of 'functional spasm' has been described, in which spasm is excited by attempts to speak. It has been thought to be similar in its nature to writer's cramp.

3. **Pulmonary Branches.**—The effect of disturbance of the pneumogastric on the respiratory movements, and the reflex effect of disturbances of the afferent pulmonary branches, have been already described. The muscular fibres of the bronchi are innervated by the nerve, and their paroxysmal contraction in asthma is thought to be produced through its agency. It has been asserted that the plain muscular fibres, said to exist throughout the lung-tissue, are supplied by it (Gerlach), and their contraction has been assumed to explain a peculiar form of emphysema, which has been observed in compression of the pneumogastric (Tuczek); but, since deep breathing of a costo-superior type was observed, it is possible that the effect is the result of the energetic respiration from the disturbance of the centre. The pneumogastric is commonly believed to contain vaso-motor fibres for the vessels of the lungs, but Brown-Séquard and Franck have separately shown that these fibres are contained, not in the vagus, but in the sympathetic. Vascular lesions of the lungs have, however, been observed after section of the vagus. Michaelson noted rapid congestion and hæmorrhage, and the congestion is sometimes noted after lesions of the pons. In a case of hæmorrhage into the pons, fatal in two hours, the writer found intense congestion with extravasation into the left lung, and hæmorrhages in the left extremity of the stomach.

After section of the vagus, animals die from chronic pneumonia, and hence the vagus has been supposed to be a trophic nerve for the lungs. But the changes have been accounted for by the entrance into the bronchi of food from the pharynx, in consequence of the obstructive paralysis of the œsophagus, and the paralysis of the larynx (Traube, Steiner). All admit that this is one cause of the pulmonary affection, but differ as to its adequacy in all cases. The question is still undecided.

4. **Cardiac Branches.**—The inhibitory effect of irritation, and the acceleration of the heart's action which results from lessened action of the vagus, have been before alluded to. The increased frequency has been several times observed in cases of local disease of the vagus in the thorax, compression by mediastinal tumours, &c. In a case of phthisis, for instance, in which the pulse was at first occasionally, and afterwards constantly, frequent (130–148), Meixner found the left vagus enclosed in a mass of enlarged glands in the upper opening of the thorax. The vagus is also the afferent nerve from the heart, and although we are normally unconscious of the cardiac action, some of the disordered sensations of disease are apparently produced through its agency. The subject of angina pectoris, and its relation to the vagus, is discussed in a separate article, but it may be here noted that in some anginal attacks the

heart's action is, for a time, arrested or retarded, and that in a few cases these symptoms have been found associated with organic disease of the cardiac plexus. Thus in a case in which, during paroxysms of intense anginal anguish, the heart's action was arrested for four or six pulsations, Heine found a tumour involving the cardiac plexus. In a case recorded by Blandin, anginal attacks were associated with a small tumour of the vagus. Further, there are afferent fibres from the heart inhibiting the action of the vaso-motor centre, and these are probably stimulated in some anginal seizures. *See* ANGINA PECTORIS.

After disease or injury of the vagus, the heart has been found in a state of fatty degeneration, and hence it has been thought that the vagus contains trophic fibres for the cardiac substance.

5. **Branches to the Alimentary Canal.**—The branches to the œsophagus are rarely diseased except in cases of affection of the nerve-trunk or of the centre. In very rare cases such disease has caused difficulty in swallowing, simulating stricture. Spasm of the œsophagus is more frequent. The vagus is the sensory, and in part the motor nerve for the stomach. Its fibres are very sensitive to any local irritation, and not rarely the seat of spontaneous neuralgia. Hunger is generally believed to be a pneumogastric sensation, and complete loss of the sensations of hunger and thirst was noted in a case of softening of the root of the vagus from an aneurysm of the vertebral artery (Johnson). Appetite, however, is not always lost in animals when the pneumogastrics have been divided (Reid). In some cases of disease of the nerve, excessive appetite has been noted. This symptom, for instance, was present in one case, in conjunction with dyspnœa, noisy breathing, and vomiting of unaltered food; *post mortem*, both pneumogastrics were found atrophied (Swan). In another case of insatiable appetite, small neuromata were found on the nerve. It is possible that the polyphagia may be in part the result of the defective digestion of food.

The pneumogastric is also in part the motor nerve of the stomach; after its section the contractions of the organ are lessened, although not altogether arrested. Vomiting is probably produced through its agency, by varied reflex and central irritation. In the latter case (as in meningitis) the vomiting is sometimes extremely rapid. The writer has known paroxysmal vomiting to result from the intermitting pressure of a tumour on the vagus; and Boinet, having exposed the vagus in an operation in the neck, noted that whenever he touched the nerve the patient vomited.

The vagus accelerates the contraction of the intestines, but no intestinal symptoms have been observed to result from its disease.

GENERAL DIAGNOSIS.—The chief symptoms on which the diagnosis of disease of the vagus, in any given case, would rest, are the laryngeal paralysis; retarded respiration; accelerated or retarded heart; and vomiting. The diagnosis of the seat of the disease rests upon the range of the symptoms, and the associated morbid processes. Disease of the trunk of the vagus is much less common than disease of its branches or roots. Paralysis of one vocal cord, for instance, is almost always the result of pressure, either on the recurrent laryngeal, or on the roots of the spinal accessory at the medulla. Bilateral symptoms are usually due to central disease, or else (if slight) are of merely local origin. In most cases of pressure on the trunk and branches of the vagus the cause of the symptoms is distinct, the only exception being deep-seated tumours in the thorax.

PROGNOSIS.—The prognosis is that of the cause of the disease, and is sufficiently discussed in other articles.

TREATMENT.—Little can be said on the general treatment of the diseases of the pneumogastric, since it depends on the different conditions to which the symptoms are due, and which are described elsewhere. Central disease, and causes of pressure on the nerve, are, as a rule, beyond the range of treatment. Whenever there is reason to suspect pressure on the nerve-roots (from the combination of paralysis of the tongue, palate, and one vocal cord), iodide of potassium should be given, since this condition is more frequently due to syphilis than to any other cause. In laryngeal paralysis the local application of electricity is sometimes useful, but more so in the weakness which depends on local causes than in that which is due to nerve-lesions. Injections of strychnine are also sometimes useful, even when its administration by the mouth is without effect. In central paralysis the treatment will depend on the indication given by the mode of onset regarding the nature of the lesion, whether softening or degeneration. In all spasmodic affections, sedative inhalations, especially chloroform, are useful; and of especial service is the diminution of the afferent impressions from the larynx such as may be produced by the application of cocaine. Bromides and morphine alone lessen, in effective degree, the irritability of the nerve-centre.

W. R. GOWERS.

PNEUMOGRAPH (πνεύμων, the lungs; and γράφω, I write).—An instrument for recording the movements of respiration. *See* PHYSICAL EXAMINATION.

PNEUMONIA (πνεύμων, the lungs).—Inflammation of the substance of the lungs. *See* LUNGS, Inflammation of.

PNEUMO-PERICARDIUM (πνεῦμα, air; and περικάρδιον, the pericardium).—A collection of gas in the pericardium. *See* Pericardium, Diseases of.

PNEUMOTHORAX (πνεῦμα, air; and θώραξ, the chest). A collection of gas in the cavity of the pleura. *See* Pleura, Diseases of; and Lungs, Perforation of.

POCK.—A popular term for pustule, as though a pocket or pouch in the skin filled with pus. From the plural of pock is derived *pox*; hence, *small-pox*, *chicken-pox*, the *great pox* or *venereal pox*, and so forth.

PODAGRA (ποῦς, the foot; and ἄγρα, a seizure). —A common synonym for gout, as it usually attacks the foot. *See* Gout.

PODALGIA (ποῦς, the foot; and ἄλγος, pain).—A name for pain in the foot, due to any cause, such as gout, rheumatism, &c.

POINTS DOULOUREUX (Fr.)—Tender points in connexion with the affected nerves in neuralgia. *See* Neuralgia.

POISONOUS ANIMALS. — *See* Venom and its Effects; Venomous Animals.

POISONOUS FOOD.—Under certain conditions, various articles of diet may become possessed of poisonous properties. This may arise from a variety of causes, in addition to the introduction of known and specific poisons. Articles of food may become more or less poisonous from the following causes:—

1. *Flesh* may contain some poisonous substance administered as a drug or eaten as a food.

2. Poisonous substances may be derived from the *vessels* in which the food has been kept, for example, tinned provisions may become contaminated with tin derived from the vessel or solder; beer and cider which have stood in leaden pipes may become contaminated with lead.

3. Poisonous substances may be added by way of adulteration, as in the case of the colouring of preserved peas and olives with copper salts.

4. Certain *kinds of foods* may develop poisons even in the fresh state, for example, meat and some kinds of fish, as mussels, salmon, and sardines.

5. Food may become poisonous from the development of poisons (such as ptomaïnes or alkaloidal poisons, and albumoses or proteid poisons) as the result of fermentative or putrefactive changes in the albuminous constituents, produced by the agency of ferments.

6. Food may be poisonous from the presence of the germs or spores of certain specific or parasitic diseases, namely, tuberculosis, trichinosis, actinomycosis, hydatid disease, and anthrax disease may be conveyed to man in this way, or the germs or spores of diseases may obtain access to food from exposure to sewer air.

7. The flesh of animals may be poisonous from the animals having fed on noxious or poisonous plants; and under this head may be classed poisonous honey which bees have gathered from poisonous plants.

8. Food, and especially milk, may become infected with pathogenic micro-organisms or poisons of human origin, for example, enteric fever, diphtheria, and scarlet fever.

9. Food may contain various parasites; for description of which *see* Entozoa.

Sound and unsound meat. The obvious characteristics of good sound fresh meat are that its colour is red; it is marbled in appearance; firm and elastic to the touch; possessing a slight but not unpleasant odour, which is especially detected when a clean knife is thrust into the meat and withdrawn; and when exposed to the air for a day or two, it should neither become dry on the surface, nor wet, nor sodden. Sound meat is slightly acid to litmus paper; unsound meat may be neutral or alkaline. With commencing putrefaction the colour of the meat becomes pale, and the smell disagreeable, and later the meat softens in parts and turns green.

Poisonous Meat. — Cases of meat poisoning have occurred from the eating of the following kinds of meat: boiled ham, baked pork, boiled and salted pork, sausages, tinned pigs' tongues, roast beef, brawn, veal pie, pork pie, beef pie, American ham, tinned ox-tongue, chicken broth.

The symptoms exhibited are those of more or less severe gastro-intestinal disturbance, with those indicating various degrees of disturbance of the nervous system. The first symptoms of illness usually set in somewhat suddenly, at a varying period after the eating of the poisonous food; they consist of nausea, vomiting, abdominal pain, and diarrhœa (the stools being generally of a very offensive character), accompanied with a sense of faintness, muscular weakness, and feeling of prostration, which is sometimes very severe. Rigors may or may not occur. These symptoms are generally followed by fever and headache (which is often intense), and great thirst.

If the illness progresses, however, other nervous disturbances may be observed, such as cramps, muscular twitchings, disturbances of vision, dilatation of the pupils, drowsiness, and occasional coma. The appearances observed in the organs of the body after death occurs are inflammatory, hæmorrhagic, or destructive changes in the stomach and intestines; engorgement of the lung-tissues with blood; and inflammatory or destructive changes in the liver and kidneys. These phenomena must be regarded not merely as the result of local irritation, but of a general disease resembling in some of its effects the ordinary specific fevers.

This point has been insisted on by Sir George Buchanan in one of his Reports to the Local Government Board, in which he says 'that the phenomena which were spoken of as food poisoning are claiming on ever-growing evidence to be regarded as true infective diseases, as much so as was scarlet fever or tuberculosis; that they have not been generally admitted into this rank arises, first, from the circumstance that some of them have seemed to be wanting in the incubation period, and, secondly, because they are rarely recognised as being transmissible from person to person; while in the Middlesborough epidemic of 1888 we found suggestion of disease bacteria operating alternately through the atmosphere and through infection of food material by them.'

The Middlesborough epidemic that prevailed during the early part of 1888, and which resulted in 490 deaths during the year, in a population of 98,000, was an epidemic of pleuro-pneumonia due, at all events in part, to the consumption of American bacon, made by soaking in water, and then only slightly drying, salted pork imported from America. In this bacon there was discovered a bacillus which was capable of producing a specific general fever, the special characteristic of which was a pleuro-pneumonia.

From investigations of the cases of food poisoning that have occurred with the various kinds of meat mentioned above, the following inferences may be drawn, viz.:—

1. In food rendered poisonous by keeping we find one or both of two things, namely, a living microscopic organism, and an organic chemical poison (ptomaïne, albumose, or toxin).

2. The material that is in all probability immediately operative in the production of morbid phenomena is the chemical poison, which is probably a product of the action of the micro-organism on the albuminous constituents of the food.

3. The micro-organism, provided its surroundings are favourable to its growth and activity, may produce its own special chemical poison from the material which affords it nourishment either outside the body or within it.

4. Both the micro-organism that produces the chemical poison in an infected food, and the chemical poison itself, may be evanescent; as on the one hand the micro-organism may be killed by its own products, and on the other the chemical poison may undergo destructive changes, so that the infected food, poisonous when eaten at one time, may fail to be poisonous when eaten at a later period.

5. In many cases of food poisoning the incubation period has been traced; in others it has been less obvious, and in some there is practically none. The symptoms which arise after the incubation period are probably due to the operation within the body of the micro-organism, and the symptoms produced without an incubation period (*i.e.* from half an hour to a few hours after taking the food) may probably be due to the operation of the organic chemical poison previously produced in the food. This inference is a fair one, since the micro-organism would require time, as in the other specific infections, for its growth and cultivation in the body, and for the formation of its poisonous chemical product; whereas the chemical poison previously produced in the article of food would operate more speedily, the rapidity of its operation being in proportion to its toxic nature, the amount taken, and the individual peculiarities of the recipient.

6. Of some of the animal foods mentioned as producing poisonous effects, Dr. Ballard has tabulated thirteen instances, in which the food was, or consisted largely of—

Pig's meat of one kind or another	in	9	instances
Butcher's meat (kind not stated)	„	2	„
Veal	„	1	instance
Beef	„	1	„
Total . .		13	

This is probably a fair representation of the relative frequency with which swine's flesh gives rise to specific diseases of the kinds referred to, as compared with animal food from other sources. In connexion with these forms of food poisoning, the poisonous effect is not necessarily always due to ptomaïnes or albumoses or toxins produced by a putrefactive decomposition of the article of food consumed. In some cases the symptoms and death are due to a true infection, extremely virulent bacilli having been found in articles of food, and also in the viscera of individuals who have died from eating such articles.

Some of these bacilli, as Dr. Klein has shown in the Portsmouth pie-poisoning case, may not be pathogenic on inoculation, though when taken by the mouth or in cultures they may produce a chemical poison, which, received into the alimentary canal, produces illness and death, if in sufficient quantity.

The toxicogenic powers of these bacteria are largely influenced by the conditions under which they develop. The most important of these conditions are—

(*a*) The nature of the food infecting the body; (*b*) the temperature; (*c*) the amount of oxygen supplied; (*d*) the time which elapses between the infection and the consumption of the food.

The poisonous properties of some kinds of meats and fish are due in some instances to the fact that the germs which they contain grow practically without any air-supply (as was in all probability the case in connexion with the tinned-salmon poisoning case investigated in 1891 by the writer, and the tinned-sardine poisoning case investigated in 1892 by Dr. Stevenson). In such cases, in all probability, the contents of the tin were not sterilised, and, after sealing, the germs within the tin continued to grow anaërobically, and elaborated a chemical poison.

On the other hand, several cases have been recorded in which canned meats were not poisonous when first opened, but soon became so on exposure of their contents to the air. In such cases, the meat in all probability becomes first infected after the opening of the can.

With regard to the nature of the chemical poisons formed in articles of food as a result of infection with pathogenic bacteria, three classes may be described—

1. The ptomaïnes or putrefactive animal alkaloids. *See* Ptomaïnes.

2. The albumoses or poisonous proteids, produced by bacterial agency. *See* Albumoses.

3. The toxins or poisons of uncertain composition, also doubtless produced by bacterial agency.

Preventive and Curative Measures.—Good cooking, namely, exposure to a sufficiently high temperature for a sufficiently long time, is undoubtedly the best treatment—short of absolute destruction—of unsound and diseased meat. Smoking meat is less effective than cooking; salting, as a rule, is more effective than smoking, but there is evidence to show that smoking may merely hold the life of micro-organisms in suspense; for instance, in the conversion of American salted pork into American hams, a specific germ (a bacillus) has been known to retain its harmful properties. The best precaution of all is cleanliness. Factories where articles of meat are prepared and tinned should be well ventilated and lighted, and clean; and the incursions of ground air, sewer air, or putrid emanations of any kind should be rigidly prevented. Kitchens and pantries should also be similarly cared for.

With regard to the curative measures for the results of eating poisonous food, these must be guided by general principles. The gastro-intestinal and nervous symptoms are to be treated, and the powers of the patient sustained until the poisonous matter is removed by excretion.

In many cases of meat and fish poisoning the following prescription for adults is a useful one, administered every three or four hours until the effects of the poison have passed away: Solution of the perchloride of mercury ♏ xx; iodide of potassium gr. v; chloral hydrate gr. v; carbolic acid gr. j; aromatic spirit of ammonia ♏ xx; chloroform water ad ℥ j; one dose.

In addition to the different forms of meat already described as producing poisonous symptoms, the following articles of food have also been known to occasionally produce toxic effects.

(*a*) *Tinned articles of food.*—Salmon, sardines, anchovies, ox tongue, pigs' tongues, meat, cherries, apples, and peas.

Tinned cherries and apples have been known to produce poisonous effects from soluble tin salts contained in them, produced in all probability by the malic acid present in the juice exerting a galvanic action upon the solder of the tins, carrying some of the tin into solution as a malate of tin (*see* four cases of tinned-cherry poisoning investigated by the writer: *Brit. Med. Journ.*, April 12, 1890). Tinned and bottled peas sometimes contain copper salts which have been added for the purpose of colouring them.

(*b*) *Fish.*—Cases of poisoning by fish, crustacea, and the various shell-fish of our islands are not infrequently met with. Generally it is the ingestion of crabs, lobsters, and mussels which produces such results. Symptoms of gastro-intestinal disturbance and nettle-rash are usual, but occasionally fatal results ensue from the use of mussels. In the case of poisonous mussels, Brieger has shown the toxic effects to be due to a ptomaïne which he has named mytilotoxine, and which is doubtless produced within the mussels by bacterial agency, the bacteria most probably gaining access to the mussels through the medium of sewage-polluted water—since it has been found that mussels gathered on shores polluted by sewage are not infrequently poisonous in their effects, and contain the toxic ptomaïne; whereas, if laid for a few months in the open sea, they soon lose their poisonous properties, and cease to contain the toxic ptomaïne.

(*c*) *Milk.*—This important article of diet may produce symptoms of poisoning or disease in many ways: (1) If acid from lactic acid fermentation (due to the presence of the *bacillus acidi lactici*), it is frequently productive of flatulence, sickness, and diarrhœa in children. (2) Milk may contain the germs of typhoid fever, scarlet fever, diphtheria, and cholera. The germs of typhoid fever may gain access to the milk, either in water polluted by typhoid stools having been added to the milk or used to cleanse the milk cans, or by exposure of the milk to sewer air. The germs of scarlet fever may be conveyed into the milk from the hands of a milker suffering from scarlet fever, or from cows suffering from a disease identical with, or closely resembling, human scarlet fever. Diphtheria is possibly conveyed from the cows themselves, and cholera through the medium of contaminated water. (3) Tubercle may gain access to the milk from the tubercular udders of cows, and if the milk is unboiled it is in this way easy to account for the high mortality of young children from tubercular ulceration of the intestines and tabes mesenterica. (4) Milk may be contaminated from the animal suffering from foot-and-mouth disease (vesicular eczema of the mouth and interdigital spaces of the feet); if there are vesicles on the teats of cows suffering from this disease the virus may get into the milk, and a person consuming that milk may be attacked with fever, vesicular eruption on the throat and lips, and swelling of the lymphatic glands of the neck.

(*d*) *Cheese.*—In cheese that has undergone a peculiar fermentation a poison has been discovered by Vaughan, which is a ptomaïne named tyrotoxicon (diazo-benzene butyrate). This ptomaïne is intensely poisonous, producing nausea, dryness of the mouth and fauces, a sense of constriction in the throat, vomiting, diarrhœa, and great nervous prostration. The symptoms usually pass off after the lapse of a few hours, but may end in death from collapse. Cheese containing this poison is not necessarily altered in appearance or taste. Butter and cream, as well as cheese, have given rise to ptomaïne poisoning.

(*e*) *Vegetables.*—Vegetables may become poisonous either from the development of poisonous matter produced by putrefactive changes, or from the addition of poisons, as in the colouring of peas with copper, or from the growth within them of fungi. For instance, actinomycosis, a disease which occasionally occurs in cattle and man, is now regarded as due to eating raw barley or other cereals upon which the actinomyces fungus has grown. *See also* Ergotism; and Mushrooms, Poisoning by.

(*f*) *Water.*—Drinking-water may produce poisonous effects, either from the presence of specific micro-organisms (generally from pollution of the water with sewage), or from contamination of the water with metallic poisons, such as lead and copper.

Arthur P. Luff.

POISONOUS GASES.—*See* Carbonic Acid, Poisoning by; Carbonic Oxide, Poisoning by; Prussic Acid, Poisoning by; &c.

POISONS.—Synon.: Fr. *Poisons*; Ger. *Gifte.*

Definition.—There is no legal definition of the word *poison*, and the definitions usually proposed are apt to include either too much or too little. Generally, a poison may be defined as a substance having an inherent deleterious property, which renders it capable of destroying life by whatever avenue it is taken into the system. Substances which act only mechanically, such as powdered glass, are not poisons. In popular language, a poison is a substance capable of destroying life when taken in small quantities. A poison, then, may be defined as any substance which, when introduced into the system, or applied externally, injures health or destroys life irrespective of mechanical means or direct thermal changes. *See* Poisonous Food.

Action.—Poisons may exert a twofold action. Their action is either local or remote, or both local and remote. The local action of a poison is usually one of corrosion, inflammation, or an effect on the nerves of sensation or of motion. The remote actions are usually of a specific character, though some writers group the remote effects of poisons under two heads, and speak of the common and specific remote effects of a poison. The local actions of a poison of the corrosive class are usually so well marked, and so easily recognised, that the fact of its administration is obvious. The same may be said, in a lesser degree, of the irritant poisons, especially the mineral irritants; but here the symptoms often so closely simulate those of natural disease, as to render the diagnosis a matter of great difficulty. An accurate acquaintance with the remote specific effects of the various common poisons is indispensable to the medical practitioner. The class of poison which has been administered or taken will thus be suggested to his mind by the symptoms observed, and not infrequently the specific poison will be suspected. In this way the physician may often be at once able to diagnose, from the symptoms alone, the administration of strychnine, henbane, or cantharides. Great care must be taken, however, not to draw a rash conclusion from one symptom; as, for instance, from the tetanic spasms which are so marked a feature in strychnine poisoning.

It is generally, but not universally, held that absorption is necessary in order that a poison should be able to exert its specific effect. Some are of opinion that a poison may destroy life by an action on the nervous system, before absorption has had time to take place. The facts in support of this view are, however, few, and open to doubt.

Modifying Circumstances.—The usual action of poisons may be greatly modified—(1) by the largeness of the dose, and the state of aggregation, admixture, or chemical combination of the poisons themselves; (2) by the part or membrane to which they are applied; and (3) by the condition of the patient. Thus, for example, opium may be a medicament or a poison, according to the dose in which it is given; and a dose of opium which may be beneficial to an adult in certain states of the system, may be fatal to a young child, or to the adult when suffering, for example, from Bright's disease. All barium salts are poisonous, except the sulphate, which is one of the most insoluble of all mineral substances. The simple cyanides are highly poisonous, and the same may be said of many double cyanides. But the double cyanide of iron and potassium (potassium ferro-cyanide) is almost without action on the system. The part or tissue to which a poison is applied must obviously greatly affect the activity of a poison, owing to the varying rapidity with which absorption takes place through the cutaneous, mucous, serous, and other surfaces of the body. Curare may be swallowed in a considerable dose, without producing any appreciable effect, whilst a small quantity of the same substance introduced into a wound will speedily prove fatal. It has been found that when a poison is slowly absorbed, so that it can be either disposed of in the system or again excreted more rapidly than it is absorbed, no poisonous results ensue; but when absorption occurs so quickly that the poison can neither be excreted nor destroyed in the system as rapidly as it is absorbed, the specific effects of the poison are developed. Curare, for instance, is absorbed by the gastric mucous membrane more slowly than it is excreted through the kidneys. But if the renal arteries be ligatured, the poison accumulates in the blood, and the specific effects of the poison are developed, just as when curare is introduced into a wound.

Idiosyncrasy has much to do with the poisonous or hurtful character of a substance. Thus pork, mutton, certain kinds of fish, notably shell-fish, and fungi (*see* MUSHROOMS, Poisoning by), have, under certain circumstances, and in certain persons, produced all the symptoms of violent irritant poisoning; whilst others, who have partaken of the same food at the same time, have enjoyed perfect immunity. More commonly, all who partake are affected, but with varying degrees of severity. Some persons are said, on good authority, to be capable of taking with impunity such violent poisons as corrosive sublimate or opium, in enormous doses, and this independently of habit, which is known to have such a large influence in modifying the effects of some poisons, notably of the narcotics. A tolerance of poisons is sometimes engendered by disease, so that a poison may from this cause fail to produce its accustomed effect. Thus opium is largely tolerated in tetanus, and in mania from drink; and mercurial compounds may in severe febrile affections fail to produce the usual constitutional effects of the metal. On the other hand, kidney-disease, by impeding elimination, may intensify the ordinary effects of a poison; and the like is observed when opiates are given where there is a tendency to cerebral congestion.

EVIDENCE.—In order to raise a valid inference in the mind of the medical attendant that poison has been administered to a patient, certain facts must be brought under his notice; and without the concurrence of at least two or more of these, the actuality of poisoning cannot be maintained. The sources of evidence in cases of suspected poisoning are the *symptoms*; the *post-mortem appearances*; *chemical analysis* of articles of food or drink, or of the body and the excretions; and *experiments upon animals*. The evidence derived from these sources being compared with the known properties and effects of various poisons in authenticated cases, will enable the physician to form a correct opinion as to the probable administration or not of a poison. The poisons most commonly administered are opium, carbolic acid, arsenic in various forms, phosphorus, oil of vitriol, strychnine, and oxalic acid.

It is rarely that the *symptoms* exhibited during life do not afford some clue to the cause of illness; and most frequently the symptoms are all that the medical attendant has to guide him to a diagnosis of the nature of the case, during the lifetime of the patient. Sometimes, however, persons are found dead as the result of poison, concerning the manner of whose death nothing whatever can be learned; a suspicion of poisoning arising from the circumstances under which the corpse is found. Here the aid of chemical analysis ought invariably to be invoked; and fortunately in these cases the delay involved in making an analysis is of comparatively little moment. The effects may in the case of many persons be either suddenly or slowly manifested; hence we have *acute* and *chronic* poisoning. Cases of chronic poisoning are usually the result of the repeated administration of small doses of lead, copper, mercury, phosphorus, or arsenic. All of these poisons are treated of in separate articles. The general conditions which should excite a suspicion of poisoning are the sudden onset of serious and increasingly alarming symptoms in a person previously in good health, especially if a prominent symptom be epigastric pain; or where there is complete prostration of the vital powers, a cadaverous expression of the countenance, an abundant perspiration, and speedy death. In all such cases the aid of the chemist is required, either to confirm well-founded, or to rebut ill-founded, suspicions.

CLASSIFICATION.—Various attempts have been made to classify poisons rationally. Perhaps the best classification, for the purposes of the medical practitioner, is that which groups poisons according to the more obvious symptoms which they produce. Our knowledge of the more intimate action of many poisons is still too slight to admit of any useful classification according to the manner in which they specifically affect the vital organs.

Poisons may in the manner indicated be classified as: (1) **Corrosives**; (2) **Irritants**:

and (3) **Neurotics.** It is perhaps at present premature to attempt a systematic division of the last class. The class of neurotics embraces poisons so widely different in their action as opium and strychnine.

1. **Corrosive Poisons.**—ENUMERATION. The action of one of the most typical of these poisons, corrosive sublimate, is fully considered under a special head (*see* MERCURY, Poisoning by). The most commonly administered corrosives are the mineral acids—sulphuric, nitric, and hydrochloric; oxalic acid; the alkalis—potash, soda, and ammonia; acid, alkaline, and corrosive salts—such as acid sulphate of potassium, carbonate of potassium, chlorides of zinc, tin, and antimony, and nitrate of silver.

SYMPTOMS.—The mineral acids and the alkalis have no specific effect on the system, their action being at first almost purely local. Some of the other corrosives enumerated may have, besides their local effects, a remote and constitutional action. The symptoms of corrosive poisoning are marked and unmistakable, except when the patient is an infant. Immediately after swallowing the corrosive substance, an acid, caustic, or metallic, burning sensation is felt in the mouth, fauces, gullet, and stomach; and this speedily extends over the whole abdominal region. Vomiting is speedy, or may, rarely, be altogether absent. The vomited matters consist at first of the ordinary contents of the stomach, more or less altered by the action of the poison. In the case of *mineral acids* they are intensely acid, and cause copious effervescence when they fall upon limestone or marble. No relief is afforded by the evacuation of the stomach; and later the vomits may be more or less mingled with altered blood, which may be dark, or even black. Shreddy mucus, casts of the gullet or stomach formed by the shedding of the mucous membrane, and sometimes even the muscular wall of the œsophagus, are rejected. The abdominal pain is not relieved, but greatly aggravated, by pressure. The whole abdomen becomes distended, owing to the gases evolved by the action of the poison; the diaphragm is pressed upon, and intense dyspnœa may result, owing to pressure upon the thoracic viscera. When a mineral acid has been administered, there is little or no bowel action, and the urine may be suppressed; but in poisoning by the *alkalis*, and by the *alkaline carbonates* and *sulphides*, there may be purging. The mouth, tongue, and fauces exhibit the local effects of the corrosive: a yellow coating in the case of nitric acid; white at first, and as if covered with white paint, from sulphuric acid; and whitish or brown and less thickly coated from hydrochloric acid. Yellow or brown stains may be observed on the skin, extending downwards from the angles of the mouth, and caused by the trickling of acid or other corrosive fluid from the mouth. Meantime the symptoms develop rapidly. The pain, thirst, dyspnœa, and dysphagia increase. The patient, at first excited, with rapid bounding pulse, becomes bathed in cold perspiration, the countenance becomes pinched, the pulse more rapid and thready. Enormous eructations of gas take place, but these afford no relief. The patient may become more or less cyanosed; but this will depend upon the amount of dyspnœa. The intellect is usually clear to the last. Signs of collapse come on, and the patient may sink within a period varying from six to twenty-four hours. If recovery does not take place, death usually supervenes within a period of twelve to twenty-four hours. Very frequently, and more especially in poisoning by oil of vitriol, the patient survives the first acute symptoms only to perish months after, should not the aid of the surgeon be invoked and gastrotomy be performed, by slow starvation, due to local injury to, and subsequent stricture of, the œsophagus. The use of bougies in these cases, to keep the gullet patent, seldom affords permanent relief.

When *nitric acid*, or *ammonia*, is the poison taken, the vapours of the acid or of the ammonia may gain access to the air-passages and lungs, provoking inflammation, which is commonly fatal. The dyspnœa and chest-symptoms will be greatly aggravated in these cases, and may overshadow the more usual symptoms due to local action on the digestive canal. In poisoning by the *caustic alkalis* (potash and soda lyes) diarrhœa, with discharge of blood, is more common than the constipation observed in poisoning by the mineral acids. Entire suppression of urine, or anuria, is the rule in poisoning by corrosive sublimate.

Oxalic acid in concentrated solution is undoubtedly a corrosive and irritant poison. Very commonly, however, it kills by its depressing action upon the heart before symptoms of corrosion have become prominent; or the vomiting, pain, and other more immediate symptoms of corrosive poison are associated with a feeble pulse, clammy skin, nervous symptoms, aphonia, and speedy death, even within ten minutes of the administration of the poison. To quote Christison's language: 'If a person, immediately after swallowing a solution of a crystalline salt, which tasted purely and strongly acid, is attacked with burning in the throat, then with burning in the stomach, vomiting, particularly of bloody matter, imperceptible pulse, and excessive languor, and dies in half an hour, or still more in twenty, fifteen, or ten minutes, I do not know any fallacy which can interfere with the conclusion that oxalic acid was the cause of death. No parallel disease begins so abruptly and terminates so soon, and no other crystalline poison has the same effects.' It must be added that binoxalate of potash, and the soluble oxalates generally, are as poisonous as the acid itself.

Anatomical Characters.—The distinction between corrosive and irritant poisons is by no means well-marked; and indeed corrosive poisons, when diluted, act as irritants. Hence we shall describe the *post-mortem* appearances of corrosive poisoning under the head of Irritants.

Diagnosis.—The diagnosis of corrosive poisoning rarely admits of difficulty; and in any obscure cases chemical analysis will remove all doubt.

2. **Irritant Poisons.**—Irritant poisons are of two classes—*metallic irritants*, and *vegetable* and *animal irritants*, these latter being grouped together. Perhaps none of them, however, act as pure irritants; and the irritant symptoms which they produce are most commonly accompanied by a well-marked effect upon the nervous system also. An irritant is a poison which causes inflammation of the part to which it is applied, usually the alimentary canal. By far the most important of the metallic irritant poisons is arsenic (*see* Arsenic, Poisoning by). Other metallic irritants are the salts of antimony, zinc, and other metals. Elaterin, essential oils, and gamboge may be cited as examples of vegetable irritants; and cantharides of animal irritants. Irritant animal and vegetable foods are separately described. *See* Poisonous Food.

Symptoms.—Irritants differ as a rule from corrosive poisons in the greater slowness with which the symptoms are developed. Usually when an irritant is swallowed, after an interval—greater or less according to the specific character of the poison—a burning pain is felt, and a sense of constriction of the mouth, throat, and gullet, speedily followed by sharp burning pain in the epigastrium; and this is increased by pressure—a mark which serves to distinguish the attack from one of ordinary colic. Nausea, vomiting, and great thirst ensue; speedily followed by pain and sense of distension of the whole abdomen, which is exceedingly tender, and perhaps visibly distended. Most commonly the vomiting is followed by purging, tenesmus, dysenteric stools, and often by dysuria. Should the poison not be speedily removed from the system by vomiting and purging, these continue unrelieved, and increase in severity; and symptoms of inflammatory fever, or it may be of collapse, supervene. The pulse becomes rapid, small, and thready; the countenance is anxious; the skin is bathed in perspiration, now warm, and again cold and clammy. The patient may never rally from the first shock to the nervous system; more rarely, having survived this, he dies in convulsions; or he may perish of inanition after more protracted sufferings. It must be borne in mind that those irritant poisons—such as diluted sulphuric acid—which, when taken in a more concentrated form, act as corrosives, may bring about starvation, necessitating such operative procedure as gastrotomy, by the injury which they inflict upon the œsophagus and stomach. Death after the administration of an irritant poison may, it is obvious, occur at very varying periods after the ingestion of the poison.

Diagnosis.—Irritant poisoning may be mistaken for various forms of natural disease. The diseases with which it is most apt to be confounded are—gastritis; gastric ulcer, with or without perforation; peritonitis; severe colic; sporadic and Asiatic cholera; and rupture of the stomach or intestines. A careful examination of the patient, and the history of the case, will often remove any doubt which may be entertained; but microscopical examination and chemical analysis of the ejecta of the patient will frequently afford the only means of clearing up the case during life. Too frequently irritant poison is not suspected until a *post-mortem* examination is made. In every case where a possibility of irritant poisoning is suggested, the aid of analysis should be invoked. For the diagnostic differences—so far as differences in symptoms are diagnostic—between irritant poisoning and the special diseases above mentioned, the reader is referred to the special articles in this Dictionary.

Anatomical Characters.—The *post-mortem* appearances in irritant and corrosive poisoning are corrosion of the mouth, fauces, gullet, and stomach, the mucous membrane being shrivelled, altered in consistence and colour, and more or less detached; irritation and inflammation of the stomach and first portion of the small intestines; ulceration; and erosion. In corrosive poisoning the stomach may be perforated, the edges of the aperture being shreddy; and in the case of sulphuric acid the viscera may be blackened (altered blood) from the action of the acid upon the blood-pigment. The small intestines are implicated to a varying extent, or may altogether escape. The large intestine may be attacked, and this is more especially the case in poisoning by mercurial preparations. Arsenic exerts a specific effect upon the gastric mucous membrane. Remains of irritants may be detected in the intestinal canal, and be recognised by their physical, microscopical, and chemical characters.

3. **Neurotic Poisons.**—Enumeration.—Under this head may be ranged a great number of poisons, having this in common, that the symptoms produced by them are more or less prominently associated with the nervous system. The class embraces pure narcotics, such as opium and morphine; hydrate of chloral; chloroform; hyoscyamus; digitalis; strychnine; prussic acid; nitrobenzol; phenol (carbolic acid); alcohol; aconite; belladonna, and many others.

Symptoms.—These are necessarily of the most varied character. All that has been already said about the onset of symptoms, their character, and the circumstances under which they have appeared, must be borne in mind in arriving at a diagnosis.

Prussic acid produces its effects in the course of a few minutes; or, it may be, seconds. The course of symptoms is very rapid; and death may be well-nigh instantaneous. The symptoms are convulsions, great disturbance of respiration, with prolonged expiration, dilated pupils, and cyanosis. *See* Prussic Acid, Poisoning by.

Morphine and *Opium*, after a stage of excitement, produce deep comatose sleep, with slow stertorous breathing; contracted pupils; and clammy, perspiring skin; all the other secretions being more or less suppressed. *See* Opium, Poisoning by.

Aconite is diagnosed by the peculiar numbness and tingling of the skin which it produces. *See* Aconite, Poisoning by.

Belladonna, and its alkaloid *Atropine*, widely dilate the pupils, and cause intense thirst, with mirthful delirium and spectral illusions.

Chloroform and *Alcohol* in toxic doses produce profound insensibility; and are, moreover, generally more or less recognisable by circumstances, some of which will be found described under Alcoholism.

Nitro-benzol causes symptoms often indistinguishable from those of prussic acid; but in consequence of its insolubility, and the slowness with which the liquid poison is absorbed by the gastro-intestinal mucous membrane, there is often a prolonged interval between the administration of the poison and the onset of alarming symptoms.

Hydrate of chloral causes death after a stage of unconsciousness; and there is scarcely any difficulty in ascertaining the nature of the case by the aid of the surroundings of the patient. *See* Chloral Hydrate, Poisoning by.

Carbolic acid or *Phenol* whitens and shrivels the membranes with which it comes in contact, and not only acts as a corrosive, but produces speedy narcosis, and greenish or black urine. The peculiar odour of phenol is always perceptible, though not infrequently overlooked.

Diagnosis.—It is impossible to enter fully into the diagnosis of each individual neurotic poison. The most frequent and important diagnoses have to be made in supposed cases of poisoning by opium, alcohol, and strychnine respectively.

In opium-poisoning the equally contracted pupils; the possibility of rousing the patient by means of external stimuli in all except the later stages—as, for instance, by flicking the feet, the application of the electric current, &c.; and the moist clammy skin, may serve to prevent the case being confounded with one of apoplexy. In alcoholic coma there is great danger of mistaking the nature of the case, in consequence of the frequency with which the alcoholic odour may be met with in cases where alcohol has been taken, either dietetically or medicinally, in moderate or somewhat immoderate doses. The very careful use of the stomach-pump can do no harm, and may not only save the patient if the case be one of alcoholic poisoning, but also serve to clear up the diagnosis. The tetanic spasms of strychnine will have to be differentiated from those of true (traumatic) tetanus. In this there is not usually any insuperable difficulty. Strychnine convulsions are intermittent; do not begin in the lower jaw; are, as a rule, opisthotonic in character, and do not affect the same groups of muscles as are implicated in true tetanus. *See* Opium, Poisoning by; and Strychnine, Poisoning by.

Treatment.—Only the general principles of the treatment of poisoning can be indicated here. The treatment in poisoning by the most important special poisons is described in separate articles. The question of the use or non-use of the stomach-pump must be decided by the nature of the poison administered. Where one of the concentrated mineral acids, a caustic alkali, a corrosive salt, oxalic acid in concentrated solution, or carbolic acid, has been swallowed, it is generally held that the stomach-pump should not be used, the danger of perforation of the gullet or stomach being considerable. The soft œsophageal syphon tube may, however, be nearly always used with safety. In all cases where a non-corrosive poison has been taken, except in the case of prussic acid, where the course of the poisoning is too rapid to permit of the use of the instrument, the application of the pump is advisable and can do no harm; in cases of poisoning by opium and alcohol, the greatest reliance must be placed on evacuation of the stomach by its aid. The corroding acids may be neutralised by the administration of lime water, or, still better, saccharated lime water; highly diluted solutions of the caustic alkalis; or, failing these, the continuous use, in frequently repeated doses, of chalk, whiting, or the alkaline carbonates—so as to avoid dangerous distension of the abdomen with carbonic acid gas. On the contrary, the caustic alkalis may be neutralised by the copious imbibition of highly diluted acid liquids. Failing the use of the stomach-pump, or even after the use of this, emetics may be administered or apomorphine injected. The prompt administration of an emetic is perhaps never inadmissible. The effects of corrosives and irritants must afterwards be met by appropriate remedies, such as demulcents and oil to sheathe the mucous membranes, opiates to relieve pain, &c. The effects of oxalic acid cannot be avoided by the administration of alkalis and alkaline carbonates, for the alkaline oxalates are themselves highly poisonous. Chalk, whiting, and soluble lime salts precipitate oxalic acid as an insoluble oxalate of calcium, and form the best remedies. Soluble sulphates are antidotes for carbolic acid. Oil greatly allays the intolerable pain attending the local action of this acid. In prussic-acid poisoning artificial respiration, persistently used, is our sheet-anchor, and may be supplemented by galvanism, alternate douches of warm and cold water, and other measures. After the use of the stomach-pump to remove unabsorbed opiates, stimulating liquids containing tannic acid, such as strong black coffee, may be given; and the patient must be kept awake by walking him about, flicking the feet with towels, the application of the faradic current, &c. Belladonna in full doses is in some respects antagonistic in its physiological action to opium. Conversely, opiates are regarded as direct antidotes to belladonna. On the same principle of counteracting effects, digitalis and aconite are counter-poisons, and hence antidotes the one to the other. The happiest results have followed the use of full doses of hydrate of chloral in strychnine-poisoning; and chloroform may be freely inhaled to allay the tetanic spasms. In alkaloidal poisoning, except where a tetanising poison, such as strychnine or brucine, has been given, the stomach-pump must be employed; and emetics and tannic acid, in the form of tincture of galls, strong black coffee, or strong tea, should also be given, with the object of precipitating the alkaloid as an insoluble tannate.

Thomas Stevenson.

POLYDIPSIA (πολύς, much; and δίψα, thirst).—A synonym for excessive thirst: sometimes used for diabetes. *See* Diabetes Mellitus; Polyuria; and Thirst.

POLYNEURITIS. — *See* Neuritis, Multiple.

POLYPHAGIA (πολύς, much: and φάγω, I eat).—A synonym for excessive hunger. *See* Appetite, Disorders of; and Pneumogastric Nerve, Diseases of.

POLYPUS (πολύς, many; and ποῦς, a foot).—Synon.: Fr. *Polype*; Ger. *Polyp*.

Definition.—This term is generally applied to any simple pedunculated growth, springing from a mucous surface; but it is sometimes extended so as to include malignant pedunculated growths in similar situations.

Varieties.—It is clear that no single description will apply to each member of the class. Hence it will be sufficient to enumerate the principal varieties of polypus, a fuller account of most of which will be found in the article Tumours, and also in connexion with the diseases of the several organs which they affect.

1. **Polypi of the Nose.**—These are of two varieties—the *mucous* and the *fibrous*; both are classed among the fibromata. Both are covered with ciliated epithelium. The fibrous variety often involves the structures at the back of the pharynx, forming the so-called *naso-pharyngeal polypus*.

2. **Polypi of the Ear.**—Polypi of the ear resemble polypi of the nose, but present a variety of structure, as some spring from the membrana tympani, others from the interior of the tympanum.

3. **Polypi of the Intestines.**—These polypi are of much more frequent occurrence in the rectum than in any other portion of the intestinal tract. They are composed of tissue resembling that of the mucous membrane of the part, and are described amongst the adenomata.

4. **Polypi of the Uterus.**—These growths are of three kinds, namely: (*a*) *cystic*, which are derived from the ovules of Naboth; (*b*) *mucous* or *soft*, resembling the polypi of the rectum; (*c*) *hard* or *fibrous*, the so-called fibrous polypus of the uterus.

5. **Polypi in other situations.**—Less common forms of polypi, consisting of some modification of the mucous membrane from which they are derived, are found in the *bladder*, the *larynx*, on the *gums*, or sometimes in the *sinuses communicating with the nose*.

Malignant polypi present no special features which would enable them to be described as a class.

Treatment.—Though polypi differ somewhat in structure, the treatment of the simple varieties of the class is the same—that is, if removal be considered advisable. Either the pedicle may be grasped and the tumour removed by avulsion; or it may be divided at a stroke by some sharp instrument, or cut through slowly or rapidly by some form of écraseur or ligature.

In removing a malignant polypus a wide margin of healthy tissue must be taken away from around the pedicle.

R. J. Godlee.

POLYSARCIA (πολύς, much; and σάρξ, flesh).—A term for excessive corpulence or obesity. *See* Obesity.

POLYURIA (πολύς, much; and οὖρον, urine).—Synon.: *Diabetes Insipidus*; Fr. *Polyurie*; *Diabète Insipide*; Ger. *Zuckerlose Harnruhr*.

Definition.—A malady or group of maladies, characterised by thirst, and a persistently excessive flow of watery urine, which has a low specific gravity, and contains no albumin or grape-sugar.

Attempts have been made to subdivide this group into smaller sections. One such section is *polydipsia* or *hydruria*, having the characters above specified as those of polyuria; another is *azoturia*, where the solids, especially urea, are in excess of the normal amount; and a third, *anazoturia*, where these are markedly deficient. The often-used term *polydipsia*, referring as it does specially to the symptom thirst, puts the effect before the cause. *Hydruria* points to the dilute character of the urine rather than to its excessive quantity. *Azoturia* has been made to include all cases where urea is unusually abundant, even where the urine is scanty, as in fevers; a condition totally averse to our notions of diabetes insipidus. *Anazoturia* very rarely occurs; for, notwithstanding the low specific gravity of the urine in polyuria, owing to the large amount passed, the quantity of urea may, and often does, exceed that excreted in health. A form of polyuria, often slightly marked, has been described as 'phosphatic diabetes,' on account of the excess of phosphates passed. The separation of these cases into a distinct group is hardly necessary. Certain factors in the above definition require special attention, the better to mark off the malady so defined from other pathological states. Thus the flow must not only be excessive, but persistently so. This separates polyuria from conditions where there merely exists a temporary flow of an unusual amount.

ÆTIOLOGY.—Polyuria is limited neither by age nor by sex. It may exist in the newborn infant, and it may be found in the patient of seventy, but on the whole it is a disease of early adult rather than of advanced life, whilst it is about twice as frequent in males as in females. Nothing is more marked in connexion with the causation of polyuria than heredity. Perhaps the most extraordinary instance of this is recorded by Dr. Gee, where the disease was directly transmitted through four generations. Sometimes one member of the family escaped, but the children were sure to be attacked. A newborn infant, a member of this family, suffered from unusual thirst, so much so that water had to be given to relieve it.

Beyond inheritance, nothing very definite can be said as to the cause and origin of polyuria. It is often connected with nervous affections or nervous excitement, and sometimes follows upon injuries to the head or disease of the brain. Drinking bouts, too, have been credited with giving rise to the disease, as have drinking cold fluids, and sudden exposure to cold. Beyond these, no valid cause can be assigned; often indeed the disease comes on without even such insufficient reasons as those given above, some of which have doubtless been assigned on the *post hoc* principle.

SYMPTOMS.—Not much need be said regarding the clinical history of polyuria. When the result of accident or mental emotion, its onset is usually abrupt, and it may end in like manner; sometimes as the result of intercurrent febrile disease. During its continuance thirst and watery urine are the two prime symptoms, for there may be little wasting, and the general health may be good. Occasionally there is increased appetite. Usually the bowels are confined, and the skin dry, though neither happens invariably. Pruritus and boils, so common in diabetes mellitus, are exceptionally met with in cases of polyuria. The condition of the patient is tolerable, so long as drink is supplied in plenty, were it not for the disturbed sleep caused by the incessant thirst and the desire to pass water; but any attempt to restrict the quantity of fluid gives rise to intense discomfort. Ultimately this constant strain wears out the patient, and may lead to death, if intercurrent disease do not carry him off.

Of the phenomena of polyuria, the urine alone requires special notice. It is inordinate in its quantity, and of a specific gravity little above that of water. It may remain persistently at 1001; but it may rise to as much as 1008 or 1010. It is transparent; almost like water; of a faint greenish-yellow tint; and with little taste, smell, or acid reaction. In quantity it varies with the amount of water consumed. If the patient is allowed to drink at will, the quantity passed corresponds broadly with that drunk, allowance being made for the watery vapour passing away by the lungs, and perhaps also by the skin. If the drink be restricted, more will be passed than is consumed, by the abstraction of water from the body. On the whole, the quantity passed is greater than in diabetes mellitus, and may sometimes be measured by gallons. Urea, though relatively deficient in any specimen of urine examined, has sometimes been found absolutely in excess, sometimes diminished. On the other hand, uric acid seems diminished, but this may depend on the difficulty of estimating it in urine so greatly diluted. Sulphates and phosphates, especially the earthy salts of the latter, are usually increased, whilst the only abnormal constituent, if such it can be called, said to have been detected is inosit; but the reactions of this substance, which has the same percentage composition as a sugar, but which belongs to the benzol series, are very unsatisfactory when occurring in urine. Acetone, oxybutyric acid, or other products of incomplete oxidation are never present.

PATHOLOGY.—As in the case of saccharine diabetes, our insight into the morbid processes concerned in the production of polyuria has been greatly aided by direct experiment. Bernard found that by pricking the floor of the fourth ventricle above the level of the 'sugar puncture' he could produce copious diuresis; and in certain animals injuries to the central lobe of the cerebellum (the vermiform process of human anatomy) are followed by a like result. From this part of the nervous system the nervous influence seems propagated to the kidneys both by the splanchnics and spinal cord, but the exact course of the fibres has not yet been clearly demonstrated. Whether the nerves are merely vaso-motor fibres, section or paralysis of which would produce turgescence of the vessels of the kidneys, or trophic fibres, irritation of which would increase the activity of these organs, is not yet determined; but in all probability paralysis of the vaso-motor fibres is the main factor in the production of hydruria.

In the definition of polyuria given above disease of the kidneys was expressly excluded; and after death, as far as the malady itself is concerned, nothing is to be found except increased vascularity of these organs. As a consequence of the disease, however, persisting over many years, and giving rise to frequent and severe distension of the bladder, when circumstances may prevent its being emptied with sufficient frequency, thickening of the walls of the bladder, dilatation of the ureters, and sacculation of the kidney have been described; but the accuracy of such observations as the results of simple polyuria is questionable. Undoubtedly the most important lesions which bear on the disease are those which have been found in the brain, especially in the neighbourhood of the fourth ventricle. These, besides the injuries already alluded to, comprehend tubercular and other forms of inflammation, tumours of various kinds—gliomatous and syphilitic, together with other local changes.

Diagnosis.—The diagnosis of polyuria, according to the definition already given, is clear. It rests on these factors—thirst, and persistent excess of urine, coupled with the absence of grape-sugar and albumin. It has further to be carefully distinguished from mere temporary excess of watery urine. Such an excess may occur where a large quantity of fluid of a diuretic kind has been swallowed, especially when there is little or no cutaneous transpiration. Again, sudden flows of urine may occur about the period of early convalescence from fever, after the absorption of serous effusions, or yet again when a hydronephrosis suddenly empties itself. All these are merely temporary and evanescent states. The total absence of grape-sugar distinguishes polyuria from diabetes mellitus, though the one state may merge into the other. In certain forms of Bright's disease, especially those characterised by contracted kidney, the urine may be excessive and of low specific gravity; but in all of these albumin and casts will be at least now and again found. Finally, polyuria is not to be confounded with such abnormal discharges of urine as may occur from time to time in what we call hysteria and its allies. Here the nervous symptoms give a special feature to the malady; nevertheless polyuria has strongly marked nervous affinities.

Prognosis.—This cannot be called favourable, for, whilst few actually perish from the uncomplicated disease, still fewer are cured of it, though a good many get well. As a rule it runs a chronic course.

Treatment.—As might be inferred from the account of our imperfect knowledge of the pathology of the disease given above, the treatment of polyuria is most unsatisfactory. If the disease can be assigned to any definite cause, we must look to that and deal with it, rather than with the excessive urination; if not, it must be our endeavour to counterbalance the draining of the tissues, and the corresponding waste, by a plentiful supply of fluid and a generous nourishing diet. The distressing excessive thirst may be somewhat assuaged by sipping acid drinks. To relieve the kidneys from the unusual stress thrown upon them, diaphoretics have been recommended. Great care should be taken that the patient be warmly clothed so as to guard against any risk from cold. Of medicinal remedies, that which has been most lauded is valerian, especially by Trousseau, who gave it in enormous doses. The extract is the preparation usually prescribed. Probably it, like other antispasmodic remedies, would be found of most service in cases allied to hysteria or similar neuroses. The whole range of antispasmodic remedies may in some cases be tried without effect. Opium and its alkaloids, though serviceable in diabetes mellitus, are worse than useless in polyuria. They diminish the thirst and the urine, but they greatly increase the patient's discomfort. Valerianate of zinc, ergotin, iodide of potassium, belladonna, and phenazone have been tried with varying success. Tonics, especially strychnine and iron, do good by improving the general health. After every medicinal remedy has been tried in vain, attention to the constitutional state and change of air at the seaside may be followed by almost complete disappearance of the polyuria. Finally, the constant electric current, both weak and strong, has been advocated, and in the hands of some has done good, whilst it has equally failed in the experience of others.

Alexander Silver. John Harold.

POMPHOLYX (πομφός, a bulla or bladder).—This term is applicable to the bullous affection of the skin more commonly denominated pemphigus, of which it is, in fact, a synonym. *See* Pemphigus.

PONS VAROLII, Lesions of.—Synon.: Fr. *Maladies de la Mésocéphale*; Ger. *Krankheiten der Brücke*.

Introduction.—The pons is liable to a variety of affections, either by morbid processes having their primary seat here, or by secondary implication from disease originating elsewhere, as by tumours of the cerebellum or base of the skull, or aneurysm of the basilar artery.

The position of the pons, its close relation to the vital centres of the medulla oblongata, the connexion of the sensory and motor paths with the cerebrum and spinal cord on the one hand, and the cerebellum on the other, and the transit through it of many of the cranial nerves, render the symptomatology of pontine affections highly complex and diversified.

Summary of Pathological Conditions.—*Hæmorrhage* in the substance of the pons is by no means uncommon, and may vary from a minute focus up to a complete disorganisation and rupture into the fourth ventricle. *Embolism* is not common; but *thrombosis*, from *syphilitic* or *atheromatous degeneration* of the basilar artery, is frequent, and is the origin of necrotic *softening* of an acute or chronic character.

Hæmorrhage.—Hæmorrhage into the substance of the pons, if of small extent, is not necessarily fatal; but if it be of large amount, death occurs suddenly, or within a very few hours. Sometimes there is a sudden onset of coma, with complete relaxation of the whole muscular system. The pupils are, as a rule, minutely contracted, and the condition resembles profound narcotic poisoning. The temperature may rise to as much as 105° F. or more. Deglutition is difficult or impossible; and death ensues from cardiac and respiratory paralysis, irregularity in the rhythm preceding the fatal issue. At other times, and of great signification from a diagnostic point of view, muscular spasms occur, either general or affecting one side more than the other, with distortion of the face, either from paralysis of one side, or this combined with active spasm of the other.

The occurrence of paralysis of one side of the face, and of the limbs of the other side, so-called 'alternate' paralysis, is pathognomonic of the pontine seat of the lesion.

Softening.—Acute embolic or thrombotic softening of the pons, with or without loss of consciousness, may lead to death rapidly, with similar paralytic symptoms; but days may elapse, or even months, after the first onset, with characteristic symptoms indicative of the position of the lesion, and death ensue either from gradual implication of the vital centres, or quite suddenly.

Localising Phenomena.—The symptoms most characteristic of lesions of the pons are a combination of paralysis of certain cranial nerves on the one side, and of the limbs on the other. The most common combination is paralysis on one side of the face and of the limbs on the opposite, the face being paralysed on the side of the lesion. The facial paralysis in this case resembles peripheral facial paralysis, both in the implication of the orbicularis oculi and degenerative change in the muscles. The limbs may be paralysed as to motion only, or there may be a combination both of sensory and motor paralysis. Sometimes the motor paralysis affects one limb more than the other, and there may be a similar distribution of the anæsthesia.

The alternate paralysis of the face on one side, and of the limbs on the opposite, occurs more particularly with lesions of the pons situated towards the pyramids, at a point where the facial roots have not crossed over to pass on to the opposite hemisphere. If the lesion be higher up, near the crus cerebri, the face and limbs may both be paralysed on the side opposite the lesion. Amongst other varieties the face alone may be paralysed, without affection of the limbs; or one side of the face may be paralysed, and the other in a state of spasm; or both sides of the face may be paralysed; or one side of the face may be paralysed, and the limbs on both sides; or both sides of the face, and the limbs on one side. Spasms in the limbs paralysed or in the others may occur; and similar irritation of the sensory strands may be indicated by excentric hyperæsthesia and paræsthesia.

Along with the motor paralysis of the limbs, there is also a varying degree of vaso-motor paralysis, and a difference in temperature of the limbs of one degree or more.

Next in frequency to affections of the facial nerve, with or without affections of the limbs of the variable character above mentioned, comes affection of the abducens or sixth cranial nerve. This gives rise to an internal strabismus, and usually of the eye on the same side as the lesion. There may be, therefore, paralysis of the face and abducens on the side of lesion, and of the extremities on the opposite side; but cases have been recorded of paralysis of the abducens on one side, and of the face and limbs on the opposite; and also of paralysis of the face, abducens nerve, and limbs on the same side as the lesion. In some cases there is conjugate paralysis of the abducens on the side of lesion, and of the internal rectus on the other. This occurs when the nucleus of the sixth is affected, which innervates the external rectus of the same side and the internal of the other by way of the posterior longitudinal tracts. *See* case by Hughes Bennett, *Brain*, vol. xii. p. 102.

Defects in articulation are not infrequently observed, depending on impaired mobility of the tongue, usually on the side of the motor paralysis of the limbs, but apparently sometimes on the other side. The fifth cranial nerve is also not infrequently implicated. The sensory portion seems to suffer more than the motor. But cases have been recorded in which the motor portion of the fifth has been specially affected, leading to paralysis and degeneration of the muscles of mastication.

The affection of the sensory division shows itself in more or less marked anæsthesia of the face, which may be general, or limited to the area of distribution of some of the branches only. The tongue is not infrequently affected on the same side, and tactile and gustatory sensibility impaired or abolished over the half of the tongue. The affection of the fifth may occur on the same side as the lesion, with or without affection of the limbs, but it would appear also that anæsthesia of the face may occur, with implication of the extremities on the side opposite the lesion.

There is thus an extraordinary complexity and variability in the symptoms which may be met with in connexion with pontine lesions. Those which have been mentioned are the most common and most significant, especially if they occur in combination. Singly they have less value, and some of them, particularly defects in articulation, are not specially characteristic. But a combination of paralysis of the limbs on one side, either motor alone, or of motility and sensibility, and of the face on the other, is significant of pontine lesion. The addition of paralysis of the abducens adds to the certainty.

Many other symptoms might be mentioned which have been noted in connexion with lesions of the pons, especially tumours, which ought perhaps to be ascribed to interference with the functions of neighbouring structures. As in other parts, however, tumours have been found invading or pressing on the pons without having given rise to any marked symptoms during life. But at other times, along with one or more of the previously mentioned symptoms, impairment of deglutition has been observed, due without doubt to pressure on the medulla oblongata. To the same cause should also be ascribed the irregularity and ultimate paralysis of the cardiac and respiratory movements, in connexion either with tumours or with hæmorrhagic effusions into the pons itself.

When a tumour presses forward in the direction of the crura cerebri, the third cranial nerves may be implicated. Ptosis has been observed in such cases; and external strabismus, from paralysis of the internal rectus, has also occurred, but comparatively rarely.

Vertigo and disorders of equilibration have been observed, but these may be attributed to an implication of the cerebellum or of its peduncles. Ataxic symptoms have, however, been described by Leyden as occurring in pontine lesions, without affection either of the cerebellum or of its peduncles. The writer has seen a case of very marked ataxy associated with anæsthesia of one side of the face, and of the limbs and trunk on the opposite side, due probably to lesion on the right side of the pons. But the cases which have been recorded are not yet sufficient to establish any very definite propositions in regard to the exact causation or special characteristics of the ataxic disorders in question. In connexion with tumours pressing on the pons, hearing may also be impaired or abolished in one or both ears. Impairment of smell has been observed on one side, when there has been anæsthesia of the face. This is probably due to the impairment of common sensibility in the nostril, intensified in some cases by the defective power of sniffing if the facial nerve is also paralysed.

Albuminuria and glycosuria have occasionally been found in connexion with diseases of the pons. It is very doubtful if any causal relationship has been at all satisfactorily established. Very often, when albumen has been found, there is good reason to believe that it has been pre-existing, for lesions of the pons frequently occur in connexion with chronic renal disease. Sugar has been found sometimes, and in other cases not. The same has been found in connexion with lesions of other nerve-centres. So far, therefore, as facts go, the evidence in favour of a direct relationship between pontine lesions and glycosuria is at present extremely slender, and in need of further investigation.

Diseases which encroach on the intracranial space produce the general symptoms of intracranial tumour, in addition to the special symptoms indicative of their invasion of the pons. D. Ferrier.

PORRETTA (La), in Italy, between Bologna and Pistoja.—Thermal, sulphurous, muriated saline waters. *See* Mineral Waters.

PORRIGO LARVALIS (*porrigo*, scurf; and *larva*, a mask).—*Porrigo* is an old-fashioned term, applied generally to eruptions on the scalp and face, whether exudative or desquamative; *larvalis*, masked, alludes to the covering of the face with an incrustation which conceals the features like a mask, such as is seen in a neglected exudative eczema of the face, an eczema pustulosum or impetiginodes. Pathologically, porrigo is an eczema. *See* Impetigo; and Eczema.

PORTAL OBSTRUCTION. — This is a condition of not uncommon occurrence, and calls for brief general discussion. Strictly speaking, portal obstruction implies that there is some direct impediment to the flow of blood in the portal circulation itself, either affecting the trunk of the vein before it enters the liver, or its branches distributed throughout the substance of this organ. It must be remembered, however, that any condition interfering with the circulation beyond the portal system, whether in the hepatic veins, the upper end of the inferior vena cava, right side of the heart, or lungs, will retard more or less the flow of blood through this system; and also that either of the tributary branches of the portal vein may be affected alone. The portal trunk may be obstructed by direct pressure upon it, as by enlarged glands, a growth projecting from the liver, thickening from perihepatitis, or a neighbouring tumour, or aneurysm; by changes in its walls, leading to constriction or complete closure; or by blocking-up of its channel, as by a thrombus (*see* PORTAL THROMBOSIS). Cirrhosis is the most important disease which obstructs the portal circulation within the liver; but this result may also arise from accumulation of pigment and other causes.

EFFECTS.—The effects of portal obstruction will depend on its seat, its degree, and the rapidity with which it is set up. They are merely those which necessarily follow mechanical venous congestion, namely, distension of the small vessels, which may end in changes in their walls and varicosity; escape of serum; a congested or catarrhal condition of mucous surfaces; hæmorrhages; and, in course of time, permanent changes in organs and structures which are thus affected. Their localisation in this case will correspond to the structures from which the portal vein receives its tributary branches, or with which the latter communicate. Hence any of the following conditions may result in various degrees from portal obstruction: (1) Congestion and catarrh of the mucous membrane lining the lower end of the œsophagus, stomach, and intestines, with consequent disorder of the secretions; dilatation and varicosity of the small vessels; or hæmorrhage into the alimentary canal. (2) Ascites, one of the most frequent and evident phenomena. (3) Enlargement of the spleen, either from mere accumulation of blood, or in chronic cases with permanent increase and alteration in the splenic structure. (4) Congestion, followed by fibroid changes, in the pancreas. (5) Hæmorrhoids, it is generally believed. (6) After a while, enlargement of the superficial veins of the abdominal wall, owing to their communications with the portal vein; as well as of the veins within the abdomen, which are tributary to it. In rare instances peritoneal hæmorrhage has occurred from the rupture of distended veins. (7) Congestion of the female generative organs in some cases.

Several of the conditions mentioned are obvious on clinical examination during life; others are only evident on *post-mortem* examination, although they assist in originating symptoms, especially in connexion with the alimentary canal, such as those of dyspepsia, flatulence, and disordered bowels, diarrhœa being not uncommon. Hæmorrhage into the stomach or bowels is usually revealed by the occurrence of hæmatemesis or melæna, but it may prove fatal without any discharge of blood externally. It must necessarily happen that, if the portal circulation is not properly carried on, the functions of the liver are proportionately impaired.

The signs of portal obstruction may set in with great acuteness, or more or less gradually. Those indicative of acute obstruction are the rapid development of abundant ascites, returning speedily after paracentesis; acute enlargement of the spleen; hæmorrhage into the alimentary canal; and speedy dilatation of the superficial abdominal veins. It must be remarked that the most striking phenomena may disappear in chronic cases, after a time, without the removal of the obstruction, probably owing to the development of new channels, by which the blood is returned to the heart without passing through the liver. *See* HÆMATEMESIS.

DIAGNOSIS.—There ought to be no difficulty in recognising the signs of portal obstruction in marked cases; and it might even be suspected before these signs are well-developed under certain conditions. The cause of the obstruction can only be made out by a consideration of each case in all its features.

TREATMENT. — Rarely can anything be done directly to remove portal obstruction. The portal circulation may often be relieved by acting freely upon the bowels, especially by means of saline and hydragogue purgatives. Treatment directed to the effects of any obstruction is frequently highly efficacious, and the most important of these may be cured or relieved, even though their cause remain unaffected. The special treatment of these symptoms, and also of the conditions upon which portal obstruction depends, is described in other articles.

FREDERICK T. ROBERTS.

PORTAL THROMBOSIS.—SYNON.: Portal Phlebitis; Pylephlebitis; Fr. *Pyléphlébite*; Ger. *Pylephlebitis.*

Portal thrombosis may be divided into two kinds: (*A*) the **Adhesive**; and (*B*) the **Suppurative.**

(*A*) **Adhesive Portal Thrombosis.**—Adhesive portal thrombosis is seen most commonly in cirrhosis of the liver, rarely as a cause of the cirrhosis itself. In the first case, it arises, not from an inflammation of the walls of the vessel, but from obstruction to the circulation. The thrombus itself is usually firmly adherent to the walls, tough, and of a red-brown colour, the vein being dilated. In very rare cases thrombosis of numerous peripheral branches of the portal vein, as the mesenteric veins, has been found giving rise to symptoms very similar to those caused by thrombosis of the trunk of the vein.

SYMPTOMS. — The symptoms of portal thrombosis are those of intense portal obstruction. There is ascites, rapidly developing itself, and, according to Frerichs, returning rapidly after removal by tapping. The veins of the walls of the belly become rapidly dilated. There may be hæmatemesis or a bloody diarrhœa. The spleen is greatly enlarged. Jaundice may or may not be present.

Diagnosis.—The diagnosis of portal thrombosis is a matter of great difficulty, the symptoms being very like those of cirrhosis, of which, indeed, it is often a mere complication. In general, it is only when the thrombosis is very acute and affecting the trunk or most of the branches of the vein, and causing very rapid ascites, splenic tumour, dilatation of the superficial abdominal veins, &c., that a diagnosis can be made.

Prognosis and Treatment.—The prognosis is always bad. Instances of recovery are extremely rare, in which cases the vein has been found converted into a fibrous thread, and a collateral circulation established. The treatment must be the same as for cirrhosis in most cases. In the very acute cases, leeches over the liver, cupping, and the administration of saline purgatives should be tried.

(*B*) **Suppurative Portal Thrombosis.**—*Pylephlebitis Purulenta.*—Suppurative portal thrombosis is commonly met with in connexion with some morbid process, most often suppuration, in the parts from which the branches of the portal vein arise. Thus, diseases of the intestines, especially of the cæcum and its vermiform appendix, are the most frequent causes. It has been seen by one of the writers caused by a needle fixed in the vermiform appendix; and Frerichs has recorded a case where a needle perforated the inferior mesenteric vein. It occurs after dysentery, and more rarely after enteric fever. It is occasionally caused by ulcer and cancer of the stomach, and follows suppurative splenitis. In the newly born, suppuration sometimes extends from the umbilical vein to the liver. The vein is found greatly dilated, and filled with a dirty grey or reddish pulp, which, under the microscope, shows small round nucleated cells like pus-corpuscles. The liver itself shows, on section, the branches of the portal vein filled with a diffluent thrombus, so that the organ looks as if pervaded with abscesses.

Symptoms.—The symptoms closely resemble those of abscess of the liver or of pyæmia. Traube thinks the diagnosis may be made if the liver and spleen be much enlarged, and if there be returning attacks of rigors with raised temperature, while between the attacks the temperature is natural or only slightly raised. Remittent pyrexia, with sweating, vomiting, diarrhœa, and rigors, are the most constant symptoms. The liver, however, is only moderately enlarged in some cases. Pain and tenderness in the right hypochondrium, with an icteric tint, in a case presenting pyæmic symptoms, should suggest this condition. There must be also evidence of some suppuration, which may involve the branches of the portal vein; and pyæmia and endocarditis must be excluded. Often, however, all these signs fail, and suppuration of most of the branches of the portal vein has been found after death when no hepatic symptoms have been present during life. Possibly the occurrence of hepatic symptoms depends upon the acuteness of the process.

Remembering, however, how frequently it is caused by disease of the appendix, any suspicion of pylephlebitis should lead to the careful consideration of the propriety of surgical exploration of the appendix.

Prognosis and Treatment.—The prognosis is always bad; the treatment must be the same as for abscess of the liver or pyæmia.

J. Wickham Legg.
Stephen Mackenzie.

POST - MORTEM EXAMINATION.—*See* Necropsy.

POST - MORTEM WOUNDS.—

Synon.: Dissection-wounds; Fr. *Blessures Anatomiques*; Ger. *Sectionwunden.*

Definition.—A variety of poisoned wounds, arising from the inoculation of a virus derived from the dead bodies of men or animals.

Similar consequences may result from the inoculation of the discharges from unhealthy inflammations in living bodies, especially those arising from *post-mortem* poisoning. The conditions necessary for the production of a dissection-wound are the virus, a means of entrance of the virus into the system, and a condition of body favourable to the development of the effects of the virus.

Pathology.—*The virus.*—The products of ordinary decomposition may cause local troubles, to be mentioned hereafter, but they never give rise to the graver forms of *post-mortem* or dissection wound. The poison is present in greatest intensity in fresh bodies, and its virulence diminishes as decomposition advances. It is not the same in all cases, and the effects vary greatly with the nature and intensity of the virus. We are not in a position to deny that in some cases the virus may be a non-organised ferment, but it is practically certain that in the vast majority of *post-mortem* wounds it is a pathogenic organism, and most commonly one of the micrococci. In the localised forms the staphylococcus pyogenes aureus or albus is most commonly found, while in the diffuse varieties, in which the lymphatics are chiefly implicated, the streptococcus pyogenes is almost invariably present (*see* Erysipelas). *Post-mortem* wounds of a serious character most commonly arise from inoculations from the bodies of patients who have died from some unhealthy inflammatory (infective) process, especially from septic peritonitis or pleurisy, pyæmia, septicæmia, puerperal fever, diffuse cellulitis, erysipelas, or spreading gangrene. The diminution of the intensity of the poison with decomposition is probably due to the destruction of the specific organism by the growth of the ordinary bacteria of putrefaction; it being a well-known fact that when two organisms are growing together in the same fluid, the stronger overpowers the weaker, checks its growth, and finally leads to its destruction.

Certain specific diseases, as glanders and splenic fever (malignant pustule), may be communicated by inoculation from the dead body, but these accidents are not classed with ordinary dissection-wounds.

Mode of entrance of the poison into the system.—Whatever the virus may be, it only acts by direct inoculation. This most commonly occurs through an accidental wound or scratch during the *post-mortem* examination; but a raw surface partly healed, or the fissures in chapped hands, or the small fissures so common at the margin of the nail, may serve as points of inoculation. In rare cases infection takes place through the unbroken skin, the hair-follicles seeming then to serve as the points of entrance. The further diffusion of the poison takes place by spreading amongst the lymph-spaces of the cellular tissue, as shown by diffuse cellulitis; by being carried with the stream in the lymphatic vessels, as in those cases in which the local affection is slight, and the first trouble is in the lymphatic glands; or by entering the blood-stream and setting up a general infective process.

PREVENTION.—In order to prevent inoculation the following points should be attended to. Before making a *post-mortem* examination of a dangerous case the hands should be carefully looked over. If any spot denuded of cuticle be found on the fingers, an india-rubber cot should be applied, its base being bound round with string. If the whole hands are sore and chapped an india-rubber glove may be used. If no india-rubber cot for a finger is to be found, an efficient waterproof covering may be made at once with gutta-percha tissue and chloroform. If the hands are sound they may be well greased with carbolic oil (1 to 10), but, as this soon wipes off, the application must be repeated several times during the *post-mortem* examination. Carbolised vaseline may be used instead of the oil, and is less easily rubbed off. Accidental wounds arise almost invariably from carelessness—the assistant being as often wounded as the operator. There is scarcely any operation in a *post-mortem* which requires two to perform it, and an assistant should therefore be dispensed with. The most common acts of carelessness are—cutting towards instead of away from the left hand; and letting the knife fall unobserved into one of the cavities, where it is concealed by blood or the viscera, and wounds the hands when next introduced. Wounds from ribs are amongst the most dangerous, as they bleed but little. To avoid these, when using the bone-forceps in cases of ossification of the cartilages, the ribs should be cut near the nipple line, and the skin folded over them whilst the viscera are being examined. In opening the head the saw is apt to slip, and to injure the hand holding the vault. To avoid this, either wrap the hand in a thick cloth, or hold the head with the left hand on the face, where it will be out of danger. Punctures during the sewing-up of the body have caused many deaths. These injuries are usually due to using too small a needle, which cannot be kept properly under control. A common packing needle sharpened is by far the safest instrument that can be used. In whatever way the wound is made the first essential of treatment is to make it bleed freely. If it is on the finger, this may be done by winding a piece of string round it from the root to the tip; then wash it thoroughly in carbolic lotion (1 in 20) or perchloride of mercury (1 in 500) and suck it. Caustics are quite unnecessary if these directions are carried out. After a *post-mortem* examination the hands should always be well washed in some strong antiseptic solution.

The condition of body favourable to the development of the effects of the poison.—Nothing is more common than for two persons to be wounded at the same *post-mortem* examination, and only one to suffer from it. Sir James Paget has brought forward strong evidence to show that constant exposure to the poison gives a certain degree of 'immunity from the worse influences of the virus,' and that one dissection-wound protects the sufferer from another, at least for some time. Anything which causes a depressed state of health favours the occurrence of *post-mortem* poisoning. Thus, we see it in students who have been some months resident in hospital, in nurses who are worn out with attending a bad case, and in dissecting-porters or others who indulge too freely in alcohol. Beyond these, no special predisposing conditions are known.

VARIETIES.—It will be convenient to discuss the several forms of *post-mortem* wounds under distinct headings according to the following arrangement:—

1. Purely Local Affections.

(*a*) *Dissecting-porter's wart*, or *anatomical tubercle.*—Although not exactly a *post-mortem* wound, this affection must be mentioned here as being one of the effects of the irritation caused by the repeated application of putrid matter to the skin. It is seen only in those whose occupation brings them much in contact with decomposing animal matter, and is of very rare occurrence. Its seat is always at the back of the hand over the knuckles, or the joints of the fingers. It is characterised by a warty thickening of the skin, which may in some cases resemble epithelioma. In other cases the thickening of the cuticle may give the skin an ichthyotic appearance. The enlarged papillæ are set closely together, and there is no true ulceration, but cracks and fissures may exist in parts, from which a serous discharge escapes. The growth tends slowly to spread. These warty growths are usually multiple, and this, together with the want of any tendency to ulceration, will serve to distinguish them from epithelioma.

Treatment.—Salicylic collodion applied daily will usually effect a cure. In other cases the constant use of wet dressing to soften the epithelium, combined with the application of a mixture of equal parts of glycerine and extract of belladonna, is of great service. Should this fail, painting with strong tincture of iodine may be tried, or, as a last resource, the application of some strong caustic.

(*b*) *The dissecting-room pustule.*—This is always the result of the inoculation of some poisonous matter into a slight abrasion or puncture. About twenty-four hours after inoculation the spot becomes red and itches. In another twenty-four hours a small drop of pus is seen raising the cuticle, and the part is intensely tender. If the drop of pus be let out the pain is at once relieved. If no treatment be now adopted to prevent it, a small scab forms, under which pus again appears, and the redness and pain return as before. Each time that this happens the sore increases in size, till it may reach about one-eighth of an inch in diameter, and it then closely resembles in appearance a small soft chancre. Without treatment the condition may continue indefinitely. It is very seldom accompanied by any constitutional disturbance. The axillary glands may be tender, but suppuration is rare, except in unhealthy subjects.

Treatment.—The best application to these sores is lint wetted with a lotion composed of solution of the subacetate of lead 1 part; rectified spirit 1 part; water 6 parts. The dressing must be kept constantly moist, so as to prevent the formation of a scab, and the shutting in of the pus. The treatment must be continued until the sore is soundly healed. If the smallest speck be unhealed it will relapse as soon as the dressing is removed. If, in spite of this dressing, it refuse to heal, nitrate of silver may be applied, or the ulcerated surface may be covered with iodoform.

(*c*) *Suppuration of the matrix of the nail.* This arises from inoculation through one of those small fissures at the side of the nail popularly known as 'agnail' or 'hangnail.' The inflammation extends rapidly to the matrix at the root of the nail. The dorsal aspect of the finger for half an inch below the nail is swollen, red, and acutely tender, and on pressing over this area pus oozes out over the nail. The inflammation rarely extends over the whole matrix, so that the distal part of the nail is usually unaffected and firmly attached, while the root is softened and loosened by the suppuration beneath it. The discharge has a strong offensive odour of decomposition. This condition is extremely chronic, the irritation being kept up almost indefinitely by the putrid discharge, which is more or less pent up beneath the nail. When recovery takes place the nail usually separates.

Treatment.—The first essential of treatment is, if possible, to render the discharges aseptic. For this purpose the finger may be soaked in the lead lotion before mentioned, or in a saturated solution of boric acid in cold water, and dressed with the lead lotion and boric-acid lint; or powdered iodoform may be pushed with a piece of card beneath the swollen skin over the root of the nail. If these simpler means fail, the nail must be removed; and the raw surface, dressed with some mild antiseptic lotion, will quickly heal.

(*d*) *Suppuration of the hair-follicles.*—This is a somewhat rare effect of *post-mortem* poisoning. About forty-eight hours after exposure to infection a varying number of small pustules, each surrounded by a red areola, form on the hairy parts of the hands and wrists. On careful examination, each pustule will be seen to have a hair passing through it. As a rule, these pustules discharge and dry up without causing further trouble, but in some exceptional cases they may be followed by constitutional symptoms or lymphatic inflammations.

Treatment.—All that is necessary is to cover the part with cotton-wool, to hasten the drying of the pustules.

(*e*) *Boils.*—Boils, which differ in no respect from those arising without known cause, may form as a consequence of exposure to *post-mortem* poisons. They probably start from inflammation of the hair-follicles.

Treatment.—This presents nothing special.

(*f*) *Ordinary whitlow.*—Although whitlow is common amongst nurses and others whose duties oblige them to dress foul sores, it is not a very common consequence of *post-mortem* wounds. When met with it presents nothing special. *See* Whitlow.

2. Diffuse Inflammation of the Cellular Tissue, spreading from the point of inoculation.

(*a*) *Diffuse cellulitis.*—The seat of inoculation becomes in from twelve to twenty-four hours more or less red and irritable, and in this state it may remain for another day, at the end of which time a brawny swelling of a dusky red colour forms round it, and rapidly extends in all directions, but chiefly in the line of the lymph-stream. At the same time there is intense tension, burning pain, and severe constitutional disturbance, high temperature, total loss of appetite, and possibly delirium. Red lines of inflamed lymphatic vessels may or may not be seen extending upwards, but glandular abscesses are rare, as in ordinary cellulitis. If unrelieved by treatment, sloughing rapidly follows the brawny swelling, first of the subcutaneous tissue, and afterwards of the skin.

Treatment.—The only treatment in such a case is free and early incision into the affected part. In one case which came under the observation of the writer the inoculation took place from a scratch from a broken rib which had penetrated a consolidated lung, and caused the formation of a foul abscess. Swelling in the finger commenced on the second day, about 10 p.m., and at 11 a.m. on the following morning it had involved the whole finger and part of the back of the hand. Red lines extended from it a little way above the wrist. Two incisions were immediately made in the palmar aspect of the finger, and one on the dorsum of the hand, with the effect of at once arresting the extension of the process. In this case the attack commenced with slight nausea, but no chilliness or rigor; there was high fever and delirium on the third and fourth days. The constitutional treatment must be the same as in other cases of diffuse cellulitis. *See* Erysipelas.

(*b*) *Spreading gangrene.*—This is an intensification of the preceding variety. A red, brawny swelling advances rapidly up the arm, quickly followed by gangrene of the subcutaneous cellular tissue and skin. This condition is extremely rare as a consequence of dissection-wounds. A case occurred in 1880, at University College Hospital, under the care of Mr. Heath, in which the patient's life was only saved by amputation at the shoulder-joint. It happened to a nurse from an accidental wound received whilst laying out the body of a patient who had died of puerperal fever.

Treatment.—Early amputation above the advancing gangrene is the only treatment.

3. Inflammations chiefly affecting the Lymphatics.

(*a*) *Inflammation of the lymphatic vessels.*—This usually commences from twenty-four to forty-eight hours after inoculation. The seat of inoculation may show scarcely any signs of inflammation, or it may have developed into a small suppurating sore. The invasion of the lymphatic inflammation is marked by elevation of temperature, chilliness, or possibly a rigor. There is malaise and often nausea, with headache. Red lines are soon after observed running upwards from the seat of inoculation in the course of the lymphatic vessels. These lines are about one-eighth to one-quarter of an inch in width, and clearly defined. They are acutely tender. The lymphatic glands to which they lead are swollen and painful. If unrelieved by treatment, suppuration frequently occurs in the lymphatic glands, or sometimes in the course of the vessels. Occasionally several lines may fuse together, giving the appearance of a band of cutaneous erysipelas.

Treatment.—The bowels should be well opened. Stimulants in moderate quantities may be taken, good port wine being especially useful, with strong beef-tea, milk, and eggs. If there is much fever, quinine may be of use in reducing the temperature. Locally, the whole course of the inflamed vessels is to be painted with a mixture of glycerine and extract of belladonna in equal parts, and the whole arm wrapped in hot fomentations, which must be frequently renewed. This treatment seldom fails to arrest the progress of the inflammation, and ward off suppuration. If pus forms, either in the course of the vessels or in the glands, it must be let out as soon as it is recognised.

(*b*) *Abscess in the lymphatic glands.*—This occurs either as a consequence of the previous condition or without any evident inflammation of the lymphatic vessels. It is frequently a complication of one of the local forms first described. The abscess forms either in the gland at the bend of the elbow or in the axilla, and presents no special features requiring description. The prognosis is not grave.

Treatment. — The abscesses must be opened as soon as recognised, and treated antiseptically.

(*c*) *Axillary cellulitis.*—This is one of the gravest effects of a *post-mortem* wound. It frequently occurs in cases in which the local affection at the seat of inoculation is so slight as to be scarcely recognisable. From twenty-four to forty-eight hours after inoculation the patient is seized with chilliness, and frequently a rigor; there is great depression; with nausea, or even vomiting, and headache. The temperature rapidly rises, reaching 104° or 105°, and there is frequently delirium. On examining the axilla some fulness, with acute tenderness, is recognised, and there is pain in moving the arm. The fulness soon extends to the front of the chest, in the region of the pectoralis major, and the veins of the region may become more clearly visible than natural. Later on there may be a blush of redness over the pectoral region, and with this there is œdema. If not relieved the swelling and redness may extend down the side of the chest, and show above the clavicle at the root of the neck. The constitutional condition assumes the ordinary characters of septicæmia. There is muttering delirium, rapidly failing pulse, dry tongue, with sordes on the lips and teeth, possibly diarrhœa, and the patient sinks into a comatose condition and dies. Sir James Paget, in his well-known lecture on his own case, explains this condition by supposing that the lymphatic glands are first swollen, and the flow of lymph through them obstructed, and that the poison then extends backwards in the distended lymphatics till it reaches the cellular tissue in which they arise, thus causing diffuse cellulitis, which, if not relieved, or if not speedily fatal, may extend to the whole area which sends lymph to the affected glands. If an incision be made early into the affected cellular tissue it will be found merely infiltrated with serum; later on the serum is turbid; still later the whole areolar tissue would be found in a sloughy condition, soaked in pus.

Treatment.—The blood-poisoning accompanying this condition is frequently fatal in spite of any treatment. The only hope for the patient lies in early recognition of the state of the part, and in making free incisions. These incisions must thoroughly open up the axillary fascia, and if there be any suspicion of extension beneath the pectoralis major, another incision must be made two, or even three, inches in length, through the muscle. This is best made in the interval between the sternal and clavicular portions. The skin and fat only need be divided with the knife, the muscular fibres being separated with the handle of the scalpel to avoid hæmorrhage. If these incisions are made with all antiseptic precautions and the antiseptic dressing adopted, the patient's chance of life is greatly increased. The constitutional treatment consists in free stimulation and abundant nourishment. Quinine may possibly be useful in large doses.

4. **Septicæmia.**—In some cases, which fortunately are very rare, *post-mortem* wounds prove speedily fatal, with the ordinary symptoms of acute septicæmia. Local changes at the seat of inoculation may be entirely wanting. *See* Septicæmia.

5. **Pyæmia.**—Pyæmia may occur as a secondary complication of the forms of *post-mortem* wound which are accompanied by suppuration and sloughing; but it presents nothing special in such cases. *See* Pyæmia.

Marcus Beck.

POST-PHARYNGEAL ABSCESS.

See Retro-pharyngeal Abscess.

POSTURE.—In this article it is intended to point out the main practical relations of posture to the ætiology, diagnosis, and treatment of various diseases. It not uncommonly happens that a patient assumes instinctively a posture by which his condition may be at once recognised, or which gives indications of importance as to his management. In other cases the practitioner makes systematic use of posture to assist him in his diagnosis, or to aid him in treatment. It should be mentioned at the outset that persons often present peculiarities with reference to posture, which are of no practical significance, and are the result either of natural differences in individuals, or of habit. For instance, some people can only sleep with the head raised very high, in an almost semi-recumbent position; others lie with the head very low, even level with or below the body. Many are unable to sleep on the back, or on one or other side, and especially the left side. The subject will be further discussed in its relations to the several points mentioned above.

1. **Ætiology of Posture.**—As an immediate cause of disease, posture is chiefly important in connexion with occupation. For instance, many persons suffer from long-continued standing; or, on the other hand, from sedentary occupations. The evil effects of prolonged standing are evidenced by the development of varicose veins in the legs, and also by the occurrence of general fatigue and debility, displacements of the uterus, and other conditions, especially in young women, such as those employed in drapers' shops. Those callings which entail constant or frequent bending forward of the body are often very injurious, and this may be aggravated by carrying burdens on the back and shoulders. Not uncommonly persons injure themselves by habitually bending forward when sitting, quite apart from occupation. Another illustration of the influence of posture in causing disease is where individuals have to work in constrained positions, such as colliers and miners. The conditions thus induced are chiefly deformities of the chest, and certain diseases of the lungs, heart, and vessels. Hanging down the head may be the determining cause of cerebral apoplexy. Posture is also of consequence in predisposing to certain affections under particular circumstances, or in modifying their effects. Thus the recumbent posture in low febrile and other conditions aids in the causation of hypostatic congestion and its consequences; a similar position promotes the accumulation of morbid products in the smaller bronchi or air-vesicles, in cases of severe acute bronchitis, which may cause further mischief; and if an attack of pleurisy should supervene when a patient is obliged to lie on his back, this will materially modify the way in which the fluid accumulates, for it tends then to collect posteriorly, and may cover the whole area of the chest in this aspect, while there is no sign of any fluid in front. Lastly, a peculiar posture in performing certain acts, such as writing, may have some influence in originating affections of the type of writer's cramp.

2. **Posture in Diagnosis.**—As examples of postures spontaneously adopted by patients, which may give useful information in diagnosis, the following are the most striking.

In many cases the posture suggests great debility, helplessness, or prostration, thus affording important indications as to the general condition of a patient. An inability to lie down constitutes a prominent feature in certain forms of cardiac and pulmonary disease, in consequence of interference with the respiratory and cardiac functions, so that the patient is obliged to sit or to be propped up in bed, or sometimes even to sit up in a chair, to assume the erect posture, or to bend forward. Again, when anything is pressing upon the main air-tube—such as an aneurysm—causing obstructive dyspnœa, the patient may instinctively lean forward, so as to take off the pressure as much as possible. In cases of unilateral lung-disease or pleurisy, the patient is often unable to lie on one or other side, especially the affected one; while in affections of the heart it is frequently impossible for him to rest on the left side. As regards abdominal diseases, acute peritonitis is usually characterised by a very striking posture, the patient lying on his back, with the knees well drawn up and bent, in order to relax the abdominal muscles. Certain positions may also be assumed in other abdominal affections, on account of their influence upon symptoms, such as pain or vomiting. In spasmodic painful attacks connected with this region, it is very common to see the patient bending forwards in a doubled-up position, and pressing upon the abdomen. In nervous diseases posture may be of conspicuous value in diagnosis. Thus, it may reveal paralysis of different parts; in cerebral meningitis the patient often lies in a curled-up position, all the limbs being bent towards the body; in spinal meningitis the head may be involuntarily drawn backwards, in order to try to relax the muscles behind; in tetanus the body is during the spasm fixed in different positions, according to the muscles affected; in cataleptic conditions any posture that is assumed is retained for a considerable or an unlimited time; whilst in wry-neck the head is turned to one side. Lastly, the position voluntarily assumed by a limb may give important information as to local diseases or injuries likely to influence it in this respect, such as those of the joints. The whole body may be distorted, as well as the limbs, in connexion with diseases of the articulations.

What has just been stated will supply hints as to how the practitioner might avail himself of *changes in posture* in aiding him towards a diagnosis in certain cases. For instance, observing the effect of such changes often gives valuable information in connexion with pulmonary and cardiac diseases, as evidenced by the influence of the respective positions upon breathing, cough, the heart's action, and other symptoms; and the same may be the case in some abdominal diseases, as well as in nervous affections or in local diseases. Change of posture is most useful, however, as an aid to physical examination, the effects it produces upon certain physical signs being noted. In this way it may give valuable help in determining the presence of fluid in cavities, such as the pleura or peritoneum; in distinguishing an internal aneurysm from conditions simulating this lesion; in detecting certain solid formations in the abdominal cavity; and for other purposes. Details on these points are given in appropriate articles. It is also of importance to study the position of the patient in examining the chest; and to remember that posture may materially influence physical signs connected with the heart.

3. **Posture in Treatment.**—Many of the preceding remarks will afford suggestions as to the value of paying attention to posture as a therapeutic measure, and it will at once be evident that if a wrong posture is the cause of any morbid condition, the first principle in treatment should be to rectify it. Besides, it will not uncommonly be found advantageous to watch patients, and to allow them to adopt, or assist them in adopting, such a position as their own sensations dictate to be the most suitable for their condition. In order to illustrate further, however, the benefits to be derived from posture, it may be well to point out some of the diseases in which its value is most strikingly exhibited.

(*a*) Posture is of great importance when general rest of the body is required, or when there is exhaustion or prostration of the whole system. The recumbent posture is clearly indicated under these circumstances, for it is the most restful of all, and involves little or no expenditure of muscular force. Hence, in acute febrile diseases of all kinds, one of the first indications in treatment is to keep the patient absolutely in bed. This is also desirable where there is excessive fatigue or prostration from any cause. The great importance of rest in bed during and after an attack of influenza may be specially noted.

(*b*) In the management of affections connected with the respiratory organs, attention to posture is frequently of service. Here its influence as regards rest again comes in, for it may be of much consequence to make as little call as possible upon the respiratory functions. Moreover, symptoms associated with the breathing apparatus are in many cases strikingly influenced by posture, such as pain, dyspnœa, or cough (*see* RESUSCITATION; and STERTOR); and the act of coughing may be materially assisted, and made more effectual as regards expectoration, by the patient assuming a sitting or erect position. The importance of the prone posture, or of bending forwards, must be remembered when there is anything pressing on the main air-tube.

(*c*) Posture often requires particular consideration in relation to disorders of the cardiac action, or to actual disease of the heart. Thus, in the syncopal state the patient should be placed horizontally, or even with the head at a lower level than the body, so that the blood may more readily reach the brain, and in this way life may be sustained. Bending the head downwards between the knees may prevent threatened syncope. In this state, or when the heart is acting with extreme feebleness from any cause, raising the patient into a sitting posture has been known to cause a fatal result, and should be carefully avoided. On the other hand, there are conditions of the heart in which the patient cannot possibly lie down, and especially where there is much dilatation; under these circumstances it may be of the greatest service to have him constantly sitting up in a properly constructed chair, and the beneficial effects thus produced are sometimes almost marvellous.

(*d*) In the treatment of aneurysms, whether internal or external, posture is frequently made use of with advantage. In the cure of this lesion in the chest or abdomen, rest is often an important agent, and on this account patients are confined to the recumbent posture for weeks or months, so as to keep the heart as quiet as possible, and also to limit the demand of the system for food, which is only given in a restricted quantity. Aneurysm in the chest is one of the causes which may originate pressure on the air-tube, and on this account attention to posture may be required in connexion with it. In the case of aneurysm in the limbs, posture is sometimes made use of to cure them, by causing pressure, as flexion of the knee for the cure of popliteal aneurysm.

(*e*) The influence of posture with respect to gravitation may often be recognised with advantage in the treatment of certain conditions. This is well exemplified by its effects on dropsical accumulations in the legs and scrotum. Even abundant anasarca may frequently be got rid of completely in a short time by keeping the legs in a horizontal position; and œdema of the scrotum likewise may soon disappear when this part is propped up. The same principle is of essential importance in checking hæmorrhage from a ruptured varicose vein in the leg; and may also be made use of in the cure of varicose veins. The influence of posture upon dropsy may give useful information as to its cause, and as to the exact conditions upon which it depends.

(*f*) As miscellaneous illustrations of the employment of posture in treatment may be mentioned the value of the recumbent position in sea-sickness, in attacks of giddiness, megrim, and neuralgic affections about the head; raising the head in comatose conditions; the prone posture in the treatment of certain forms of spinal disease; prolonged decumbency or peculiar positions to restore a displaced uterus; and various positions in which limbs are placed on account of local diseases, to relieve pain, to prevent muscular tension, to promote the escape of pus, or for other purposes.

(*g*) Lastly, it must be remembered that it is not uncommonly requisite to change the position of a patient more or less frequently, if he should be confined to his bed. For instance, this is necessary in low febrile diseases, in order to prevent the occurrence of hypostasis at the bases of the lungs, or the formation of bed-sores on parts subjected to pressure; as well as in many cases of spinal or cerebral disease, and in very emaciated patients. Change of posture is further useful in assisting the escape or expulsion of morbid secretions from the air-passages, when they tend to accumulate there.

FREDERICK T. ROBERTS.

POUGUES, in Loire, France.—Alkaline chalybeate waters. *See* MINERAL WATERS.

POULTICE (πόλτος, porridge; *puls*, thick soup).—SYNON.: Cataplasm; Fr. *Cataplasme*; Ger. *Breiumschlag*.—Poultices are soft moist applications, usually applied hot, but occasionally cold. They may be used merely as a means of applying heat and moisture; or they may contain some drug intended to exert a specific effect. Of the innumerable poultices formerly in use, only six are now officinal.

Poultices may be arranged thus: 1. The *simple* poultice, composed of linseed meal. The practice of using bread soaked in hot water as a poultice has deservedly fallen into disrepute, as it soon becomes sour and offensive. 2. *Disinfecting* poultices, namely, cataplasma carbonis, and cataplasma sodæ chlorinatæ. 3. *Sedative* poultices, such as cataplasma fermenti and cataplasma conii. 4. The *counter-irritant* poultice, for example, cataplasma sinapis.

1. Simple Poultice.—The simple poultice, by its heat, causes a dilatation of the vessels of the part to which it is applied, and thus hastens the progress of inflammation, either towards resolution or suppuration. It softens the cuticle, and relaxes the skin by its moisture, and thus favours swelling, and lessens tension and pain. In internal affections, such as bronchitis, pleurisy, or pericarditis, large poultices are frequently applied to the skin over the inflamed part. They benefit the patient partly by their warmth, and partly by exerting an extremely mild counter-irritant effect, consequent upon the redness and congestion of the skin which they produce. They are, however, somewhat troublesome; they soon become cold and hard; and if the patient be restless, their weight causes them to shift, and fragments break off and drop into the bed, and there drying cause considerable discomfort. For application to external inflammations a few folds of lint, soaked in hot water or any appropriate lotion (sedative, stimulant, or antiseptic), covered with oil-silk, and afterwards with a thick layer of cotton wool, will be found to answer every purpose of a poultice, and to be much more cleanly and less troublesome.

Linseed-meal poultices applied to boils usually cause a fresh crop to spring up round the original boil, from the irritation they give rise to. They should consequently never be used, wet boric acid lint or salicylic wool moistened with boiling water being substituted. In internal inflammations a poultice may often be advantageously replaced by cotton-wool only, covered with oil-silk and secured by a bandage. If any counter-irritant action is required, a few drops of chloroform or turpentine may be sprinkled on the wool.

Linseed-meal poultices are best made from meal from which the oil has been expressed, as the pure meal becomes rapidly rancid. The *British Pharmacopœia* recommends the addition of a little olive oil. The following is a useful method of making a linseed-meal poultice: Heat the basin in which the poultice is to be made with boiling water; then empty it and put into it again as much boiling water as may be necessary to make the required poultice; sprinkle the meal into the water, stirring vigorously, till the proper consistence is attained; lastly, stir in a small quantity of warm olive oil. By adopting this plan the poultice will be free from lumps. The poultice should then be spread with a broad spatula on a piece of rag or tow. It must be of a uniform thickness, and neither so thick as to be too heavy, nor so thin as to cool and dry too rapidly. A poultice should be changed every two or three hours by day, and every four at night, if the patient is sleeping. In all cases where there is suppuration, a poultice is the dirtiest application that can be made to the wound. Wet boric acid lint or some other moist antiseptic dressing should always be used instead.

2. **Disinfecting Poultices.** — *Cataplasma carbonis* is a horrible compound of wood-charcoal, linseed meal, and bread, and was formerly supposed to have some disinfectant properties. Both this and the *cataplasma sodæ chlorinatæ* have been entirely replaced by more cleanly or efficient antiseptic applications. The best of these are boric acid lint, salicylic wool, and carded oakum. If carded oakum be used, it must be made into a soft and even pad, and may be dipped in hot water before being applied. It is a powerful antiseptic, and very cheap, but has the disadvantage of blackening the skin with the tar it contains, and sometimes causes considerable irritation. Both these inconveniences may be overcome to a certain extent by greasing the skin with carbolic oil (1 to 10).

3. **Sedative Poultices.** — *Cataplasma fermenti* is composed of beer yeast, 6; flour, 14; water (100° F.), 6. After mixing, it is to be placed near the fire till it rises. The carbonic acid was credited with both sedative and antiseptic properties. It was chiefly used in boils, but from personal experience the writer can state that it has none of the virtues attributed to it. *Cataplasma conii* is composed of juice of hemlock, 1 ounce; linseed meal, 4 ounces; and boiling water, 10 ounces. Evaporate the hemlock juice to half its volume, and add to the linseed meal and water previously mixed and stir them together. It has been chiefly used in cases of cancer to relieve pain.

4. **Counter-irritant Poultice.**—*Cataplasma sinapis*, the ordinary mustard poultice, is an invaluable counter-irritant. It is composed of mustard in powder, 2½; linseed meal, 2½; boiling water, 10. The linseed meal is to be mixed with the water, and the mustard added, constantly stirring. It must be remembered that mustard varies much in strength, and that since it has been made the object of the special attention of the authorities engaged in carrying out the Adulteration Act, its strength has considerably increased. Its action should extend only to producing redness of the skin, for if kept on too long it will cause vesication, and has even been known to give rise to sloughing. The time a mustard poultice can be kept on varies from ten minutes to half an hour or more, according to the strength of the mustard. The guide most usually relied upon are the sensations of the patient. An ordinary patient is not likely to keep it on too long, as the smarting soon becomes unbearable. Patients who are much in the habit of applying mustard poultices to the same part—as, for instance, the front of the chest—acquire a singular power of resistance to the irritative action of the mustard. The mustard poultice is indicated whenever mild and rapid counter-irritation is desired. It is especially useful in bronchitis, and in muscular rheumatism, as lumbago or pleurodynia. Rigollot's mustard-leaves, and the *charta sinapis* of the *British Pharmacopœia*, are excellent substitutes for the mustard poultice. They are cleaner, more easily applied, and can be more accurately adapted to the spot required. They should always be used in preference when obtainable.

MARCUS BECK.

PRÆCORDIAL ANXIETY or OPPRESSION.

—SYNON.: Fr. *Angoisse*; Ger. *Präcordialangst.*

DEFINITION.—A sensation of constriction, attended with anxiety, referred to the præcordia; for the most part persistent, but at times recurrent.

Ætiology.—Anxiety or oppression of the præcordia is due to dilation and inhibition of the right side of the heart, more especially of the auricle; whereby, though the walls of the heart in structure are unimpaired, their elasticity is neither duly excited nor supported.

The *predisposing* and *exciting causes* are, for the most part, to be found in an abnormal condition of the blood, so that the due nutrition of the heart, whether as regards muscle or nerve, is not supplied nor its contractile power effectually excited; and also (though the duration of the attacks may not be so persistent as in the above form) in a flatulent and distended stomach and alimentary canal, exciting to inhibition, both locally and reflexly—through efferent impulses descending the vagus. Though there may thus be deficient innervation, whereby the irritability of the heart is impaired, it does not appear to be a simple neuritis, but mainly dependent on some abnormal condition of the muscular functions temporarily established, an impure blood failing to stimulate the fibres to a due expansion and contraction, or flatulent distensions directly or indirectly, in like manner, interfering with these functions.

Description.—Præcordial anxiety shows itself by a distressing sensation in the region of the heart, characterised by an irregular rolling, tumbling, or falling motion, supervening on a feeling of constriction. It is accompanied by feelings of anxiety; by restlessness, which may pass into a state of extreme agitation; by a sensation of approaching syncope, with fear of death; and by chilliness passing into a cold clammy perspiration. Though there may be a soreness or dull aching, there is neither pain nor palpitation, and it appears to have no alliance with real præcordial pain. The urine is not increased, but rather diminished. Sleep is impossible. The attack often comes on during sleep, and soon, perhaps, the restless anxiety necessitates rising from the couch and walking about; often flatulence oppresses, and gas is evolved, with relief to the symptoms. The attacks are recurrent, and of varying duration. Though præcordial anxiety is here only referred to, as uncomplicated with organic disease, it should be borne in mind that the heart may not be altogether free from indications of more than functional disorder. *See* Angina Pectoris.

Treatment.—During the attack relief is generally obtained in locomotion, and in occasionally administering small amounts of some diffusible stimulant or warm carminative, camphor and the compound spirit of ether being specially applicable. In the intervals fresh air, attention to dietetic rules, the free evacuation of the bowels without purging, and light nervine bitters, will be found useful. T. Shapter.

PRÆCORDIAL PAIN. — Synon.: Heartburn; Fr. *Cardialgie*; Ger. *Magenschmerz*.

Definition.—Pain referred to the region of, but not originating in, the heart; not paroxysmal, but occasionally recurrent.

Ætiology.—Præcordial pain has its origin mainly in morbid sensibility of the intercostal and pneumogastric nerves, and secondarily in the nerves of the brachial plexus and the cerebro-spinal nerves supplying the front of the thorax. The *immediate* cause of this affection is an abnormal and morbid sensibility of the several nerves implicated. It has its *predisposing* cause more often than otherwise in an ill-directed and low mental condition, and where healthy physical exertion is neglected, malnutrition, the hysterical temperament, the broken constitution of the gouty and rheumatic, and low forms of dyspepsia largely predispose to it.

Description.—Spasmodic præcordial pain may vary from a slight uneasiness to an intense anguish. It notably differs in character; it may be sharp and lancinating, dull and heavy, twisting, or grinding. Its seat may be defined, or it may be diffused over a large surface. It is met with mainly in persons of a nervous temperament, in the gouty and dyspeptic, in the course of certain of the blood-diseases, and as an accompaniment of special female disorders. A common seat of this pain is the left fourth intercostal space below, or, rather, outside, the line of the nipple. The patient associates it with the heart; and yet describes it as not so deeply seated, nor in any respect influenced by its action—having no rhythmical exacerbations; generally it is confined to this spot, but may be diffused over the chest. A severe form of this pain, though for the most part confined to the outer region of the heart, often extends from the præcordia to the left shoulder, the neck, and the stomach; sometimes, though rarely, to the arms. These several forms of pain have analogies with each other, their differences being mainly in seat, in intensity, and in their complications with other disorders; they are irregularly remittent; they do not partake of the nature of cramp or spasmodic constriction; and apparently they have little or no influence on the heart's action, or on that of the respiratory organs. For the most part, though their manifestation may be severe, and therefore alarming to the patient, they do not, simply and unassociated, indicate the presence of disease of a fatal tendency. They are to be esteemed as capable of alleviation, and generally of cure. If there be danger, it is chiefly due to complications with organic disease of the heart, or other contiguous organs; they partake of the nature, and obey the laws, indications, and phenomena, of ordinary nerve-pains, such as tic-douloureux, or those of sciatica or lumbago.

Treatment.—The treatment of these affections requires that their origin, seat, intensity, persistency, and complications should be well considered; each being a measure of disorder, and a guide to the means of alleviation. The severe form of pain, whether persistent or recurrent, which appears to have its seat mainly in the branches of the vagus nerve, is essentially due to malnutrition, and of a low dyspeptic origin, marked by flatulence and acidity, and requires, with well-regulated diet and exercise, very careful medical management. The indications for the most part are to correct the acid or gouty diathesis. Alkalis and the alkaline mineral waters, light bitter infusions, and warm alterative aperients, are often most useful in these cases. The intercostal pain is somewhat persistent and difficult of alleviation, and requires, besides attention to the morbid states with which it may be associated, whether these be the hysterical, the dyspeptic, the plethoric, the hypochondriacal, or the emaciation and weakness of exhausting diseases, strict regulation of diet and exercise, with residence in a pure air. The pains originating in disordered conditions of the blood usually find relief in the treatment laid down for their alleviation. T. Shapter.

PRÆSYSTOLIC.—A term implying antecedence to the ventricular systole, and used in connexion with a cardiac murmur or thrill occurring during this period of the cardiac revolution. *See* Heart, Valves and Orifices of, Diseases of; and Physical Examination.

PREBLAU, in Carinthia, Austria.—Acidulated alkaline waters. *See* Mineral Waters.

PREDISPOSITION TO DISEASE.

Definition.—That state of the body which renders it peculiarly liable to be affected injuriously by a morbific agent; determining in the case of a 'non-specific' agent the particular disease which it shall induce in each of several individuals similarly exposed to it; whilst, in the case of a 'specific' agent or 'morbid poison,' it determines the relative liability of several individuals, similarly exposed to it, to become the subjects of the particular disease it is capable of originating, and also influences the severity of the attack.

Thus, of several persons equally exposed to severe cold, which, by chilling the general surface, produces contraction of the cutaneous capillaries and consequent internal congestion, some shall not suffer seriously in any way; but one shall be attacked by bronchitis, another by pneumonia, another by apoplexy, another by gastro-intestinal disturbance, another by nephritis, another by gout, and so on, according to the part of the body which the congestion most affects in each individual.

Again, of several individuals equally exposed to the poison of cholera, some shall escape altogether, whilst others shall be attacked by choleraic disease: and of the latter, some may suffer only from diarrhœa; in others nothing more may be induced than vomiting, cramps, and rice-water evacuations; whilst in others the disease may develop itself in its full intensity, and rapidly proceed to a fatal termination.

Predisposition may be either *congenital* or *acquired*; and in the former case—unless induced by malformation, or by causes acting through the maternal system during pregnancy—it is usually *hereditary*.

Hereditary predisposition to disease seems to follow the same modified laws of heredity as the transmission of *family* peculiarities. These do not imply the same duration or universality in the action of the causes which have evolved them as do the characters of species and race; and consequently, whilst tending to perpetuation if the parentage on both sides be limited to such as participate in them, they tend on the other hand to die out by free interbreeding. Still, we often see a family feature, or some other physical or mental peculiarity, 'cropping up' after a dormancy of several generations; thus clearly evidencing the transmission of a potency, which manifests itself whenever some deficient condition has been supplied. So there are certain constitutional states or *diatheses*, which particular abnormal habits of life tend to induce, when their operation continues with cumulative force through successive generations. These, when fully established, so penetrate the entire organism, that perhaps no one process goes on exactly as it would in perfect health. And, when they have once firmly rooted themselves in it, they tend to propagate themselves hereditarily like family characters, even when the original factors have ceased to act, but still more when they continue in operation. Of this we have a conspicuous instance in the hereditary transmission of goître, and its gradual aggravation into cretinism, among the inhabitants of those Alpine valleys in which a close stagnant atmosphere, privation of sunlight, bad ventilation of dwellings, filthy personal habits, and some other local conditions not yet understood, have concurred, through a long succession of generations, to engender the constitutional state which expresses itself in these forms of disease.

So, the fullest evolution of the gouty, the scrofulous, or the cancerous diathesis may require the continued action of their factors for several successive generations; it may be interfered with by the introduction of normal factors by intermarriage; and during its progress the manifestation of these diatheses may be so trivial as to attract but little notice. But when either of them has been fully established by the sufficiently prolonged action of its causes, its hereditary transmission, like that of family peculiarities, becomes the rule rather than the exception, save in so far as it is modified by interbreeding. And even where it seems to have died out, never showing itself in the spontaneous production of any its characteristic forms of disease, it shall modify the course of almost any other malady, or complicate the results of some accidental injury. Where both parents are the subjects of the same well-marked diathesis, the transmission of it to the offspring is almost a certainty; and the manifestation of it is likely to be yet more marked, if the parents inherit also the same *family* idiosyncrasies.[1]

Although the predisposition to *insanity* is often undoubtedly hereditary, it does not seem to partake of the constitutional nature of a diathesis, except where it depends on the existence of one of the definite forms of malnutrition already specified. The fact seems to be that the nervous system is so peculiarly liable to be shaped and modified by the mode in which it is habitually called into exercise, that it takes-on a particular *abnormal* form of activity far more readily than any other organ; and thus, when a special form of malnutrition has once established itself, this may be transmitted to the offspring without the prolonged action of its special factor through many successive generations. We see this particularly in the effect of habitual alcoholic excess, which not only produces a tendency to insanity in the subject of it, but also engenders in the offspring (especially when *both* parents are drunkards) a disordered state of brain-nutrition, which may express itself in idiocy, epilepsy, alcoholic craving, mental instability, weakness of will, uncontrollable hysteria and the like, as well as in insanity. And the same may be said of abnormal moral habits, which, when they have fixed themselves in the cerebral organism, tend to reproduce themselves in succeeding generations; as we see illustrated in a very striking manner in hereditary kleptomania.

But of all these acquired forms of disordered *neurosis* it may be said that, as it is the peculiarity of the nervous system rapidly to grow to the mode in which it is habitually exercised, so there is less tendency to the hereditary perpetuation of such disorder than where it depends upon an established diathesis, provided that the right methods of physical and moral invigoration are employed for the restoration of the normal activity of the brain.

Although it can scarcely be doubted that various other acquired predispositions tend to reproduce themselves in the offspring, there are none which do so with any approach to the constancy and definiteness which are exhibited by those which have become 'constitutional'; and they may, therefore, be dismissed without special notice.

Among the diseases produced by the action of specific poisons, there are some to which the hereditary predisposition must be said to be *universal*; the cases in which these poisons are imbibed for the first time without producing their characteristic effects being quite exceptional. In this category are to be ranked the exanthemata, and probably syphilis. Dismissing the latter as limited in its propagation by the speciality of its mode of transmission, we recognise the universality of the predisposition to the former in the extraordinary manner in which any exanthem introduced into a community, whose isolation had prevented its invasion for a long previous interval, spreads through a whole population.[1]

But the original liability to any of the exanthemata appears, as a rule, to be extinguished by one attack of it; the cases being exceptional in which the poison develops itself a second time in the body of anyone who has once *fully* exhibited its characteristic effects. And the liability is greatly diminished, and the severity of the second attack usually much mitigated, even when the first action has been incomplete—as is often seen in epidemics of measles and scarlatina. This seems the *rationale* of the 'protection' afforded by vaccination against small-pox; there being (in the writer's opinion) no reasonable doubt that the vaccine virus is nothing else than small-pox poison modified by transmission through the cow, and that the protective influence of vaccinia is thus of the same *kind* as that exerted by a first attack of variola, though perhaps rather lower (unless re-vaccination has been practised) in *degree*.

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[1] The worst case of this kind that the writer ever saw or heard of, was where the parents were first cousins—children of two brothers who were both gouty, and who belonged to a family noted for the strong personal and mental resemblance of its members.

[1] Thus, in 1846, the poison of measles having been conveyed to the Faroe Islands, where it had been unknown for sixty-five years, the disease rapidly spread among their inhabitants, affecting old and young alike; more than 6,000 persons out of a total of 7,782 were attacked by it in the course of six months; and scarcely any escaped, save the few aged persons who had been affected when young in the previous epidemic, and the inhabitants of one of the smaller islands, who kept up a rigid quarantine. The Icelandic records (which have been well kept for many centuries) show a similar prevalence of any exanthem that has been introduced after a long interval. Thus in 1707, out of a total population of about 65,000, no fewer than 16,000 (or nearly one-fourth) *died* in an epidemic of small-pox; so that it can scarcely be doubted that, as in the previous case, almost every individual exposed to the poison must have been *attacked* by the disease, unless he had previously been the subject of it. Thirty-four years had elapsed since the disease had been last known in the island; and many persons who had had it before, took it a second time.

Much light has during recent years been thrown on this subject by parallel researches in epizoötic diseases; for it has been found that the poisons of splenic fever and fowl-cholera can be modified in like manner by 'cultivation'; and that the inoculation of these modified poisons produces in the subjects of it very mild forms of those diseases, which serve as a protection against their malignant attacks. And it may now be laid down with tolerable certainty (1) that the blood of an individual who has been the subject of any of those specific diseases which usually occur only once in life, is so altered (whether by addition or subtraction), that it is no longer liable to be acted on by the same poison; and (2) that this alteration may be produced, and 'protection' imparted to the subject of it, by even a greatly mitigated form of the disease, such as may be induced by the introduction of artificially modified poison. It may not, Sir Joseph Lister thinks, be too sanguine an anticipation, that means may ere long be found for so tempering the poisons of measles and scarlatina, as to make an innocuous 'vaccination' afford a similar protection against their worst effects.[1] *See* IMMUNITY.

Acquired predisposition.—Any habitual infraction of the laws of health will induce a *general* liability to disease, by producing a depressed condition of the vital activity, whereby the organism is rendered less capable of resisting the influence of morbific agents. But this infraction may be of a kind which induces a liability to some particular disease; as when the habit of rapidly eating a large meal tends to injure the digestive power; or the habit of living in over-heated rooms predisposes to bronchial and pulmonary attacks.[2]

It is, however, in determining the invasion and epidemic spread of diseases that depend upon the zymosis set up in the blood by the introduction of certain specific poisons, that the effect of 'acquired predisposition' is most distinctly seen, and can be most definitely expressed. During the severest visitation of cholera or diphtheria, for example, the number attacked is really small in comparison with the entire population; and while, of those who escape, the great mass may be assumed not to have been exposed to the action of the poison at all, yet it is unquestionable that a large proportion of those who are as fully exposed as those attacked by the disease, do not become the subjects of it. A medical practitioner, again, may unconsciously carry about with him a septicæmic contagium, which is innocuous, not only to himself, but to a large proportion of the persons with whom he comes into contact; and yet it may take fatal effect upon certain individuals, who, nevertheless, have received no stronger dose of the poison than the rest. Further, it is not infrequently seen that the practitioner or nurse who long seems completely 'proof' against any attack of the epidemic malady to which he (or she) is ministering, at last succumbs to it. It is clear, in these and similar cases, that there must be some 'predisposing condition' not supplied by the normal human body, which determines the zymotic action of the *materies morbi* in the individuals who manifest its effects.

Such 'predispositions' have been recognised and specified by all who, at various times, have scientifically studied the ætiology of epidemics; and it has been universally noted that unwholesome food, bad water, and foul air have exerted a singular potency in favouring the action of the poison on individuals and communities. The advocates of the 'germ theory' and of the 'chemical theory' of zymotic poisons are at one in regard to this fact—that the presence of nitrogenous matter, in a decomposing or readily decomposable state, affords the best possible pabulum, either for the development of bacillar organisms, or for the action of ferments. And, building on this foundation, the writer long since[1] came to the conclusion, that the common condition which all those agencies tend to produce, which experience has shown to be specially favourable to the development of zymotic disease, is this: The presence, in the blood of the individual attacked, of an excess of those decomposing effete matters, with which the circulating current is normally charged to a limited amount, during their passage from the parts of the body in which they are poured into it, to the excretory organs by which they are eliminated and cast forth. If the amount of these matters be limited to that which is being continually generated in the ordinary waste of the body, and if the great emunctories (the lungs, the liver, the intestinal glandulæ, the kidneys, and the skin) all do their proper work, the products of that waste are drawn off from the blood-current as fast as they are poured into it, so that the stream is kept pure. But if, on the one hand, such decomposing matters be either abnormally introduced from without, or be generated in abnormal amount within the body; or if, on the other hand, the normal process of elimination be in any way obstructed; or if, still more, an abnormal excess of the one process concurs with deficient activity of the other, a rapid accumulation of these matters takes place in the blood; and this, by providing the pabulum requisite for the development of the poison, supplies the very condition necessary for its morbific activity.

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[1] See his address 'On the Relation of Micro-organisms to Disease,' in *Quart. Journ. of Microscopic Science*, April 1881.

[2] The writer was informed by Mr. Gulliver, when surgeon in the Life Guards, that the young powerful men of his regiment, mostly sons of Yorkshire farmers, suffered greatly from bronchitis and pneumonia; in consequence, he believed, of their liability to become chilled on going out into cold air, after being shut up for many hours a day in stables unduly heated for the purpose of imparting sleekness to the coats of the horses. The animals themselves suffered in like manner.

[1] See his Paper on 'The Predisposing Causes of Epidemics,' in the *Brit. and For. Med. Chir. Review*, vol. xi. (1853), p. 159.

Of the effectiveness of the introduction of putrescent organic matter, either in food, water, or air, the cholera epidemic of 1848–9 afforded instances so glaring that they here need only to be adverted to.

Of the even more marked potency of the excessive generation of effete matter within the body, we have a typical example in the extraordinary proclivity of the *puerperal female* to suffer from the action of any septic poison to which she may be exposed.[1] Nothing can be plainer to the physiologist, than that the return of the uterus, after parturition, to its non-pregnant condition, involves a rapid 'waste' of its muscular substance, the products of which will be poured into the blood-current far more rapidly than they can be eliminated; this state continuing until the process is completed. The like condition exists in subjects of severe injuries, and of operations; and not only do these exhibit a special proclivity to the action of specific poisons like scarlatina (the disease only then declaring itself, although its germs must have been previously received and lain dormant),[2] but they show a peculiar liability to suffer from the ordinary septic poisons which have no effect upon the healthy carriers of them, erysipelas and adynamic surgical fever' being thus communicable.[3]

Excessive exertion, again, whether bodily or mental (such excess being marked by the feeling of fatigue), has always ranked among the most potent of predisposing causes; and its action is clearly traceable to the same source, the abnormally rapid 'waste' of the tissues whereby the blood-current becomes unduly charged with the products of their disintegration.[1]

Ample evidence is afforded by army experience of the special liability of soldiers to zymotic disease, when on long and fatiguing marches; and this especially in hot climates, where, the activity of the respiratory process being reduced by the high external temperature, the products of the waste tend to accumulate in the blood-current.

Of the predisposition induced by the accumulation of effete matter consequent upon obstructed elimination, none is more marked than that which results from overcrowding. The effect of defective air-supply is not only to reduce the quantity of carbonic acid got rid of by expiration, but also (which is probably of yet greater importance in relation to zymotic disease) to diminish the normal oxidation of those nitrogenous effete matters, of which (when thus metamorphosed) it is the special business of the kidneys and skin to get rid. The accumulation of these within the body speedily makes itself manifest in the offensiveness of the halitus of the breath (the condensation of which shows the presence of fœtid matter) and of the cutaneous transpiration; and thus, although there may be no introduction of decomposing matter into the body, or specially rapid internal production of it, the blood-current becomes as effectually charged with the pabulum of the zymotic poison as if this had been injected into it.[2]

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[1] This proclivity was never more strikingly displayed than in the former experience of the Vienna Lying-in Hospital, where a comparison of the mortality in the two sides of the institution, one attended by midwives, and the other by medical students, showed that an annual average of from 400 to 500 deaths out of 3,000 deliveries was distinctly traceable to the unclean habits of the latter, who were accustomed to come into the wards fresh from the dead-house. The enforcement of proper precautions soon lowered this excessive mortality to the standard of the other side.

[2] Sir James Paget, in *Brit. Med. Journ.*, 1864, vol. ii. p. 237.

[3] Sir James Simpson, in *Edinb. Monthly Journ.*, vols xi. and xiii.

[1] It is within the experience of everyone, that the sense of fatigue bears no constant proportion to the amount of exertion put forth; and that whilst, on the one hand, any obstruction to the eliminating processes (as by bad ventilation of the sleeping apartment) prevents its removal by rest, an unusually severe and prolonged strain may be sustained without its induction when the excretory apparatus is stimulated to increased activity, as in 'training.' And there is strong reason, therefore, for regarding this feeling as indicative of the degree in which the blood is charged with the products of nervo-muscular waste.

[2] Thus it has come about, that, while the average mortality of European troops in India under favourable circumstances does not exceed 30 per 1,000, it has been raised at particular stations through a long succession of years—solely by overcrowding in ill-ventilated barracks—to 75 or even 100 in the 1,000; whilst in certain Indian gaols, in which the air-space was actually at one time less than 100 cubic feet per prisoner, the mortality rose to an annual average of *one in four*.

A most remarkable instance of the combined action of the two last-named predisposing causes, resulting in the *double*-charging of the blood with the pabulum most suited to the development of zymotic poison, was furnished by the terrible outbreak of cholera, which carried off *one-eighth* of the troops stationed at Kurrachee in 1846; no fewer than 464 deaths having then occurred out of a total strength of 3,746. Some of the troops (*a*) had recently come off a long and fatiguing march, but were well accommodated in airy barracks; and their loss was at the rate of 96·6 per thousand. In another regiment (*b*), which had not been on the march, but was overcrowded in small ill-ventilated tents, the

The strong predisposition to zymotic disease induced by intemperance, which has been no less conspicuously manifested in the experience of our Indian army, seems clearly traceable to the same source. For the habitual presence of alcohol in the blood-current undoubtedly diminishes the oxidation of the waste-products, and thus occasions their accumulation in the system; and this at a greater rate in hot climates than in cold, on account of the already reduced activity of the respiratory process in the former. Where, again, the rate of waste is abnormally increased—as on the march of troops—the evil influence of alcoholic liquors is still more strongly manifested; and this will be again aggravated by overcrowding in tents or barracks.[1]

On the connexion between famine and pestilence it is unnecessary to enlarge; but it affords the keystone of our cumulative argument. For in whatever way it is to be accounted for, the fact is certain, that a state of general blood-contamination is produced by the accumulation of non-eliminated products of waste. In the Irish famine of 1847, the fœtid secretions from the skin, the rapid supervention of general putrescence after death and its manifestation even previously, and the frequent termination of life by colliquative diarrhœa, all evidenced the peculiar fitness of the body so conditioned for the development of a zymotic poison.

And thus we seem furnished with a scientific *rationale* for all that experience has taught as to the conditions of the spread of zymotic disease; which, by giving greater definiteness and consistency to medical doctrine, will afford a surer and more positive basis for preventive hygiene, both public and individual.

But whilst it is specially in establishing a predisposition to zymotic disease, and in aggravating the severity of its attacks, that the contamination of the blood-current by the accumulation of waste-products most strikingly manifests itself, there can be no doubt that it lowers the healthy vigour of the body generally, and thus renders it more ready to be affected by any disease to which it may be constitutionally liable. Where any form of malnutrition exists—whether resulting from imperfect performance of the primary digestive processes, producing ill-made blood, or from imperfect conversion of blood into tissue—there must be premature degeneration and augmented 'waste'; and the rate of this augmentation must tend to increase, if special attention be not given to the eliminating processes. Here we have the *rationale* of the fundamental importance of pure fresh air, as cool as it can be borne, to the scrofulous subject; and of the remarkable cures sometimes effected in patients in whose lungs tubercular deposit has already commenced, by the hazardous discipline of a hardy outdoor life. When any serious malady has once established itself, the degeneration of tissue, as shown in the rapid wasting of the body, takes place with augmented rapidity; and the necessity for the removal of its products is proportionately urgent. And this is not the less important when the progress of the disease is stayed; for the purification of the blood from the contamination it has received is absolutely essential to the establishment of those recuperative processes on which the final issue depends. Of the due elimination of the waste-products, their oxidation is the first and most fundamentally important act; and of the direful consequences of past ignorance and neglect of this principle—evinced on a large scale in the overcrowding and bad ventilation of hospitals, poorhouses, and gaols—their records too surely tell. Even now our practice is far from perfect in this particular; and it is scarcely going too far to affirm that, not only the public, but the medical profession, have still much to learn as to the importance of an ample supply of pure air, both for the prevention and the cure of disease.[1]

William B. Carpenter.

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rate was 108·6 per thousand. And in a third (*c*), which had made the march like *a*, and were overcrowded like *b*, the mortality was 218 per thousand, or at a rate actually exceeding their high rates added together.

[1] Of this, Dr. Parkes's experience as assistant-surgeon to the 84th Regiment in India, afforded a striking illustration. A large proportion of the men of this regiment were total abstainers, and the remainder were very temperate. During the year 1846–47 it was quartered for eight months in the healthy barracks of Fort St. George, Madras; it then performed a march of between 400 and 500 miles to Secunderabad, in a very wet and unhealthy season, through a country infested with fever and cholera; and the remaining two months were spent in overcrowded barracks at Secunderabad. Yet the mortality during that year was only 13 in an average strength of 1,072, or at the rate of 12·1 per 1,000. Continuing during the next year in the same overcrowded barracks, its loss was raised to 34·9 per 1,000; but this was *less than half* the average mortality of the troops quartered in the same barracks for fifteen years past. The 63rd Regiment, with which they had exchanged, though not specially noted for intemperance, had there lost 73 men in the first nine months of the previous year, or at the annual rate of 78·8 per 1,000; and, having then marched to Madras to take the place of the 84th, had so many sick when the two regiments met on the road, as to be forced to borrow the 84th's dhoolies.

[1] The peculiar susceptibility of the nervous system of children often affords a most striking *test* of atmospheric impurity that might otherwise pass unheeded. In the last century, *trismus nascentium* (a disease now rarely seen) was one of the principal factors of the very high rate of infantile mortality which then prevailed. This disease continued to be very fatal in the Lying-in Hospitals of Dublin, after it had almost disappeared from those of London; and it was mainly by the attention to their ventilation enforced by Dr. Joseph Clarke,

PREGNANCY, Diseases and Disorders of.—SYNON.: Fr. *Maladies et Troubles de la Grossesse*; Ger. *Krankheiten und Storungen der Schwangerschafts.*

Under this heading are included all those complaints which arise from the pregnant state, or which, occurring during gestation, are so modified, or exercise such an influence over it, as to require special treatment. The subjects of false pregnancy and concealed pregnancy will also be noticed. The principal conditions which demand consideration in this article are therefore the following: (1) Vomiting and other sympathetic or reflex disorders of early pregnancy; (2) Certain diseases specially liable to eventuate in abortion; (3) Ptyalism; (4) Displacements of the Gravid Uterus; (5) Embolism; (6) Extra-uterine Pregnancy; (7) Pruritus of the Pudendum; (8) Œdema of the Labia and Lower Extremities; (9) Œdema of the Upper Extremities; (10) Hæmorrhoids; (11) Dropsy of the Amnion; (12) Cramps; (13) Eclampsia; (14) False, and (15) Concealed Pregnancy. *See also* FŒTUS, Diseases of.

The foregoing list of the principal diseases of pregnancy might be much extended if we were to include mastodynia and mastitis, jaundice, constipation, diarrhœa, cardialgia, headache, insomnia, palpitation and hypertrophy of the heart, rheumatism, inflammation of the uterus, pudendal hæmatocele, &c. To these and most other diseases pregnant women are liable; but not being peculiar to pregnancy, or essentially modified thereby, they require no notice in this place.

It would also be beyond the scope of this article to refer to all those anomalous sympathetic disturbances of the nervous system, such as longings, morbid or depraved appetite, hysterical excitability, nervous pains, odontalgia, &c., that sometimes attend gestation, and which, unless excessive, may be regarded as symptoms, and not included amongst the diseases of pregnancy.

1. Vomiting.—The most common complaint of early pregnancy is morning sickness, or nausea and retching, usually confined to the forenoon, and continuing from the third week after conception until the period of quickening.

The sickness of pregnancy is generally attended by no loss of appetite or impairment of health, and may thus be distinguished from vomiting caused by gastric or other diseases. In some exceptional instances, however, this complaint assumes a graver aspect; continues throughout the whole term of gestation; harasses the patient by continual retching; and, as occurred in one case which came under the notice of the writer, may even cause death from exhaustion.

ÆTIOLOGY.—Morning sickness has been referred by different authorities to fulness of the vessels of the uterus; to tension affecting the nerves of the uterus, especially those which arise from the sympathetici maximi and communicate with the plexus at the mouth of the stomach; to displacements of the uterus, and to the compression undergone by the uterine tissues, markedly by the nervous fibres at the seat of the flexion.

TREATMENT.—The treatment of this complaint depends on the period of pregnancy, the severity of the symptoms, and the constitution of the patient. In ordinary cases it may be prevented by the patient remaining in bed until the usual period for its return has passed over. Her diet should be light, and she should take as little fluid as possible, especially avoiding all warm drinks, such as tea. The bowels should be regulated by mild antacid aperients or effervescing salines. At the same time some of the so-called specifics may be ordered, such as oxalate of cerium, or salol in two-grain doses, or diluted hydrocyanic acid with infusion of calumba. It is unnecessary to refer at any length to all the remedies, too generally useless, which have been proposed for this complaint, including the dilatation of the cervix uteri, first suggested by Dubois; the hypodermic injection of morphine, chloral hydrate, carbolic acid, minute doses of ipecacuanha, and the topical application of a 4 per cent. solution of hydrochlorate of cocaine to the cervix uteri.

In some cases of excessive vomiting persisting during pregnancy and occurring in plethoric patients, six or eight ounces of blood may be taken away with advantage. If, notwithstanding this, the sickness continues, and the patient be in danger of dying from exhaustion, the propriety of inducing premature labour becomes a grave question. In no case should so serious a measure be resorted to without full deliberation and consultation. In all cases it should be deferred as long as possible, and in fixing the period for its performance regard should always be paid to the possible viability of the fœtus.

2. Diseases disposing to Abortion.—The expulsion of the fœtus before the ordinary period of viability may result from diseases or abnormalities affecting either the mother or the ovum. This subject is fully discussed in a separate article. *See* MISCARRIAGE.

3. Ptyalism.—This is an occasional complaint of early pregnancy which seldom requires any treatment. In exceptionally severe cases, salivation may be controlled by

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that the mortality of the infants born in them was reduced. The disease has continued to our own day, under precisely similar conditions, in St. Kilda, and some parts of Iceland, where *two-thirds* of all the children born have died in the first twelve days. Even in what would be accounted the well-ventilated dwellings of our own middle and higher classes, obstinate cases of spasmodic croup, recurring with the appearance of every tooth, are frequently seen, which immediately yield on the removal of the little patients to the pure air of the country or the seaside.

the application of tanno-glycerine and astringent gargles, especially chlorate of potassium in infusion of bark.

4. Displacements of the Gravid Uterus.—(*a*) *Retroversion.*—This form of displacement sometimes occurs in early pregnancy, from pressure of the enlarging womb on the neck of the bladder, which, thus prevented from completely emptying itself, becomes so distended that it gradually forces the fundus uteri downwards and backwards into the hollow of the sacrum, whilst the cervix is tilted upwards and forwards against or above the symphysis pubis. The symptoms of this occurrence are difficulty in passing water, or even complete retention of urine, with tenesmus and powerless straining to empty the bowels. At the same time a sense of weight, or fulness, and bearing-down pains in the pelvis are complained of.

Treatment.—The treatment of retroversion during pregnancy must be prompt, as, if it be complete, it not only occasions considerable suffering to the patient, but also certainly ends in the premature expulsion of the fœtus when not rectified. In cases of slight retroversion, the displacement may be remedied by emptying the distended bladder with the catheter, then replacing and subsequently supporting the uterus with either a Hodge's or other suitable pessary, and keeping the patient lying on her face for a few days. In complete retroversion this becomes a matter of considerable difficulty. The patient should be placed on her hands and knees; the bladder emptied; and the fundus pushed up from the rectum by a couple of fingers of one hand, whilst with the other hand the cervix is pulled down. A well-bent pessary should be passed up into the posterior *cul-de-sac* of the vagina, and the recumbent position maintained for some time.

(*b*) *Anteversion and Anteflexion.*—Anteversion and anteflexion, to such an extent at least as to give rise to any urgent symptoms and to call for active treatment, are very exceptional complaints during pregnancy. In such cases, however, the patient complains of bearing-down pelvic pains, and on examination the os uteri will be found in the posterior *cul-de-sac* of the vagina, looking towards the sacrum, the fundus uteri pressing on the neck of the bladder, and thus occasioning at first incontinence of urine, which, as the displacement increases, changes to difficulty in micturition or complete retention. In anteversion, abortion is said to occur at an earlier period than in retroversion.

Treatment.—The treatment consists in placing the patient on her back; mechanically reducing the displacement; and applying a suitable pessary.

5. Embolism.—We occasionally, though fortunately rarely, meet with cases of sudden death during pregnancy which cannot be accounted for by cardiac disease, aneurysm, or accident. In the pregnant state, the blood being overcharged with fibrin, a strong predisposition to the formation of a fibrinous clot or thrombus exists, and this is increased by any circumstance that depresses the circulation, such, for instance, as the fainting that frequently attends quickening. Thus a thrombus may be formed which, by becoming impacted in the pulmonary artery or elsewhere, at any subsequent period of gestation, may block the current of the circulation and so cause sudden death.

There are no symptoms by which a thrombus can be recognised, until its presence is discovered after death. Hence the only lesson we can learn from the history of such cases is the necessity of attention during gestation—firstly, to the diminution as far as possible, by dietetic and other means, of the existing hyperfibrination of the blood; and secondly, to the prevention during that period of the occurrence of any undue depression of the circulation.

6. Extra-Uterine or Ectopic Gestation.—The development of a fertilised ovum elsewhere than within the uterine cavity, albeit comparatively infrequent, is the most important of the pathological possibilities connected with pregnancy. The ovum may be diverted from, or arrested at any point of, its physiological course from the ovary to the uterus, and nevertheless maintain vitality and continue to grow in its abnormal situation, which in the great majority of such cases will be found in either of the Fallopian tubes. Besides tubal gestations, however, other forms of ectopic pregnancies are possible, and in rarer instances the situation of the misplaced ovum-cyst has been abdominal or intra-peritoneal, in others ovarian, and in others again its location has been tubo-uterine or interstitial.

Ætiology. — Until within the last few years little was known with any certainty on this subject. Judging from the general history of cases of this kind, ectopic pregnancy is as a rule consequent on previous puerperal or pelvic inflammation, by the extension of which to the Fallopian tubes their integrity, functional and structural, is impaired or destroyed. For, inasmuch as impregnation does not normally take place in either the ovary or the Fallopian tube, but within the uterus itself, its occurrence elsewhere is probably most generally due to denudation of that ciliated epithelium lining the tubes, the chief function of which under normal circumstances is to prevent the entrance therein of spermatozoa. 'If,' says Mr. Tait, 'there has been a destruction of the ciliated layer, which is not reproduced, then we have the possibility, in the first place, of a spermatozoon entering the tube, and, still more important pathologically and clinically, after impregnation, the ovum may become attached to the walls of the tube as it normally is to the uterus.'

SYMPTOMS AND DIAGNOSIS.—Ectopic gestation is liable to be confounded with the following conditions, namely—normal pregnancy, more especially when complicated by ovarian prolapse into Douglas's space; pelvic hæmatocele or abscess, uterine fibroid, or fibro-cystic tumours similarly situated; and retro-displacements of the gravid uterus before the fourth month. In the commencement of an ectopic gestation there is absolutely no possibility of discriminating between it and normal impregnation.

The diagnosis of this condition must in the first instance rest mainly on the clinical history of each case. Extra-uterine gestation seldom occurs in primiparæ, and most frequently happens in second or third pregnancies after a long interval of sterility. The ordinary symptoms of early pregnancy are then generally well marked, with possibly one exception, as menstruation may either be suppressed in these cases as in normal pregnancy, or else, and more usually, there may be periodic hæmorrhagic discharge *per vaginam*. But, almost from the commencement, the patient complains of some localised abdominal or pelvic pain, with occasional exacerbations of a severe colicky character, together with a distressing sense of fulness, soon traceable to a distinct and increasing tumefaction, generally retro-uterine, and discoverable on rectal examination. Under such circumstances, even at a comparatively early period, we may suspect ectopic gestation. This suspicion must now, if possible, be made a certainty, or disproved, by a carefully conducted conjoint recto-vaginal and bi-manual examination. In this way, without resorting to the use of the sound, which is contra-indicated and would be unjustifiable, the physical condition of the uterus, its appendages, and the surrounding parts, can be ascertained. If the pregnancy be tubal, although the uterus will generally in such cases be found hypertrophied and almost as large as in normal gestation, the os will be soft and patulous. Behind, or to either side of, the posterior uterine wall may be discovered in Douglas's space a well-defined globular, firm, elastic, or semi-fluid tumour, which if re-examined after a few days will be found to have rapidly developed in size; and which, if once felt, can hardly be confounded with anything else likely to be met with in that situation.

The consideration of the remarkable series of developmental changes by which the vitality of the erratic ovum may be maintained in these cases would be entirely beyond the scope of the present article. What chiefly concerns the practitioner is the ordinary course and result of an ectopic gestation. On this point it is sufficient to say that in the most frequent, namely, the tubal, form of extra-uterine pregnancy, the case, if left to its own course, will probably terminate at about the third month, or earlier, by the rupture of the distended tube. This accident is generally unmistakably evinced by sudden collapse, following intense pain in the Fallopian region, and will in most cases eventuate in speedy death from intra-peritoneal hæmorrhage. Should this not take place, however, we can confirm the diagnosis by vaginal examination, on which the firm elastic tumour previously existing in Douglas's space will commonly be found replaced by a soft boggy tumefaction filling the pelvic fossa, and pushing the uterus forwards and upwards. Such is the general course of such cases. To this general rule there are, however, several exceptions of great practical importance. In the first place, it is possible, though not probable, that the ectopic ovum-sac may remain unruptured for a sufficient time to admit of the development of a viable child therein. Secondly, when rupture of an early ectopic gestation-cyst occurs into the broad ligament, the consequent hæmorrhage may become arrested without any surgical interposition, the effusion in these exceptional cases being of no greater moment than an ordinary hæmatocele, and leaving the patient with as good a chance of recovery as in any other form of pelvic hæmatocele. Thirdly, the escaped fœtus may possibly maintain its vitality in a new extra-uterine situation, and be thence ultimately extracted by abdominal section. And, lastly, in many well-authenticated instances the undelivered fœtus has eventually become dried up or mummified, and thus retained for an indefinitely protracted period without giving rise to any very obvious symptoms of its presence.

TREATMENT.—Under this heading two entirely distinct questions must be considered. The first is, what course should be adopted when rupture of the sac has occurred, and when the patient, if left to nature, will probably die from intra-peritoneal hæmorrhage and shock. Under such circumstances there can be no room for hesitation in acting on the rule of practice which has been well formulated by Mr. Tait: 'Open the abdomen, go at once to the seat of the rupture—that is, the broad ligament—and tie it; for until you come to the ligament itself the tissue is always so rotten and friable that any attempt to arrest the bleeding in any other way cannot succeed. Then clear out the *débris* and put in a drainage-tube. Of course, amputation of the ligatured mass is a matter of necessity; nobody would ever dream of leaving such a thing to putrefy in the abdomen.'

We have, secondly, to consider in what way we can best deal with ectopic gestations which come under observation before rupture of the sac has taken place. These cases cannot be so summarily disposed of. In their management we have three courses open to us. In the first place comes the arrest, or attempted arrest, of the development of the erratic ovum, either by the topical employment of electricity as a fœticide, or by the injection into the sac of morphine with the same intention, or by the draining off of the liquor amnii by aspiration or otherwise. These are each and all strenuously advocated by various authorities. Nevertheless, they are here mentioned merely to warn the practitioner against placing any reliance on their utility in such cases. The fœtus may possibly be destroyed by any one of them, but its destruction is by no means synonymous with the arrest of the ovuline tumour, since, as the writer has seen clinically exemplified, the placenta may not only retain its vitality, but even acquire an increased or monstrous developmental activity after the death of the embryo. By the second of the methods of procedure recently recommended in the treatment of this condition—namely, immediate surgical interposition, or resort to laparotomy and removal of the erratic ovum as soon as its misplacement is discoverable—the trouble may be effectually and possibly safely disposed of. But this practice is open to the objections, that it may not only be entirely needless, for, as the late Dr. Mathews Duncan said, 'in many cases no treatment whatever is required,' but also that it eliminates any possibility of preserving the life of the child, which is a factor never to be lost sight of in any obstetric difficulty. Thirdly, there remains the conservative and wiser policy of careful and watchful expectancy, with the view of prolonging the duration of the ectopic gestation, so far as may be compatible with the safety of the mother, until a period of viability can perhaps be reached, when the child may be extracted by the now comparatively safe and successful methods of modern abdominal surgery.

In this connexion it therefore becomes a matter of practical importance to determine at what period of early gestation can a living or possibly a viable child be extracted. In a case recorded by the writer, delivery took place at four and a half months, and the child, which weighed nine ounces, lived for an hour and twenty-five minutes after birth; another, born at the same period, survived for twenty minutes; another, delivered 195 days after last menstruation, lived six hours; two children delivered at the sixth month survived twelve and twenty-four hours respectively; and one born before completion of the seventh month lived for a considerable time, or at least until the writer lost sight of the patient after the puerperal period. These were, however, merely cases of live birth at an early period of fœtal existence; but many well-authenticated cases of viability under similar circumstances have also been recorded. Amongst such is that mentioned by Capuron, of Fortinio Liceti, who appears to have come into the world after a gestation of only four months and a half, and to have remained in it to the age of eighty. M. Devergnie cites the case of Cardinal Richelieu, who is asserted to have been born at the fifth month. In a well-known Scotch case, cited by Taylor and by Beck, it was decided that a child born in the sixth month after marriage, and which survived, was legitimate. Though such instances as the foregoing, the list of which might be easily extended, of viability before the seventh month can only be regarded as exceptional cases, their possibility is a fact that cannot be wholly overlooked in considering the period at which operative interference in cases of ectopic gestation is advisable.

7. **Pruritus of the Pudendum.**—Pruritus is occasionally a distressing result of the general hyperæsthesia and congestion of the generative organs during pregnancy, and consists in intense irritation, extending over the external orifice of the vagina, labia, and clitoris. The itching occurs in paroxysms which are most troublesome at night, and in aggravated cases wear out the patient, mentally and physically, from the loss of rest and constant irritation. In most cases this may be relieved by washing the parts with tar soap; giving an effervescing saline containing bromide of sodium in full doses, together with mild aperients; and the local application of boric acid or of a solution of hydrochlorate of cocaine, either separately or in combination with menthol or with peppermint water.

8. **Œdema of the Lower Extremities.** Œdema of the lower limbs, from the pressure of the gravid uterus on the veins, is a common complaint in the later months, and seldom requires any treatment beyond rest and aperients. Nor is the dropsical tumefaction of the labia, which occurs from the same cause, more serious.

9. **Œdema of the Face and Upper Extremities.**—This is always an alarming symptom during pregnancy, very frequently foretelling uræmic convulsions, and, if attended by albuminuria, urgently demands active treatment, such as depletion by cupping over the loins, and strong saline purgatives.

In all cases and forms of dropsy during pregnancy, the urine should be frequently tested for albumin; and if this be found, the case must be treated as one of impending convulsions.

10. **Hæmorrhoids.**—At all times women are more subject to this complaint than men; and during pregnancy, owing to the pressure of the gravid uterus on the hæmorrhoidal and iliac veins, comparatively few escape either internal or external piles. As Smellie observed, 'the same method of cure may be

administered as that practised at other times, though greater caution must be used.'

11. **Dropsy of the Amnion.**—This condition is met with in some cases of abortion from vesicular or other placental disease. It also occurs from simple over-secretion of the amniotic fluid, and is then chiefly of interest as the cause of a condition to which the older writers attached great importance, namely, pendulous belly. This was regarded by Devanter and other of the older writers as the ordinary source of obliquities of the uterus, and of difficult labour. Without discussing that question, we must regard this condition as of some importance, not only from the inconvenience it occasions, and which may be palliated by a well-fitting, supporting abdominal belt, such as every pregnant woman should wear, but still more from the probability of its leading to *post-partum* hæmorrhage, from inertia of the over-distended uterus. Hence in these cases it is necessary to deviate from the ordinary rule of midwifery practice, by rupturing the membranes, the presentation being natural, as early as possible during labour.

12. **Cramps.**—Cramps in the legs, from uterine pressure on the large nerve-trunks at the brim of the pelvis, are common during the last months of pregnancy, and generally come on at night in the course of the anterior crural nerve, extending down into the calves and feet. In ordinary cases no treatment is required, unless friction over the seat of pain, and some aperient, can be so called. Where, however, as sometimes happens, the cramps become unusually severe and frequent, their recurrence may be prevented by the pressure of a bandage or elastic stocking.

13. **Eclampsia.**—This is, with one exception, the most serious complication of gestation. The true convulsions of pregnancy are *sui generis* in their nature, though they are usually, but erroneously, classified as hysterical, epileptic, or apoplectiform.

Hysterical convulsions, being nothing more than a manifestation of hysteria, accidentally affecting a woman in the early months of pregnancy, require no special treatment, nor any further notice in this connexion.

The so-called epileptiform and apoplectiform convulsions of pregnancy are identical in their character, and are influenced in their symptoms by the constitutional state of the patient and the severity of the attack, rather than by any essential difference in the nature of the disease.

SYMPTOMS.—The premonitory symptoms of convulsions are of considerable importance, as by their timely recognition, and the adoption of suitable treatment, the approaching attack may be often warded off. In the majority of cases, eclampsia is preceded by œdema of the upper extremities, face, and eyelids; pains in the lumbar region; albuminuria; and headache, vertigo, or peculiar irritability of temper.

In asthenic eclampsia, the clonic spasms commence with twitching of the muscles of the eyelids, soon increasing in violence; extend to every part of the body; and recur at irregular intervals. In anæmic patients, throughout the attack, the face may be cool and pale, the eye glistening, and the pupil contracted; but, generally, as the convulsions recur more frequently, the impeded respiration induces symptoms of venous congestion: the face becomes livid; the breathing stertorous; the pulse full and labouring; and thus the disease passes from the first into the second stage, or from the so-called 'epileptiform' into the so-called 'apoplectiform' convulsions.

In plethoric women, however, the complaint commonly assumes the apoplectic character from the first, setting in by a violent convulsion, immediately after which the patient falls into a comatose state, the convulsions meanwhile recurring at frequent but irregular intervals. After some time, under favourable circumstances, the convulsions cease, and the patient slowly regains consciousness. But, on the other hand, the coma may become more profound, the pulse more labouring, the respiration more embarrassed, and the extremities colder, until at length 'the last sad scene of all' is closed by a violent convulsion.

These convulsions, although they are more frequently observed in the latter months, may occur at any time of pregnancy, as well as during labour, and within the puerperal period.

PATHOLOGY.—The cause of eclampsia is a subject on which innumerable theories have at different times prevailed. It was formerly referred by some authorities to congestion of the brain; by others to uterine irritation acting upon the upper part of the spinal cord and medulla oblongata.

It was almost universally held up to a few years ago, and to the present time is still generally believed by a majority of obstetricians, that this disease is the result of uræmic blood-poisoning, probably consequent on nephritis, acute or chronic, for we find the convulsions of pregnancy frequently associated with dropsy, albuminuria, and a diminished excretion of urea and uric acid.

That convulsive action may be occasioned by uræmic blood-poisoning is well known in other conditions; and during pregnancy the same effect may also be produced by the pressure of the gravid uterus on the renal emulgent veins, interfering with the functions of the kidneys.

More recently, however, this view has been to some extent displaced by what is known as the 'Traube-Rosenstein theory,' the chief part of which is the assumption that the cause of puerperal convulsions consists in cerebral anæmia, consequent on serous effusion disturbing the cerebral circulation, and resulting from increased arterial tension during pregnancy. Neither the general symptoms of puerperal convulsions, nor the results of the plan of treatment which he has found most effectual in the general treatment of the disease, would seem to the present writer to support this last-mentioned theory. Still, it is a fact that in some instances puerperal convulsions occur irrespectively of any renal disease, and without the existence of albuminuria.

The influence of mental and moral impressions in causing convulsions has been remarked by all obstetricians. The fact of its being the patient's first pregnancy has also some influence; thus, of eight cases that came under the writer's notice, five were primiparæ.

Treatment.—In the treatment of the convulsions of pregnancy, whenever any of the premonitory symptoms already described, and more especially albuminuria, are observed, we should direct our efforts to the depuration of the blood, by cupping over the kidneys, and the administration of mild diuretics, saline purgatives, diaphoretics, and a milk diet. At the same time we must endeavour to allay nervous irritability by sedatives, of which in these cases the best is bromide of potassium.

During the convulsions, precautions to prevent the patient from biting her tongue, or from injuring herself in any way, should in the first instance be taken. One of the most effectual means of shortening the paroxysms is cold affusion on the head and face. In the asthenic form of eclampsia, however, this remedy should be used cautiously. In all cases of well-marked puerperal convulsions the bowels should be unloaded by calomel and jalap, or by a drop of croton oil, or by the asafœtida enema; the head should be shaved and blistered, or ice applied, and at the same time sinapisms be put on the legs.

In cases of sthenic convulsions blood-letting is the only remedy of undoubted efficacy in subduing the convulsive action. If the patient be plethoric, and her pupils be contracted, we may, as a rule, bleed. If, on the contrary, the pupils be dilated, the condition of the brain may be considered as anæmic, and blood-letting would probably be out of the question. *See* Depletion.

The amount of blood that may be taken from a plethoric woman suffering from eclampsia should be measured by the patient's condition, and the effect produced, rather than by the quantity abstracted. In hysterical convulsions, if cold affusion does not suffice, the inhalation of chloroform or ether will generally cut short the attack. But in true puerperal convulsions it requires to be used with great caution, being contraindicated whenever the circulation is depressed, or where there is any tendency to apoplectiform symptoms. In suitable cases, however, he has found chloroform serviceable in subduing the convulsions, and prolonging the intervals between them. Chloral hydrate, opium, and belladonna have also been used. As a substitute for blood-letting, the tincture of veratrum viride is employed by some American obstetricians. In the actual treatment of convulsions, time is, however, too important to be wasted in experimenting with these uncertain drugs; though in the prophylactic treatment of convulsions during pregnancy and after parturition, the writer has found small doses of belladonna beneficial in calming the nervous susceptibility so intimately connected with convulsive action.

In every case of convulsions towards the end of pregnancy, our primary object should be to deliver the patient as speedily as is consistent with her safety and that of her child.

14. False Pregnancy.—Synon.: Pseudocyesis.—This is a subject of considerable interest in an obstetric as well as a medicolegal aspect. Spurious pregnancy is of more frequent occurrence than is generally supposed; nor is it confined, as some writers assert, to sterile, hysterical, and dyspeptic elderly women of the upper classes.

Ætiology.—The great majority of cases are met with about the period of 'the turn of life,' or between the ages of forty-five and fifty. The causes of pseudocyesis, besides those before referred to, namely, change of life, dyspepsia, and hysteria, are very numerous, including ovarian disease, uterine tumours and physometra, abdominal plethora and obesity, molar pregnancy, and cystic disease of the ovum. Molar pregnancy generally terminates between the third and fourth months; but if continued beyond the latter period, the absence of the positive signs of pregnancy would show the true nature of the case.

Symptoms.—The symptoms of spurious pregnancy are occasionally so close an imitation of those of true gestation as to present great difficulties in their diagnosis. Most of the ordinary signs of pregnancy are simulated with extraordinary exactness in many cases of pseudocyesis. Thus we may have amenorrhœa, followed by irritable stomach; swelling of the mammæ; turgescence of the nipples; and rapid enlargement of the abdomen, concurring in a woman who wishes to become pregnant. In cases of pseudocyesis, the last of these symptoms may frequently be traced to an excessive deposit of fat in the omentum, or to the presence of some intraperitoneal tumour. Moreover, it may also be caused by distension of the large intestines by accumulated fæces, or, more commonly, by flatus, constituting what the poor in Ireland graphically describe as 'a windy dropsy;' or it may be due to dropsical effusion into the peritoneal cavity.

If to these symptoms be added, as is generally the case, some derangement of the patient's nervous system, we have the superstructure on which most cases of spurious pregnancy are built. As a rule, those who suffer from pseudocyesis either fear or wish to be pregnant.

Few cases are more difficult to deal with in practice than those now under consideration, and seldom is the obstetric physician more unpleasantly situated than when called in consultation to a patient who, having persuaded herself and those about her that she is pregnant, has made all the usual preparations for the expected event. Cases of this kind show the necessity for much caution in pronouncing any woman pregnant. If the physician disregard this caution, and unfortunately fall in with his patient's opinion, without sufficient examination in a case of pseudocyesis, as soon as the true state of the case becomes obvious, he will probably be made the scapegoat for that mistake, and suffer all the opprobrium of which a woman's wounded pride is capable.

Diagnosis.—The diagnosis of spurious pregnancy is always a matter of much difficulty during the first months of the disorder. But, however closely the early symptoms of pregnancy may be simulated, the positive signs of pregnancy after the fifth month cannot be counterfeited. And, even from the very first, in spurious pregnancy it may generally be ascertained, on careful inquiry, that there is something unusual in the symptoms—either some essential one is wanting, or else the symptoms which belong to one period of pregnancy manifest themselves at another, and commonly earlier, time than is natural.

The utility of auscultation as a certain means of diagnosis in these cases is, under some circumstances, doubtful. Even in the last month of gestation, the fact of the sounds of the fœtal heart and placental *souffle* not being distinguished on auscultation is no proof that the uterus may not contain a living child. Nor is the value of the positive evidence, derived from the sounds of the fœtal heart and placental *souffle*, as great as it is sometimes supposed to be. An experienced auscultator can with certainty pronounce on the existence of a living child *in utero* from the auscultatory signs present. But all medical practitioners are not experts in this special subject; and the writer has seen sufficient proof that, by those who form a diagnosis, in such cases, from the presence or absence of any one sign of pregnancy, opinions are sometimes pronounced in haste, which have to be repented at leisure.

A careful examination of the abdomen may, even at a very early period of gestation, enable us to ascertain if there be any uterine enlargement, although before the fifth month it will not enable us to distinguish between the enlargement caused by disease, and that occasioned by pregnancy. To do this, we must institute a vaginal exploration, to determine whether the conditions of the os and cervix uteri be what are usual at the corresponding period of pregnancy, and then, by conjoint or bi-manual examination, ascertain the exact condition of the uterus.

In cases of pseudocyesis where the patient, being anxious to be thought pregnant, contributes to the deception by making her abdominal muscles so tense and rigid that it becomes impossible to ascertain the size and position of the uterus, we may readily dissipate the phantom tumour, and overcome the action of the muscles, by the use of chloroform.

Treatment.—It is needless to add anything about the treatment of the cases we have been considering. Pseudocyesis is only an effect of certain morbid conditions, the recognition of which the writer has endeavoured to point out. The treatment of these causes will be found fully described in the articles on these several subjects.

15. **Concealed Pregnancy.**—Concealed pregnancy is a subject so closely allied to pseudocyesis, that a few words on it appear a suitable sequence to the foregoing observations. It becomes essential for every medical practitioner to be prepared to meet cases of concealed pregnancy and attempted abortion under various disguises, and thus be enabled to detect and frustrate such crimes. So often has the writer detected pregnancy in patients who applied for emmenagogues under the pretext of simple amenorrhœa, that he makes it a rule—especially in hospital practice, where the class of persons above referred to are more likely to be met with—not to administer any medicine of this kind until he has satisfied himself as to the true state of the case, though this should be done without any expression of a doubt that might be unfounded.

Thomas More Madden.

PREMONITORY (*præ*, before; and *moneo*, I warn).—This word is associated with symptoms which give an indication or warning of the advent or onset of certain diseases or seizures; for instance, rigors during the invasion of fever, and the various auræ preceding an epileptic fit.

PRESBYOPIA (*πρέσβυς*, an old man; and ὤψ, the eye).—Impairment of the power of accommodation of the eye, the result of progressive senile changes, in consequence of which the nearest point of distinct vision lies at more than nine inches from the eye. Distant vision may be perfect; but the eye, unaided by an appropriate convex lens, cannot see clearly objects less than nine or more inches from the eye. *See* Vision, Disorders of.

PRESSURE.—This is an important subject from several points of view, but it will only be practicable in the present article to discuss it briefly from a general aspect, without entering into details.

1. **Ætiology of Pressure.**—As one factor in the causation of various morbid conditions, pressure is not uncommonly of much consequence, and it may itself originate certain lesions.

The pressure often comes from without, of which the following illustrations afford sufficient examples. General pressure upon the chest and abdomen, preventing the movements of breathing, may lead to death from suffocation, to fractured ribs, or to other consequences. This sometimes happens, for instance, when a person is crushed in a crowd, or is buried in a fall of earth, although the head may be free. Hanging and strangulation are forms of violent pressure exercised on the windpipe and vessels in the neck. The pressure of clothing is often very injurious in connexion with the chest, especially that produced by tight stays or belts. This leads to contraction or distortion of the chest; interference with the functions of the lungs, heart, stomach, and other viscera; displacement and distortion of organs; or actual pulmonary disease. A familiar illustration of the effects of pressure is found in the development of corns and deformities of the feet, from wearing tight or badly fitting boots; and in the distortions of the feet artificially produced in Chinese women by means of systematic pressure applied in early life. In this connexion may also be mentioned the wearing of tight garters, or other forms of local constriction, which especially tend to interfere with the passage of the blood through the veins, and to develop varicose veins. Occupation may be the cause of pressure originating disease. Thus, prolonged sitting at various occupations has been supposed to set up sciatica. Direct compression upon any part of the body, by implements used in certain callings, may originate morbid conditions. For instance, pressure thus produced upon the sternum is liable to cause deformity of the chest; and when exercised upon the epigastrium, it has been supposed to account, in some instances, for the local development of cancer of the stomach. Lastly, prolonged pressure from lying in one position for a length of time not uncommonly causes localised inflammation, gangrene, and bed-sores, in persons suffering from low fevers, paralysis, emaciation, and other conditions. *See* ULCER and ULCERATION.

Pressure is often exerted by morbid conditions in the body itself, affecting other structures in their neighbourhood, and thus inducing secondarily various symptoms or lesions. It may be more or less diffused, as in the case of an effusion of fluid into a serous cavity; or concentrated upon a certain limited region or individual structure, as often happens with aneurysms and solid tumours. In this way movements are often interfered with; or more obvious effects may be produced, namely, displacement of organs and other structures; compression of tubes, canals, hollow organs, or vessels, which may lead to their complete closure; irritation and inflammation, which may end in suppuration, ulceration, or gangrene; or actual destruction or absorption of tissues. The phenomena induced will depend upon the seat of the cause of pressure, and the structures which it affects.

2. **Pressure in Diagnosis.**—Patients may be conscious of a local subjective feeling of pressure, as in the chest or epigastrium, which in some instances may be of a certain value in diagnosis; but such sensations must never be regarded as reliable. The objective effects of pressure are, however, often evident, and afford clinical signs of the greatest diagnostic value, as is frequently illustrated in cases of diseases of the chest and abdomen. Moreover, the practitioner can, by means of pressure with the fingers or hand, himself determine many points of essential significance in the investigation of numerous cases. Indeed, pressure is often an important part of palpation or manipulation, as employed in physical examination (*see* PHYSICAL EXAMINATION), and is especially useful in the following particulars: By this means we are able to determine the existence and degree of local tenderness or hyperæsthesia. Pressure also helps to reveal the presence of air or fluid in the subcutaneous cellular tissue. It is absolutely necessary for bringing out the feeling of fluctuation, degree of resistance, tension, and other sensations; while the effect of pressure in modifying certain physical conditions may be of great service in diagnosis, as is exemplified by the influence thus produced in many cases upon an accumulation of fæces in the intestines. Pressure upon arteries or veins is employed with the view of observing its effects upon the local circulation, upon particular vessels, or upon tumours and other morbid conditions; and, in the case of the arteries, to determine the compressibility and degree of tension of the pulse.

3. **Pressure in Treatment.**—In this connexion the first point to be noticed is the necessity of removing any source of external pressure which is causing mischief; and also of getting rid of internal pressure, if this is practicable. Pressure may, however, frequently be itself employed with advantage as a therapeutic agent. It may be thus used in a more or less diffused manner; or concentrated on a limited surface. It may be practised by the fingers or hand; by means of plasters, bandages, elastic supports, and similar appliances; or by special surgical

apparatus, such as the tourniquet, acupressure, the ligature, the clamp, or trusses of different forms. Pressure also constitutes one element in friction, shampooing, and massage.

As regards the objects for which pressure is employed, in the first place, it not uncommonly helps to relieve pain, which may be illustrated by the effects of manual pressure in subduing the pain of intestinal colic; the relief often afforded to certain forms of headache by applying a bandage or handkerchief tightly round the head; and the beneficial results following the fixing of more or less of one side of the chest, by means of strapping or other agents, in cases of early pleurisy, pleuritic adhesions, or pleurodynia. Local pressure may also cure certain forms of neuralgia. Again, direct compression is sometimes employed to check symptoms produced by reflex influence; thus, pressure over the ovary may put a stop to vomiting, spasmodic or convulsive movements, and other phenomena of a hysterical character. Another use of pressure is to arrest the process of inflammation, which is exemplified by the practice of strapping the testicle in the early stage of orchitis. In relation to this point, a very important object for which it is employed is to promote the absorption of morbid accumulations and products, whether originating from inflammation or other causes. Thus, it helps to get rid of air; of fluid effusions, inflammatory or dropsical; of fibrinous exudations; and of thickenings or indurations resulting from acute or chronic inflammation. Pressure is again frequently taken advantage of for its influence upon the blood-vessels. Thus it checks different forms of hæmorrhage, the kind of compression required varying with the precise form of bleeding. Elastic pressure, according to Esmarch's method, has been found of great service in preventing bleeding during operations. In connexion with arteries, direct compression is also often employed for the cure of aneurysms. As regards the veins, pressure is of essential service in preventing the injurious consequences likely to result from varicose dilatation of these vessels, and in giving them support; while it is also made use of in the cure of varicose veins, especially in connexion with certain operative procedures. In the case of the abdomen, diffused pressure or support by means of a suitable bandage or other apparatus is often of much service to counteract the ill-effects of relaxed and flabby walls. Direct pressure may also be used to excite contraction of the intestines, bladder, or uterus, under certain circumstances; and to aid in the removal of accumulations in the bowels. Lastly, pressure is made use of in preventing certain forms of displacement of organs and structures, and in attempting to cure the conditions upon which they depend, as is exemplified by the application of a truss in cases of hernia, and by some of the operations for the radical cure of this complaint.

FREDERICK T. ROBERTS.

PRETORIA, in the Transvaal.—*See* AFRICA, SOUTH.

PREVENTION OF DISEASE.—*See* PERSONAL HEALTH; and PUBLIC HEALTH.

PRIAPISM.—SYNON.: Fr. *Priapisme*; Ger. *Priapismus*; *Ruthenkrampf.*

DEFINITION.—A term generally understood to signify unduly occurring or unnaturally prolonged erection of the penis, accompanied or not, as the case may be, by inordinate sexual desire, and by more or less pain and physical and mental distress.

It is important to distinguish between mere turgescence of the organ—*false* priapism; and *true* priapism, or perfect erection. The former depends simply upon distension by blood, induced or permitted by relaxation of the walls of the blood-vessels and blood-spaces; it may be associated with comparative flaccidity, and, though uncomfortable, is rarely painful. The latter requires for its production, not only distension by blood, but a certain kind and degree of tension or contraction of the intrinsic muscular fibres of the trabeculæ and sheaths; it is characterised by manifest rigidity, and if long continued—as it may be for several days or even longer—usually gives rise to considerable suffering.

DESCRIPTION AND CAUSES.—Priapism, more or less pronounced, from time to time occurs in connexion with various morbid affections of the general system, or of particular organs. Thus it usually, though not invariably, attends erotic mental derangement. It occurs frequently in tetanus and hydrophobia; and sometimes, occasionally even to a distressing extent, during recovery from the eruptive fevers, and in gouty and diabetic subjects. It has been noted in some cases of tumour or other disease of the cerebellum and pons Varolii; and in the earlier stages, or among the first indications, of certain diseases of the spinal cord, leading on to paraplegia. An overloaded condition of the lower bowel, especially in conjunction with enlarged and irritable prostate, inflamed hæmorrhoids, distension of the bladder, stone in the bladder, phimosis, urethritis, and other conditions, may be enumerated as not infrequent local causes of troublesome, though transient, priapism, acting either by pressure on the blood-vessels, or by reflex nervous influence. It also occurs among the results of injuries of the central nervous system, as well as of the penis itself. Injuries of the spinal cord, especially in the cervical and lumbar regions, are liable to be followed by continued or recurrent priapism, or by turgescence with flaccidity. Sudden erection, with emission, not infrequently attends injury of the cervical spine. Numerous cases are on record in which, during violent coitus, or otherwise during erection, the penis itself has undergone injury; and some portions or other of the sheaths of the corpora cavernosa, with the included blood-vessels, have been ruptured, or some blood-vessels have been ruptured, the sheaths remaining entire. In such cases extravasation of blood, followed by turgescence of the corpora cavernosa, may occur; and sooner or later the most persistent, and often very painful, priapism ensues. Thus it would appear that no one definite cause or explanation of the occurrence of priapism can be specified. Indeed, the subject has not hitherto been well worked out.

Treatment.—The treatment generally must depend upon the due recognition and treatment of the condition on which the priapism depends. If of central origin, it is to this point that attention must be directed. But it not infrequently happens that the local suffering is so considerable as to demand special measures for its relief. In some cases cold applications, in others warm or hot fomentations with anodynes, have proved most efficacious. Leeching has rarely been useful. Bandaging, masturbation, and sexual congress have often been tried; but the result, as a rule, has been to increase rather than to mitigate the evil. In cases in which extravasation of blood following injury is the cause, it may be necessary to make incisions, turn out any clots, and arrest further hæmorrhage; but permanent damage to the organ usually results, sometimes after prolonged suppuration, and sometimes even after risk to life.

In some cases the administration of iodide of potassium, in others of bromide of potassium in large doses, in others again the inunction of mercurial ointment, have been followed by successful results.

Among other medicines that have seemed more or less useful in various cases may be especially mentioned chloral hydrate, lupulin, camphor, hyoscyamus, and belladonna. Opium has often exacerbated the trouble. Free purgation is beneficial in most cases.

Arthur E. Durham.

PRICKLY HEAT.—An eruption of minute pimples, which cover the skin more or less extensively, and are attended with burning heat, and a most tormenting prickly itching. The affection occurs for the most part in hot climates, and attacks principally those who are unaccustomed to extreme heat; hence it is often experienced by travellers in tropical regions. Pathologically it is an eruption attended with great irritability of the skin, and has received the designation of *lichen tropicus* from its dependence on heat of climate. *See* Lichen.

PRIMARY (*primus*, the first).—This word is either used to imply that a disease originates in an organ or structure from a local cause, such as *primary pleurisy* or *peritonitis*, or *primary attacks*; or it is associated with the first manifestation of a disease, such as the *primary sore* of syphilis, or *primary cancer*. It is also applied to the *direct* or *immediate* symptoms of a disease, as distinguished from those which may be produced *secondarily* or *remotely*.

PROCIDENTIA (*pro*, downwards; and *cado*, I fall).—A falling down of certain organs or structures from their natural position, as of the uterus, rectum, or iris. *See* Prolapsus.

PROCTITIS (πρωκτός, the anus).—Inflammation of the anus or rectum. *See* Periproctitis; and Rectum, Diseases of.

PRODROMATA (πρό, before; and δρόμος, a course).—A synonym for premonitory symptoms. *See* Premonitory.

PROGNOSIS. — *See* Disease, Prognosis of.

PROGRESSIVE MUSCULAR ATROPHY. — Synon.: Chronic Spinal Muscular Atrophy; Wasting Palsy; Amyotrophic Lateral Sclerosis; Chronic Poliomyelitis; Fr. *Atrophie Musculaire Graisseuse progressive* (Duchenne); Ger. *Muskelatrophie*; *Muskellähmung*.

Description.—Progressive muscular atrophy is characterised by slow wasting of the muscles, beginning in some particular part, usually spreading and increasing, until it is wide in extent and extreme in degree. The changes in the muscles depend upon a slow degeneration in the ganglion-cells of the anterior cornua of the spinal cord, accompanied by a degeneration in the motor nerve-fibres arising from the cells. With this degeneration of the cells and peripheral fibres there is usually also associated a similar change in the pyramidal tracts of the cord, sometimes, at least, to be traced up to the motor cortex of the brain.

Charcot has divided cases of this disease into two varieties, the so-called 'protopathic' form, in which the affection consists essentially of a primary degeneration of the motor cells of the cord, the nerve-fibres proceeding from them and the muscles; and the 'deuteropathic,' in which there is also degeneration in the pyramidal tracts, to which the affection of the spinal cells was thought to be secondary. To this second class he gave the name 'amyotrophic lateral sclerosis,' but the distinction is not valid. The pyramidal fibres always degenerate with the motor cells and at the same time. The two varieties are essentially the same disease.

Ætiology.—Males are more frequently

attacked than females in the proportion of about three to one. The disease is one of adult life, commencing as a rule between the ages of twenty-five and forty-five. Cases have been recorded in which the affection commenced as early as twelve and as late as seventy, but most juvenile atrophies are primarily muscular. An inherited neuropathic disposition is to be recognised in a small proportion of cases, but direct inheritance of the disease is very rare. All classes of society are affected, and it is doubtful whether workers with the muscles suffer with greater frequency than is accounted for by their greater exposure to certain exciting causes. Of these, one of the most important is mental distress and anxiety, an influence especially potent in females late in life. A mental shock, such as that produced by a fright, has sometimes seemed to excite it. Another distinct cause is exposure to wet and cold, which is a cause of so many chronic spinal diseases. Sometimes the exposure has been habitual; sometimes there has been a single severe exposure, immediately succeeded by neuralgic pain, either in the part which subsequently wastes, or in other regions, indicative of the deleterious influence exerted on the nervous system. Excessive use of individual muscles may cause slight wasting; it is doubtful, however, whether this influence produces general muscular atrophy. Injury to the cord is a rare cause. The commoner sequel to such an accident is disseminated myelitis, which may be manifested by muscular wasting combined with other symptoms. In a few cases, concussion has been slowly followed by typical progressive muscular atrophy, as if some perversion of the nutrition of the nerve-elements had been produced by the accident. More rarely a fall, in which a limb has been injured, has been followed by muscular atrophy commencing in that limb. Syphilis is an occasional antecedent, and no other cause may be traceable. That syphilis is not without influence in the causation of such cases is probable from its relation to other diseases, as tabes. Occasionally syphilis and neurotic heredity can both be traced. In the cases in which atrophy has followed an acute specific disease such as measles, the malady is probably a chronic neuritis. Such cases are often of the 'peroneal type,' so called from the muscles in which wasting commences. Lead poisoning may produce chronic muscular atrophy, as well as the common acute paralysis with rapid wasting. It closely resembles the ordinary form of progressive muscular atrophy in seat and features, thus differing from the acute extensor palsy. In many cases no cause for the disease can be discovered.

ANATOMICAL CHARACTERS.—The muscles are reduced in size and pale in colour. Parts may be hardly distinguishable from adjacent fat. On the other hand, the muscle may be dark as a whole, and pale streaks in it may mark the position of local degeneration. There are four well-defined microscopic changes in the fibres: (1) Simple narrowing, with little or no change in the striation. The striæ may appear to be farther apart than normal, and sometimes the fibrillary segmentation is unusually distinct. (2) Simple fatty degeneration, the transverse striation giving place to a granular appearance. The granules become larger and fewer, and ultimately distinct globules are seen scattered through the sheath. (3) So-called 'vitreous degeneration,' probably a distinct process from fatty degeneration. The sheath, in such a condition, contains only a clear material enclosing a few fatty globules and a few faint transverse striæ. (4) A longitudinal striation develops in the fibre, with which at first the transverse striation co-exists. As the latter becomes more and more faint, the fibre comes to have the appearance of a fasciculus of longitudinal connective-tissue fibres. Sometimes with this longitudinal striation the fibre presents a transverse striation much finer than normal. This change may sometimes be present alone. Fatty globules may accumulate between the fibres, with, in some cases, granules and masses of reddish-brown pigment. The nuclei are often increased, and sometimes the fibres of the interstitial tissue. The capillaries may be dilated and distended. Muscular fibres, practically unaltered, may often be seen side by side with others profoundly changed. The sheaths finally become empty and shrink, and may be scarcely distinguishable from the interstitial fibrous tissue.

There are many degenerated fibres in the peripheral nerves, conspicuous in the terminal branches to the muscles. These degenerated fibres can be traced to the anterior roots, which are diminished in size. The amount of degeneration in them corresponds to the wasting present in the muscles. The posterior roots are unaltered. The spinal cord is often softer than natural at the affected part, and the white substance of the lateral columns is grey and translucent. With the microscope the anterior cornua are seen to be much changed at the level at which the nerves to the muscles most affected are given off. Most of the large cells have disappeared, or are represented by small angular bodies. Frequently a few large cells can still be seen, but most of these have lost their processes, and are more globular than normal. The interstitial tissue is also increased.

There is distinct degeneration in the anterior root-fibres passing from the cornu through the anterior column. A few fibres may remain, but whole fasciculi appear to be replaced by fibrous tissue. There is also degeneration of fibres in the anterior commissure.

In the white columns there is usually considerable, often almost complete, degeneration of the pyramidal tracts, anterior and lateral, and the resulting sclerosis extends, in slight degree, beyond their limits. The degeneration can often be traced up through the decussation and through the medulla oblongata, and even through the pons and crus to the internal capsule. By the products of degeneration it can sometimes be traced through the white substance to the cortex. But it has also been found to cease at the crus or at the decussation.

In cases in which bulbar symptoms have been present the motor nuclei in the medulla have shown changes similar to those present in the grey matter of the cord. In other cases the changes in the nuclei have been slight; but in such cases the degeneration of the pyramids has been extreme, and no doubt involved the fibres connecting those nuclei with the cortex. The sympathetic nerves and ganglia, when examined, have shown no considerable alteration.

SYMPTOMS.—Wasting and weakness usually come on together; but in covered parts, such as the shoulder, the loss of power is frequently noticed before the wasting has been apparent. In the hand, not infrequently impairment of the power to carry out some fine action, such as writing, draws attention to the wasting.

The disease commences in the upper limb in nine-tenths of the cases, and almost as often in one arm as in the other, and in the hand as in the shoulder muscle. From the part first affected it spreads to the other muscles of the limb. In the hand, the thenar muscles and interossei are usually the first to suffer, and of the latter the abductor indicis is usually most conspicuously affected. Occasionally the disease begins in the forearm, especially in the extensor muscles; the ulnar extensors suffer most. Of the shoulder muscles, the deltoid is generally the first to waste; the supra- and infra-spinati are often affected with it; and the triceps usually suffers less and later than the biceps.

The muscles of the back are in most cases early involved in the wasting. The middle and lower parts of the trapezius suffer first, the rhomboids and erectors of the spine later. The serratus, latissimus, and pectoralis major are subsequently involved, but they may escape wholly or in part. According to the affection of the muscles connected with the scapula, the position of the bone changes. The highest part of the trapezius shows sometimes (but not always) a remarkable indisposition to waste, and it was hence termed by Duchenne the *ultimum moriens.* The muscles that extend the head on the spine often suffer in considerable degree, and a difficulty in the carriage and movement of the head is the result. The increased efforts of the weak extensors to balance the head on the spine, under such conditions, often cause a synergic over-action of the frontales which are habitually associated in action with the extensors. The skin at the back of the neck lies in transverse folds when the head is put back, which the patient may be unable, as he lies in bed, to move from side to side. In striking contrast to the wasting of the neck is the condition of the platysma, which always escapes, and not uncommonly undergoes hypertrophy as if in an attempt at compensation. The muscles of respiration suffer in the majority of cases, constituting a grave source of danger to life. The intercostals rarely escape altogether, and the diaphragm is involved in many cases. The muscles of the abdominal wall occasionally waste, but far less frequently than those of the thorax.

Wasting in the legs is much less common than in the arms, and if it occurs is usually slighter in degree; but occasionally the disease first manifests itself in the legs, and is more intense there than elsewhere. The face almost always escapes the general atrophy, and its normal appearance may present a striking contrast to the rest of the body. In many cases the lips and tongue are paralysed as part of the bulbar palsy which so often accompanies the spinal disease.

As the wasting progresses, hollows and prominences, usually invisible, become manifest, and various contractions and deformities occur as a result of the unequal affection of antagonistic muscles. In the hand the usual deformity is that of the 'claw-hand,' a result of paralysis of interossei, with unantagonised action of their opponents. Lordosis is common when the trunk and thigh muscles are involved.

The electrical irritability of the affected muscles varies in character. The rule is that, in a slowly progressive case, there is diminution in the readiness and degree of response to each current, a diminution which goes on *pari passu* with the wasting, until finally, when the wasting is extreme, it becomes extinct. But the voltaic irritability of the muscular fibres very often persists long after it is impossible to elicit any response to faradism, which acts only on the nerve-fibres. Although the quality of the voltaic irritability is usually normal, the qualitative change of the 'reaction of degeneration' without the quantitative may be present, A.C.C. being evoked more readily than C.C.C. When there is very rapid and considerable paralysis a typical reaction of degeneration may be present, and between these extreme forms various intermediate conditions may be met with.

The mechanical irritability of the muscles is considerably increased, and the spontaneous flickering—the so-called 'fibrillary twitching'—in the muscles is frequent, but not invariable. It is not uncommonly observed in muscles not yet wasted, but in which atrophy subsequently occurs.

The myotatic irritability in cases in which there is 'atonic atrophy,' the muscles being flaccid and toneless, is lost, and lost early. But where there is rigidity from the first (otherwise described as 'tonic atrophy'), even when the wasting is considerable, the myotatic irritability is preserved and sometimes increased.

Beyond the vague pains already referred to, which sometimes occur in the region in which wasting of the muscles is soon after perceived, there are no sensory symptoms. 'Numbness' and 'deadness' may be occasionally complained of, but cutaneous sensibility is never impaired, nor do the muscles ever lose their sensibility.

The functions of the sympathetic are not, as a rule, impaired. Dilatation or contraction of one pupil has been observed, chiefly in connexion with atrophy of muscles that are supplied from the lower part of the cervical region. The reflex action of the iris is usually normal, and optic nerve-atrophy never occurs. Nystagmus is rare.

The visceral functions are usually little disturbed. Sexual power, indeed, is often lost, but the sphincters rarely suffer, even when the wasting is extreme. Slight, but inconstant, changes have been found in the urine. Glycosuria has been associated with bulbar symptoms, but only in a few instances.

COURSE AND COMPLICATIONS. — In most cases the malady is steadily progressive, but the rate at which it advances varies much. It may, however, become stationary; unfortunately the period at which this most frequently happens is in the later stages of the disease, when little but life remains. Sometimes progress ceases at an earlier stage, least rarely in the cases in which the atrophy is strictly symmetrical. When its course at the commencement of the wasting is rapid, it usually continues rapid until it has attained a wide extent When it begins slowly, it continues slow throughout, save for the occasional acute paralysis of some particular group of muscles. Such local loss of power may come on in a few days. The extensors of the wrist and fingers are the muscles most commonly affected in this way. When there is weakness of the legs without wasting, the onset of this may coincide with the atrophy of the arms, or may succeed it at any interval. It is rare for the weakness in the legs to occur first.

The most frequent complication of progressive muscular atrophy is bulbar paralysis, the result of a degeneration of the cells of the bulbar nuclei similar to that of those in the spinal cord. In rare cases muscular atrophy in the arms is accompanied by the symptoms of locomotor ataxy in the legs; and general paralysis of the insane has been met with as an exceptional complication. Severe and frequent headaches are occasionally present throughout the course of the disease.

The chief danger to life is from pulmonary disease, induced by the entrance of particles of food into the lungs, or by exposure to cold, and rendered grave by the weakness of the muscles of respiration. Bulbar paralysis also is a frequent cause of death, either by its interference with swallowing and nutrition, or through laryngeal paralysis. Less commonly, death results from bedsores and septicæmia, or from intercurrent maladies.

PATHOLOGY.—The constancy of the association of changes in the motor cells of the spinal cord, degeneration of the motor root-fibres, and wasting of the muscles, together with the analogous effects of focal lesions of the anterior cornua, leave no doubt of the relation of the muscular wasting to the disease of the cells and of the fibres proceeding from them. The condition of electrical excitability, its slow failure as nerve and muscle degenerate together, is explained by the slowness of the change in the nerves, permitting a similar rate of degeneration in the muscle. It is only when the usual slow process is varied by a more acute change in the cells and fibres, that the muscular tissue is for some time less damaged than the nerve-structures, and so presents paralysis in excess of wasting, and voltaic irritability in excess of faradic. Thus a slow decay of the lower segment of the motor path is the essential lesion in this disease, to which the conspicuous symptom is merely secondary. But the disease is rarely limited to the lower segment of the motor path. The pyramidal tracts, as already stated, are commonly degenerated, and it is probable that the degeneration often extends through their entire extent and involves the motor cells of the cortex. There may be no symptoms to suggest such a condition. The degeneration of the lower segment has usually caused atonic atrophy of the muscles, so as to produce the loss of all reflex action and mask the excess of myotatic irritability which degeneration of the upper segment would produce. The relation of these degenerations in the upper and lower segment to each other has been much discussed. Considering the very common occurrence in other conditions of an affection of one of these segments without any involvement of the other, one cannot be regarded as a result of the other, and hence the only adequate explanation of the facts is that the degeneration of the upper and lower segments is simultaneous, or, if not simultaneous, at least so far independent that neither is the cause or consequence of the other, both being the result of the same tendency to degeneration in the elements of the motor path.

It can be easily understood that the relative degree in which the two segments are affected may vary, and that such variations must give rise to numerous varieties of the disease. Thus weakness of the legs, with excessive myotatic irritability, often going on to spasm, is explained by the degeneration of the pyramidal fibres for the lower limbs, while the part of the lower segment related to these remains unaffected. The weakness of the legs usually succeeds the wasting in the arms. In most cases in which spastic paraplegia is followed by wasting in the arms, the latter have not shared the spastic palsy. When this condition is associated with slight wasting of the legs, without considerable change in electrical irritability, the condition exists in which we must assume that the motor cells of the cord, while structurally intact, undergo slight changes in nutrition. These are so slight as to cause no alteration in aspect, or at least so trifling a change that we are as yet unable to detect it. They are perhaps the result of degeneration in the termination of the pyramidal fibres. When such degeneration is secondary to a focal lesion of the cord or brain, its effect is not usually sufficient to arrest the myotatic irritability or to cause wasting such as attends the destruction of these cells.

But in some cases the muscular wasting may be great, although the increase of myotatic irritability persists. The condition then is one of ‘tonic atrophy.’ In those cases it is common to find that many nerve-cells have disappeared or are very small, while others remain normal or slightly changed in aspect. We have then apparently, in addition to the degeneration of the upper segment and the nutritional changes mentioned, a considerable degeneration of many, but not destruction of all, the elements of the lower segment. This cannot be regarded as simply secondary to the degeneration of the upper segment. It must be the expression of a distinct pathological tendency similar to that which elsewhere causes the atonic atrophy and total wasting, but insufficient to prevent the less affected cells from causing rigidity under the influence of the degeneration of the upper segment. It is doubtful whether the tonic atrophy ever goes on to atonic atrophy. If the result ever occurs, it is extremely rare. Nor does it seem that atonic atrophy ever gives place to tonic atrophy with excessive myotatic irritability. The rigidity which is the effect of degeneration of the upper segment is not produced if the lower is already so much changed as to abolish myotatic irritability. And yet the pyramidal tracts are constantly found degenerated, although the muscles have been flaccid to the last. In the rare cases in which muscles with atonic atrophy become rigid towards the end of the process, this is probably the result of changes in the muscles themselves, and is not dependent upon the central nervous system.

Diagnosis.—The diagnosis of the developed disease is simple Doubt is only likely to arise in the early stages and when limitation to the one group of muscles raises the question whether the origin of the wasting is local or central. Such local atrophy is generally the result of an affection of peripheral nerves; and paralysis due to disease of a single nerve, or a plexus, will usually be recognised by its limitation. The distinction of some forms of multiple neuritis is much more difficult. This is especially the case when there has been a subacute onset, such as is common in neuritis, and this difficulty is increased by the fact that neuritis may affect only motor branches, as in lead palsy. But the subsequent slow wasting of other parts will render the character of the spinal disease evident; while in the peripheral affection a careful search will usually reveal other evidence of neuritis, as well as an obvious cause. In cervical pachymeningitis the association of sensory symptoms is distinctive, and the same applies to tumours of nerve-roots. Disseminated myelitis may cause widespread muscular atrophy, but symptoms of irregular damage to other than motor parts of the cord are also present. In syringomyelia, atrophy may occur indistinguishable from that in the disease now under consideration, but a careful examination will reveal the peculiar disturbance of sensibility, the loss to pain without loss to touch, characteristic of this condition.

The distinction from idiopathic muscular atrophy, especially when this begins late in life, is sometimes difficult. This is only true of the cases where no pseudo-hypertrophy is present. The characteristic distribution of the wasting, especially its commencement in the legs, its very slow course, and the tendency to affect other members of the same family, will usually distinguish this condition. Whenever several cases of muscular atrophy occur in the same family, or atrophy begin during childhood or youth, the probability is great that the affection is idiopathic and not spinal.

Prognosis.—The nature of the disease renders the prognosis in every case grave and uncertain. The chief factors in forming an opinion are the observed progress of the disease, and the energy which it has manifested. The possibility of arrest is greater in middle life than in advanced age. It also seems to be greater in cases in which the wasting is symmetrical than in those in which the two sides are irregularly affected. Spontaneous cessation rarely tends to take place until an advanced stage is reached, but arrest by treatment may take place at any period. Bulbar symptoms increase the gravity of the prognosis; and weakness of the respiratory muscles, especially combined with an affection of the medulla, constitutes a grave danger to life. If the malady ceases to advance, there may be a certain amount of recovery of power, especially if the loss has been rapid and recent. Wasting that has existed for six months will probably remain unchanged. In a typical chronic case there is little hope of any actual recovery of tissue or power, as these depend upon destruction of nerve-elements which do not seem to be restored.

Treatment.—Favourable conditions of life—fresh air, gentle exercise, the absence of mental strain—are essential. Only one method of treatment has seemed to the writer to be certainly capable of arresting the disease, and that is the hypodermic injection of strychnine. In seven almost consecutive cases in middle life, this treatment has been followed by arrest within a month of its commencement, and the arrest has been permanent in all the cases but one. In senile cases the treatment has failed. Administration of the drug by the mouth has not the same effect, and failure by the mouth does not lessen the prospect of good from its subcutaneous use. It may be that the drug, administered hypodermically, is brought more rapidly in contact with the nerve-elements, and acts on their nutrition with a relatively greater momentum. It is best to give one injection daily, at any convenient place. The most convenient salt is the nitrate, and the dose should be $\frac{1}{100}$ of a grain increased to $\frac{1}{40}$. When arrest seems to have taken place, it is well to intermit the injections for one week in three or four. Other nervine tonics may be given by the mouth at the same time. In a malady so grave it is desirable to neglect nothing that may have a beneficial influence.

Local treatment has not much effect on the wasting. Electricity and massage are of service in stimulating the circulation and muscles, and the latter measure is useful in preventing contractures. The constant current is that which is in general of most service, but faradism may be used if the muscles respond to a strength of current which is not painful.

No special bath treatment is of service, and antisyphilitic treatment invariably fails. In some cases it seems to accelerate, and the writer has known it apparently to cause the disease. All treatment should be pursued in moderation, and its effects carefully watched.

W. R. Gowers.

PROGRESSIVE MUSCULAR DYSTROPHY.—Synon.: Idiopathic Muscular Atrophy; Myopathic Atrophy.

Definition.—A primary disease of muscles not depending on morbid changes in the spinal cord.

Two forms are recognised—(1) the *pseudo-hypertrophic* form; (2) the *simple atrophic* form.

1. Pseudo-Hypertrophic Muscular Paralysis. Synon.: *Atrophia musculorum progressiva myopathica*; Fr. *Paralysie pseudo-hypertrophique*; Ger. *Myopathische progressive Muskelatrophie.*

Definition.—A progressive muscular paralysis, appearing mostly in boys, in which the ultimate fibres of the affected muscles atrophy, but many of the muscles themselves appear to be hypertrophied, in consequence of the development of interstitial fat and fibrous tissue.

Ætiology.—Pseudo-hypertrophic muscular paralysis is a disease of boys, few cases having been observed in girls or in adults. In a large number of cases it begins in infancy, the weakness becoming manifest at the time the child should begin to walk. In some instances it has been found to be hereditary, several children in the same family having been affected. Nothing definite is known as to the direct causation of the malady.

Anatomical Characters.—In the earlier stages of the disease, the muscles chiefly affected are those of the legs and lower part of the back, particularly the gastrocnemii, the posterior muscles of the thigh, and the erectores spinæ. These muscles are enlarged, and they are felt to be firm and hard. This is not, however, due to true hypertrophy, for if a portion of the muscle be removed during life by the *emporte-pièce* or harpoon, an instrument constructed by Duchenne for this purpose, the muscular fibres are found to be atrophied, and much of the apparent bulk is seen to be due to an interstitial development of fat and fibrous tissue. Subsequently, the remaining muscles of the trunk, upper limbs, and sometimes even of the face, become similarly affected, in most cases these muscles merely wasting without any apparent enlargement, but in other cases the apparent hypertrophy being present in the upper as well as the lower half of the body. In the later stages of the disease, the whole of the voluntary muscles, including those which at first were enlarged, become more or less wasted. The diseased muscles are found after death to be composed in a great measure of ordinary fat-cells. The true muscular substance has to a considerable extent disappeared, and only a few ultimate muscular fibres are seen running at intervals through the fat. Some of these ultimate fibres retain their normal size and appearance; others are much decreased in size, though still showing the striation—only a few of the atrophied fibres have lost their striation, and become granular. The diseased muscles also contain a considerable quantity of fibrous tissue, some of which is probably the remaining sheaths of muscular fibres which have undergone complete atrophy. There is less fat and fibrous tissue in the wasted muscles than in those which are pseudo-hypertrophic, but the changes in the ultimate muscular fibres are the same in both.

The spinal cord and the motor and sensory nerves exhibit no morbid changes. In one case, however, Lockhart Clarke and Gowers discovered marked alterations in the spinal cord, the principal change being extensive disintegration of the grey matter at the centre of each lateral half of the cord, and of the anterior commissure.

Symptoms.—The symptoms of a well-marked case of pseudo-hypertrophic muscular paralysis are very striking, and cannot easily be overlooked or mistaken. When the child is stripped, the muscles of the calves are seen to be larger and firmer than natural, and the same apparent hypertrophy may be present in the muscles of the thigh, the glutei, the lumbar muscles, and others. Occasionally the muscles of the upper half of the body exhibit a similar increase in size, especially the infra-spinati, but much more frequently they are wasted, so that the emaciation of the upper half of the body contrasts strongly with the apparent excess of muscular development in the lower half. The next most obvious symptom is protuberance of the belly. There is no abdominal enlargement, but the antero-posterior curvature of the vertebral column in the lumbar region is much exaggerated, and the shoulders are thrown back. This unnatural curve is not caused by any disease of the vertebræ, for it entirely disappears when the patient sits or lies down. When the child stands, the legs are held apart, and the heels raised off the ground. He walks almost on tiptoe, as in talipes equinus, and with a most peculiar gait—a waddle, as if he needed to balance the body first on the one leg and then on the other. Walking soon tires him. If he attempts to go fast he falls, and he is very easily knocked over. He can readily stoop so as to touch the floor, but generally has great difficulty in raising himself to the erect posture, using powerful muscular effort, and having to assist the movement by means of the hands placed on his knees. When sitting, he can recover himself from the bent position with comparative ease. In some cases, contraction of the affected muscles takes place and deformities result; the earliest and most common being contraction of the calf-muscles, so as to produce talipes equinus. The pseudo-hypertrophied muscles retain considerably more power than the muscles which are merely atrophied. The electro-contractility of the muscles is unaltered, but of course in the later stages becomes impaired. The knee-reflex is absent. The general health of the patient is unaffected until the later stages of the disease. In many cases of pseudo-hypertrophic muscular paralysis there is some deficiency in mental power.

Duchenne divides the progress of pseudo-hypertrophic paralysis into three stages: In the first stage, lasting several months or even one or more years, there is merely weakness of the muscles, causing the peculiarities in the attitude, and in the mode of progression. Little or no enlargement of the muscles has taken place. During this stage proper treatment may bring about recovery. In the second stage the characteristic hypertrophy appears, and the weakness extends to the muscles of the upper limbs. This stage may last for years. In the third stage complete paralysis of most of the muscles of the upper and lower limbs and of the trunk supervenes. The patient lies helpless, unable to change his position. All the muscles, even those which were formerly hypertrophied, pass into a state of atrophy. The sufferer may live in this weak state until carried off by some intercurrent disease.

Pathology. — According to our present knowledge, pseudo-hypertrophic muscular paralysis is a perverted growth of muscle, with development in its substance of interstitial tissue and often fat, and consequent atrophy of the muscular fibres. The disease of the muscles is not secondary to morbid changes in the spinal cord, as was at first believed by many observers.

Diagnosis.—Pseudo-hypertrophic muscular paralysis has such peculiar and well-marked characters that it cannot easily be mistaken. It is readily distinguished from the various forms of spinal paralysis by the evident enlargement and unusual firmness of the paralysed muscles of the lower limbs. From spinal curvature, depending on disease of the vertebral column, it differs in this respect, that the curve of the spine which is present in pseudo-hypertrophic paralysis disappears when the patient sits or lies down.

Prognosis.—The prognosis is most unfavourable, but less so when the disease develops late.

Treatment.—This is only available in the first stage, before the hypertrophic symptoms are marked. Duchenne recommends localised faradisation and shampooing, and he records two cases which were cured by these means. The writer saw one case which had entered on the second stage, in which this treatment completely checked the progress of the malady, and even brought about considerable improvement in the strength of the lower limbs. This patient has since reached manhood with hardly any weakness or deformity, and in excellent general health. It is probable that massage and gymnastic exercises might prove useful. General tonic treatment is undoubtedly beneficial, but no medicinal remedies are known to have any special control over the disease. Tenotomy may be required where muscular contraction has taken place, and if done early is very beneficial.

2. **Simple Idiopathic Muscular Atrophy.**—This form of myopathic atrophy is in many ways closely allied to the pseudo-hypertrophic form, but is much more rarely met with. There is here the same atrophic condition of the affected muscles, without the interstitial overgrowth of fibrous and fatty tissue. It resembles the hypertrophic form, too, in its tendency to run in families, but differs in the following respects: it affects both sexes equally; it rarely appears in early childhood, usually after the age of fifteen; and it commences oftener in the arms, or in some cases in the face, than in the legs. The reaction of degeneration is absent in the affected muscles. There is no morbid change in the spinal cord or brain. The *progress* of the disease is variable, generally very slow. The muscular atrophy may become universal. The *diagnosis* of this condition from muscular atrophy of spinal origin should not be difficult. The same *treatment* is to be employed here as in pseudo-hypertrophic paralysis.

ALEXANDER DAVIDSON.

PROLAPSUS (*pro*, forward; and *labor*, I slip).—This word signifies that an organ or structure has fallen or slipped down, but implies a greater degree of displacement than *procidentia*; so that the organ or structure may protrude through a natural or artificial orifice. The condition is of most importance in connexion with the rectum and the uterus. *See* PROCIDENTIA; ANUS, Diseases of; and WOMB, Diseases of.

PROPHYLACTIC } (πρό, before; and
PROPHYLAXIS } φυλάσσω, I guard).
These terms are used in connexion with treatment, and indicate the means employed for the prevention of disease. *See* DISEASE, Treatment of.

PROSOPALGIA (πρόσωπον, the face; and ἄλγος, pain).—Prosopalgia signifies pain about the face. It may depend upon neuralgia of one or more branches of the fifth pair of nerves (*see* TIC-DOULOUREUX). Its paroxysmal character, unilateral position, and anatomical localisation will indicate this form. Another form is of rheumatic origin. In this the pain is more or less constant, diffused about the face or forehead, and does not follow the course of a nerve-branch. Movements, and especially stooping, increase it. Occasionally such pain is of syphilitic origin, and is especially apt to occur in connexion with the appearance of the secondary rash.

DIAGNOSIS.—In rheumatic prosopalgia the pain is diffused and increased by pressure. If it depend on syphilitic periostitis there will be tenderness on pressure, and the parts will be swollen and less elastic than normal. There will also very likely be a certain amount of fever; and the pain will be increased at night.

TREATMENT.—Chloride of ammonium in half-drachm doses, dissolved in half a tumbler of water, should be given every four hours. If there be any evidence of syphilitic infection, iodide of potassium should be given, in doses of from ten to twenty grains every four hours.

For the rheumatic form of face-ache five grains of iodide of potassium, with thirty grains of bicarbonate of potassium, may be given every four or six hours, after the administration of an aperient. This may be followed up by sulphate of quinine or iron. Locally, a mixture of equal parts of camphor, chloral hydrate, and menthol, rubbed down together in a mortar, may be applied; or a liniment containing chloroform, belladonna, and opium. Decayed teeth should be extracted.

T. BUZZARD.

PROSTATE, Diseases of.—SYNON.: Fr. *Maladies de la Prostate*; Ger. *Krankheiten der Prostate.*

It is not proposed in a work principally devoted to medical subjects to deal at all fully with the affections of the prostate gland; the present article must, accordingly, be taken rather as an index to guide the practitioner in his diagnosis, than as anything approaching a complete disquisition on their pathology or treatment.

GENERAL RELATIONS.—The points of practical importance in connexion with the anatomy of the prostate are as follows: In the examination of the rectum the healthy prostate is felt as a firm substance in the middle line, somewhat divided into two lateral lobes. The whole organ is about 1½ inch in width, with its apex opposite, namely, in the recumbent posture below, the apex of the pubic arch; that is, about 1½ inch from the anus, in a moderately thin subject, but much farther in a very fat one. The whole gland is 1¼ inch in length, its posterior limit being usually about three inches from the anus—in other words, about the distance to which the forefinger can reach. From this it may be deduced that, as the *trigonum vesicæ* commences immediately behind it, a fully distended bladder masks more or less completely the natural outline of the gland. It may thus also be gathered that the vesiculæ seminales are beyond the ordinary reach of the finger, and that when these are infiltrated by disease, their apices, or perhaps only the vasa efferentia, can be detected. The practitioner should by no means neglect the digital examination of the prostate, as it will often yield information of the greatest value; and it may be observed that the best position for the patient, if it be desired to compare the relative size of the lobes of the prostate, is the supine; whereas, if it be required to explore the rectum as far up as possible, the patient should be placed on one side with the hips flexed. The deviations from the normal type he may expect to meet with are —uniform or partial enlargement from simple hypertrophy, or from chronic or acute inflammation, in the latter case possibly attended by a sense of fluctuation, due to abscess; irregular hardness, most marked about the vasa efferentia, depending on a tubercular deposit; the existence of small hard nodular masses, which are calculi in the substances of the gland; or the irregular enlargement caused by a new-growth. It must be borne in mind that tumours or abscesses originating in neighbouring parts may surround the prostate and completely obscure its outline; thus the writer has met with the case of a large hydatid cyst between the rectum and the bladder that rather closely simulated malignant disease of the prostate, and effectually prevented its actual condition from being determined. It will not be forgotten that a certain degree of tenderness of the prostate does not imply a deviation from health, and that a more or less considerable enlargement in old age is so common as to be almost reckoned by some authors as normal. The effect of this enlargement on micturition will be mentioned farther on. The copious plexus of veins which surround the prostate communicates freely with those of the penis and rectum; and it is not unimportant, from a clinical point of view, to remember that these are thus connected not only with the systemic, but with the portal circulation. These veins may become the seat of phlebitis and its sequelæ from various causes.

The principal diseases of the prostate may be considered in the following order:—

1. **Prostate, Hypertrophy of.**—The results of Sir Henry Thompson's observations (*Clinical Lectures on Diseases of the Urinary Organs*) were, that one-third of all men over fifty-five have some enlargement of the prostate; but that a comparatively small number of these suffer any inconvenience from it; and that it usually begins between the ages of fifty-seven and sixty—rarely, if ever, before. though it may more rarely commence later. Very considerable enlargement of the lateral lobes may cause no inconvenience; but if the part which forms the floor of the prostatic urethra, the so-called middle lobe, be even slightly enlarged, or if, as has been shown by McGill, a ring of prostate tissue be formed at the neck of the bladder, difficulty in micturition is sure to result. It is thus easy to understand how a simple hypertrophy may reach enormous dimensions without giving rise to symptoms, while those which are caused by the enlargement of a prostate, which feels almost normal to the finger introduced into the rectum, may, on the other hand, be very severe indeed.

Symptoms. — The symptoms are briefly these: The stream of urine becomes dribbling, and there is an obvious difficulty in emptying the bladder; there is frequency of micturition, especially at night and in the early morning; perhaps a little pain before the act, but none afterwards; and no alteration in the character of the urine. If unrelieved, these early symptoms are followed by incontinence, depending upon over-distension of the bladder; and, from the same cause not improbably, cystitis and dilatation of the bladder, dilated ureters, and, perhaps, pyelitis and chronic interstitial nephritis. Patients with chronic hypertrophy of the prostate usually suffer from time to time from attacks of acute congestion, such as are described later on.

Anatomical Characters.—The structure of a hypertrophied prostate is but a slight modification of that of the gland itself.

Treatment.—In regard to treatment of hypertrophy of the prostate, it is only necessary here to give two words of warning. First, that most of the evils resulting from this condition depend upon the fact that the bladder is never emptied. It is essential, therefore, that the patient's powers in this respect should be ascertained without delay by catheterisation, and if it be discovered that a certain amount of residual urine remains, he should be taught to pass an instrument himself, and directed to do so at least once a day. Secondly, cystitis has often been caused by setting up putrefaction of the urine by a catheter not surgically clean. The simple precautions of washing it before and after use in an antiseptic solution (say 1 to 20 carbolic acid, or 1 to 2,000 sublimate), and of lubricating it with carbolised oil (1 to 10 or 1 to 15) which has not been too long prepared, will avert with certainty this catastrophe, and prevent the unnecessary loss of many lives. The reader must consult surgical works as to the difficulties which an enlarged prostate offers to the introduction of a catheter, and the manner in which they may be overcome. A method of removing the middle lobe or the ring of prostatic tissue, referred to above, has been suggested by McGill, and practised with success by him and others.

2. **Prostate, Congestion of.** — Congestion is a condition which follows on chronic hypertrophy, and is commonly known as 'an attack of the prostate.'

Symptoms.—An old man, suffering from the symptoms already described, is suddenly seized—as the result of some indiscretion in diet, an exposure to cold, or some other apparently trivial cause — with complete retention, accompanied by bloody urine;

possibly a raised temperature and quick pulse, and considerable local uneasiness. If the case do not improve, and especially if the urine be allowed to putrefy, the tongue becomes dry and brown, the pulse more rapid and weak, and the patient passes into a low typhoid condition, which is not unlikely to end fatally.

Treatment. The treatment is in large measure surgical, consisting in the proper passing of catheters. Scarcely less important are the careful regulation of the bowels and the administration of a diet sufficiently light, and yet not too lowering, together with, in most cases, a certain amount of stimulant, for it must be remembered that the patient is probably weak, and that death from asthenia is much to be dreaded. The writer would again urgently insist on the importance of preventing putrefaction of the urine, which is the most fertile source of death in such cases; he can affirm from experience that this end may be attained by the thoughtful employment of antiseptic treatment, even in those cases in which it becomes necessary to keep the bladder empty by tying a catheter into the urethra.

3. Prostate, Chronic Inflammation of.—Synon.: *Chronic Prostatitis.* This is not an uncommon affection amongst young and middle-aged men, depending most frequently on a prolonged gonorrhœa, in which the prostatic part of the urethra has been involved.

Symptoms.—The symptoms of this disease resemble rather closely those depending upon stone in the bladder, namely, more or less frequent micturition, with a feeling of heat and weight in the perinæum, and pain, not usually severe, along the penis, extending to the tip; there is also at times a little blood passed at the end of micturition; and all the symptoms are aggravated by exercise. Generally there are frequent nocturnal emissions. The urine is cloudy, and on standing yields a muco-purulent deposit containing small white filiform shreds. A rectal examination shows that the prostate is enlarged, sometimes very slightly, and seldom to any great extent; it is always tender, but the tenderness is not, as a rule, great. The diagnosis can scarcely be made without passing the sound.

Treatment.—The treatment consists in rest, the administration of laxative medicines, and the application of blisters or some other form of counter-irritation to the perinæum; alcoholic stimulants are to be avoided; and the urine should be rendered bland by alkalis and diluents, as in cases of urethritis.

4. Acute Inflammation of the Prostate.—Synon.: *Acute Prostatitis.* Acute prostatitis may arise as the result of a gonorrhœa, or of cystitis; from the irritation produced by calculi or other mechanical causes; perhaps sometimes idiopathically, or from exposure to cold or wet; and from undue sexual excitement, or the too free use of alcohol if gonorrhœa be present. It may occur in men of any age, and is accompanied by symptoms such as those depending on chronic inflammation, but much more intense; the frequency of micturition and pain during the act causing sometimes almost unbearable agony, and the dysuria amounting in some cases to complete retention, while the tenderness of the gland is very great, a condition which makes an action of the bowels very painful. Such cases may terminate by becoming chronic; they may undergo complete resolution; or suppuration may occur. In any case there will probably be some elevation of temperature, and in the event of the formation of abscess there may be great and sudden rises and falls, accompanied by rigors and sweatings, with a dry, brown tongue, forcibly suggesting pyæmia. Rectal examination reveals a large, hard, and excessively tender prostate. The enlargement may be symmetrical or unilateral. If an abscess have approached the surface, its position will be indicated by a soft boggy sensation. Prostatic abscess may burst into the rectum, bladder, or perinæum.

Treatment.—The treatment of acute prostatitis consists in rest, and carefully regulated diet; diluent and alkaline medicines; purgatives; local blood-letting from the perinæum, by leeches or otherwise (some French surgeons have recommended the application of leeches to the interior of the rectum); with hot fomentations, and morphine suppositories. If an abscess forms it may be opened through the rectum, but it is better to incise it through the perinæum, as this plan is most likely to prevent the formation of that most troublesome and almost incurable condition, a recto-vesical fistula.

Abscesses sometimes form *around* the prostate (periprostatic). They are not so likely to involve the danger of the formation of a recto-vesical fistula; and they should be treated by early incision.

5. Prostate, Tubercle of.—This, though not a common affection of the prostate, occurs perhaps more frequently than is generally supposed, and is of great interest, not only on account of its special features, but because it is usually a part only of a more or less general affection of the genito-urinary tract. Thus in cases where the epididymes are hard and swollen and the cords knotty from tubercular deposit, the finger introduced into the rectum will probably detect a hard nodule in one or both of the vasa efferentia. This, if seen *post mortem*, is found to consist of a tubercular or cheesy mass, and if the condition have advanced farther, the prostate itself may have become involved: there may be either separate nodules of tubercular deposit in a more or less advanced state of cheesy or, more rarely, calcareous degeneration; or the whole gland may have become hollowed out into an irregular cavity, filled in part with cheesy material, and discharging pus.

Symptoms.—This disease may begin in childhood, or in adult life. Its symptoms are most obscure. At first there are probably none at all; but as the disease advances, there will arise those of tumour of the prostate, together, perhaps, with those of abscess; that is, there will be occasionally blood, and generally pus, in the urine; frequency and pain in micturition; tenderness and swelling in the rectum, and so forth. Abscess from this cause has been known to burst into the peritoneum.

Treatment.—The treatment can only be palliative, and must be directed to the relief of the symptoms as they arise; but at the best it is unsatisfactory. Occasionally it may be possible to open a tubercular abscess through the perinæum, but it is doubtful how far such a procedure is to the advantage of the patient.

6. **Prostatic Calculi.**—These are small bodies, generally multiple, formed in the glands of the prostate, usually late in life, but occasionally in comparatively young men. They probably begin as a deposit of animal matter; but later they are made up principally of phosphate, and partly of carbonate, of lime. They may produce no symptoms at all, or they may project into the urethra, and give rise to great irritation at the neck of the bladder, and the symptoms of vesical calculus; such will also be present if, as sometimes happens, they convert the whole gland into a single cavity, in which the calculi lie side by side. In this case they will be felt through the rectum, rubbing against one another; and indeed prostatic calculi, unless they be very small, are, as a rule, to be felt in this situation.

Vesical calculi of considerable size may become encysted in the prostate; and, on the other hand, prostatic calculi may find their way into the bladder. Prostatic calculi may give rise to abscess.

If any treatment be required, it is purely surgical, and must consist in the removal of the stones by forceps, a lithotrite, or a perineal incision.

7. **Prostate, Phleboliths of.**—The pathologist very often meets with phleboliths in the veins surrounding the prostate, the result no doubt of old phlebitis.

8. **Prostate, Tumours of.**—The so-called *fibrous tumours* of the prostate are in all probability simply local hypertrophies, and are composed principally of plain muscular tissue. *Cystic disease* is described as a pathological rarity, the gland being occupied by numerous cysts, containing serous or mucous fluid. *Melanosis* of the gland has also been observed. *Cancer* of the prostate occurs not very infrequently, and is usually soft, though it is sometimes hard enough to be worthy of the name of scirrhus. The writer would speak with great caution of malignant tumours of the prostate; such as he has himself examined have been cancers, with a very irregular arrangement of both stroma and epithelial cells.

Tumours of the prostate may be at present considered as beyond the reach of surgical interference, though suggestions for their removal have been gravely made in Germany.

9. **Prostate, Atrophy and Absence of.**—Atrophy of the prostate is said to occur as the result of pressure, sometimes from an unascertained cause, or from simple senile decay. Congenital absence of the prostate has also in rare cases been observed, but is of little clinical interest.

R. J. Godlee.

PROSTRATION (*pro*, forward; and *sterno*, I stretch).—This word signifies both the act of overthrowing; and the condition of being overthrown, overcome, or depressed. In medical science it is generally employed in the latter sense; and is used to express a condition of system in which the bodily energies as a whole, or the more active of them, have so completely succumbed to the effects of injury, disease, or powerful emotional influences, that they cannot be made to respond to ordinary stimuli. When prostration affects the *whole* system, the patient is said to suffer from *general prostration of the vital powers.* The principal forms of prostration of a *single* system, on the other hand, are—(1) *muscular prostration*, in which there is complete exhaustion of the voluntary muscles; and (2) *nervous prostration*, in which the nerve-centres, and especially those associated with the mind, are so completely overpowered that sensation and motion appear to be in a measure temporarily suspended.

The causes, symptoms, and treatment of prostration in its several forms are more fully discussed in other articles. *See* Collapse; Debility; Exhaustion; Shock; and Syncope.

J. Mitchell Bruce.

PROXIMATE CAUSES (*proximus*, nearest).—A synonym for the immediate or exciting causes of disease. *See* Disease Causes of.

PRURIGO (*prurigo*, the itch).

Definition.—Prurigo is a severe and chronic disease of the skin, characterised by intense pruritus, and the formation of large, pale, scattered papules.

History and Symptoms.—Prurigo is comparatively rare, and until lately was overlooked as a distinct disease by English writers, who usually described cases of it as those of congenital eczema. This is explained by the fact that the disease is often masked by a great deal of superadded eczematous eruption, which is much aggravated by the scratching of the patient. 'In every case,' says Hebra, 'the earliest appearance is that of sub-epidermic papules as big as hemp-seeds, and recognised rather by touch than by sight, since they rise but little above the level of the skin, and do not differ from it at all in colour.' The development of these papules is attended with intense itching, and consequently the tops of the more prominent ones are soon scratched off, and a little drop of blood escapes, forming a small dark crust at the summit of the papule; this gives to the disease one of its characteristic appearances. When the affection has lasted for a considerable time, we notice that the skin becomes dark from increased pigmentation, and at the same time thicker and harder than normal, so that it is difficult to pinch it up between the finger and thumb; the parts affected become more or less eczematous, so that the eruption is somewhat masked; and the lymphatic glands in the groin become enlarged.

The regions of the body most commonly affected are the trunk, the buttocks, and the extensor surfaces of the limbs, especially the forearms and the legs below the knees. The scalp, the armpits, the flexor sides of the wrists and elbows, the palms and soles, groins, and hams are generally unaffected, even in severe cases. The lines and furrows of the skin become more plainly marked than normal on the parts attacked; this is especially noticeable on the backs of the wrists and on the forehead, which gives the patient a peculiar expression when the face happens to be a seat of the disease. The skin assumes a rough and brawny texture, which is more easily detected by touch than by sight.

Prurigo, though not strictly congenital, appears first at a very early age. The early form of the eruption is very often like that of lichen urticatus; at other times it closely resembles a papular eczema. As, however, age advances, the distinctive characters of the disease become more marked. The malady is generally worse in the winter than in the summer, and in a severe form is almost incurable.

In addition to the above-described prurigo of the young, we also meet with a spurious form of the malady which first shows itself in old age, and is commonly known as *prurigo senilis.* The eruption in this case is greatly aggravated, if not entirely produced, by the scratching of the patient.

Diagnosis.—The word 'prurigo' is sometimes colloquially misapplied when simple pruritus is meant; thus, we often hear the expression 'prurigo senilis' used when no eruption is present. These cases are generally either examples of chronic urticaria or of senile changes in the cutaneous nerves, leading to excessive and persistent itching. For the reasons already indicated, prurigo is more often mistaken for severe congenital eczema than for any other disease. Careful examination, however, of those parts of the body which have not been much scratched, together with the distribution of the eruption, will generally lead to a correct diagnosis. The malady may also be mistaken for scabies or phthiriasis, but in both these diseases the parasite can be detected, and in scabies the distribution of the eruption and the history of the case are quite different from those of prurigo.

Treatment.—As has already been stated, prurigo, in a severe form, is incurable, but rest in bed for a few weeks always has a markedly beneficial effect. The itching may be greatly relieved by warm borax and soda baths, followed by the inunction of carbolised oil, or some similar application. Sometimes a very weak sulphur ointment is useful in relieving the itching; also a weak ichthyol ointment. Internal remedies do not appear to be of much value. Arsenic is, however, often useful in helping to get rid of the eczema which is so frequently associated with the disease. Robert Liveing.

PRURITUS (*prurio*, I itch).—Synon.: Fr. *Prurit*; Ger. *Jucken.*

Definition.—A form of perverted sensation of the skin, and most external parts of the mucous membranes, characterised by itching.

Ætiology.—General pruritus may accompany senile degenerative change of the skin (*pruritus senilis*). Apart from scabies and other defined diseases giving rise to itching, pruritus most often accompanies hepatic derangement, functional or organic; dyspepsia, Bright's disease, or diabetes mellitus. Pregnancy or ovarian or uterine disease may cause it; also depression of the mind. Local pruritus is more often due to local causes. The season of the year may determine pruritus, hence P. hiemalis (Duhring).

Symptoms.—Pruritus may be local or general, slight or severe, continuous or intermittent. It is generally most marked at night. Local forms are—

(*a*) *Pruritus genitalium.*—This form is chiefly found in women with uterine disease, such as a granular condition of the os uteri, or during pregnancy, or at the change of life. Diabetes is a frequent cause, and should always be sought for. In children, ascarides of the rectum or in the vagina, or other irritating causes in the rectum, may be present. In men, *P. scroti et penis* is more often the result of eczema or uncleanliness. Pruritus on and around the pubes should always suggest the presence of *pediculi pubis.*

(*β*) *Pruritus ani.*—This is usually connected, in adults, with piles, eczema, or profuse sweating; and in children with thread-worms.

Diagnosis.—It is essential to remember that pruritus is most often a symptom of external irritation, and care should be taken to exclude in the diagnosis such conditions as pediculosis and scabies; other parasites must be remembered—gnats, bugs, fleas, &c.; coarse articles of clothing may be the cause. After exhausting these, the above-mentioned causes, such as dyspepsia, should be investigated, and the urine examined in all cases.

Possibly we may have to do with urticaria, no lesions being visible. In such cases there would be a history of wheals at some period of the disease. In local forms, such causes as those suggested must be searched for.

Treatment.—For general pruritus, if no cause can be found, the diet must be simple, and the bowels freely relieved. If causes exist, such as dyspepsia or hepatic trouble, these must be dealt with on general principles. These measures failing, cannabis indica may be tried, ♏ x. of the tincture, increased to ♏ xx., three times a day, well diluted with mucilage, and taken after meals. As external remedies, the following lotions will be found useful: Liquor carbonis detergens ʒij., water to ℥viij.; carbolic acid in water 1 in 60; perchloride of mercury gr. j.–ij.; water ℥j.; this possesses the advantage of being odourless. Camphor and chloral, equal parts, rubbed down in a mortar to liquefaction; this may be used pure or diluted. Baths are useful containing alkalis, or sulphurated potash ℥iv. in 30 gallons of water. For pruritus vulvæ strong solution of subacetate of lead ʒss. to ℥j. of water; or a solution of nitrate of silver gr. v.–xx. to ℥j. of water, may be painted on every two days, or the compound tincture of benzoin may be painted on every night. For pruritus ani, mercurial ointments containing ammoniated mercury gr. x.–xx. to ℥j. of lard, or calomel gr. x. to ℥j.; these may be combined with carbolic acid or creasote. Sponging the scrotum or vulva with water as hot as it can be borne generally gives relief for a time.

Edward J. Sparks. Alfred Sangster.

PRUSSIC ACID, Poisoning by.—

Synon.: Fr. *Empoisonnement par l'Acide Cyanhydrique*; Ger. *Cyanwasserstoffsäurevergiftung.*

Prussic or hydrocyanic acid is one of the best known and most deadly of poisons. In the anhydrous condition it is stated to kill with almost lightning-like rapidity. Prussic acid is met with in commerce only in a diluted state. In this country two strengths of prussic acid are usual, the Pharmacopœial acid containing 2 per cent., and the so-called Scheele's acid containing about 4 per cent., of anhydrous prussic acid in aqueous solution. The soluble cyanides, more especially cyanide of potassium, largely used by photographers and by electro-platers, are common articles of commerce, and produce the same deadly results as the acid itself. The fatal dose of prussic acid is the equivalent of about one grain of the anhydrous acid.

Anatomical Characters.—In persons who have died of prussic acid poisoning, the eyes are glistening; the extremities are blue; the face is pale or livid; and the lips are cyanosed. The blood throughout the body has frequently the peculiar odour of the acid, and is of a dull hue, with a peculiar bluish cast—a glimmering appearance. The stomach is sometimes reddened, but not more than is common after other asphyxial modes of death.

Symptoms.—In fatal doses the symptoms of prussic acid poisoning set in very speedily; and in consequence of the readiness with which this poison is absorbed from the alimentary canal, and diffused throughout the circulation, the onset of symptoms is reckoned by seconds rather than by minutes. Occasionally the patient may be able to walk into an adjoining room, to compose himself in bed, or perform like actions; but it is rarely that he will have time to dispose of the cup, glass, or bottle in which the poison was contained, before he is taken seriously ill. The symptoms may be divided into three stages. The *first stage* is very brief, and manifests itself by difficult respiration, slow cardiac action, with a tendency of the heart to stop in diastole, whilst its beats are irregular. There is disturbed cerebration, and an awestricken aspect of countenance. This preliminary stage speedily ushers in the *second* or *convulsive stage*, the onset of which is occasionally signalised by a piercing shriek, though this is less frequently observed in man than in animals. With widely dilated pupils, the patient is suddenly thrown into violent clonic and tonic convulsions. The respiration is marked by shortness of inspiration, and prolonged efforts at expiration. The countenance becomes cyanotic. Vomiting is commonly observed; and the urine, fæces, and even semen in the male are spasmodically evacuated. The patient now sinks down, probably in a state of unconsciousness, and with complete loss of muscular power. The convulsive stage speedily passes into the *third*, or, as it may be termed, *asphyxial stage*, with slow, gasping, stertorous respiration, extreme collapse, loss of pulse, and more or less complete paralysis of motion. The skin is cold, clammy, and cyanosed. Death may be ushered in with irregular spasms. The onset of symptoms being rarely delayed beyond one or two minutes, death may occur within two or three minutes more. Power of volition is rarely continued in fatal cases for more than two minutes after taking the poison. Fifteen minutes is the longest interval which has been known to elapse between the taking of the poison and the commencement of symptoms; and then the patient recovered. Should the patient survive for thirty minutes, good hopes may be entertained of recovery. The longest period which is known to have elapsed between the taking of the poison and death was one hour and a quarter.

Diagnosis.—This is rarely difficult. The *foudroyant* character of the illness, and the usually speedy death of the patient, coupled with the peculiar odour of the acid, and the finding of a cup or glass containing the remnants of the dose, seldom leave any doubt as to the nature of the case. Nitro-benzol poisoning closely simulates prussic acid poisoning, however, except that the onset of symptoms is generally much later in nitro-benzol poisoning than when prussic acid has been taken. Nevertheless, when crude bitter-almond oil, impure from the presence of prussic acid, has been swallowed, the close similarity between the odour of the oil and that of nitro-benzol may lead to error. Fortunately, the same treatment may be adopted in both cases.

Prognosis.—This in all cases is very doubtful; and no general rules can be laid down.

Treatment. — Prompt inhalation of the fumes of ammonia should, if possible, never be neglected. The successive administration of a solution of the mixed per- and proto-salts of iron, followed by an alkaline carbonate, so as to convert the acid into an inert ferrocyanide, has been recommended on purely chemical grounds. There is, however, seldom or never time to admit of this elaborate treatment. A more practicable mode is to treat the patient with alternate douches of warm (115 F.) and cold water, so as to stimulate the respiratory functions; artificial respiration may also be employed, together with friction of the limbs. An emetic should be administered. Faradic currents of electricity to the cardiac region should not be neglected. Atropine is not, as has been asserted, a true physiological antidote to prussic acid; but, injected subcutaneously, it may be of use as a respiratory stimulant. Spite of all treatment, the patient usually succumbs.

Thomas Stevenson.

PSEUDO- (ψευδής, false).—This is used as a prefix to various names of conditions, and signifies that they simulate certain diseases or conditions which they really are not; for example, *pseudo-angina*, *pseudo-asthma*, and *pseudo-cyesis*.

PSEUDOCYESIS (ψευδής, false; and κύησις, pregnancy).—A synonym for spurious pregnancy. *See* Pregnancy, Diseases and Disorders of.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.—*See* Progressive Muscular Dystrophy.

PSEUDO-TABES.—A term, signifying false tabes or locomotor ataxy, which is given to certain forms of multiple neuritis occurring more especially after poisoning by alcohol, arsenic, or as a sequence of diphtheria, in which the paralytic symptoms are generally slight, but where the muscular sense and other modes of sensibility are more or less involved, with the result of producing an ataxic condition of the limbs. *See* Neuritis, Multiple.

PSILOSIS (ψιλός, bare).—Synon.: *Psilosis Linguæ et Mucosæ Intestini*; Popularly known in the East as 'Sprue,' a term applied to the disease by the Dutch, the word having reference to the symptoms in the mouth.

Definition.—A chronic disease of the digestive tract, so far as is known occurring only in certain parts of Asia; unattended by fever; the most marked symptoms being diarrhœa, rawness and soreness of the tongue and throat, with a disposition to superficial ulcerations of the buccal mucous membrane, the presence of dyspeptic symptoms of various kinds, the passage of characteristic frothy, yellowish, or greyish-yellow, pultaceous stools, progressive debility, emaciation, and, in unfavourable cases, terminating in death from atrophy and exhaustion; the disease in such cases usually lasting over several years.

Ætiology.—The disease is climatic. Cases of it occur in Ceylon, the Straits Settlements, Indo-China, Java, Manila, and apparently the whole coast of China, more particularly the south. The cause is unknown, but the probability of a bacterial origin is considerable. In one case the writer found that a particular rod-bacterium prevailed in the motions in numbers over the other organisms in proportion as the disease was aggravated; and in cultivation-experiments this organism liquefied the gelatine with great rapidity. In two recent cases under the writer's care, Dr. Wethered found a similar-shaped bacterium present in almost pure cultivations in enormous quantities.

Anatomical Characters.—The pathology of this disease has not yet been much investigated, although it has been recognised for some time that in fatal cases the small intestine is thin, shining, and translucent; generally in a condition recognised as atrophic, and lined by a covering of mucoid material which gives to the gut a peculiar velvety feel when handled, as though there had been some thickening of the coats, which, however, does not occur. The only case known to the writer in which the intestine has been examined microscopically is described by him in a paper in the *British Medical Journal* for June 14, 1890, which contains a report by Dr. Wethered of a careful examination he had made in a fatal case which was under the writer's care. In this case the stomach, duodenum, upper part of jejunum, and large intestine were found practically healthy. The tongue was found to be denuded of its epithelium in certain circumscribed parts. The whole of the œsophagus was extensively diseased, the lining and glandular epithelium of the tube being entirely destroyed, and the surface formed by the bare submucosa. In the lower part of the jejunum there was slight inflammatory exudation around Lieberkühn's crypts, with a little destruction of the follicles at some parts. In the ileum the mucosa was almost entirely destroyed, its place being taken by a soft structureless substance. The submucosa was thickened, and contained an abundance of fibrous tissue of a solid character. The coats of the blood-vessels were thickened—a condition of sclerosis.

Symptoms.—The symptom to which the patient's attention is most directed is the occurrence of diarrhœa, which varies, however, very greatly in different cases. Sometimes it begins insidiously, the one irregular loose motion in the morning scarcely attracting attention, and it might be overlooked entirely if there were not other symptoms associated with it, such as griping and general uneasiness. In other cases the diarrhœa is more marked from the beginning, the patient having several loose motions during the early morning without any further diarrhœa until the following day. There are cases, on the other hand, of which the writer has recently observed one well-marked example, in which the disease begins with a sudden acute diarrhœa which lasts unchecked by remedies, within a short time other characteristic symptoms being observed. The amount of diarrhœa frequently bears no proportion to the other symptoms, being sometimes comparatively slight in otherwise well-marked cases. The motions are characteristic. At the outset they may consist of a copious discharge of a pale straw-coloured yellowish fluid, which is passed especially in the early morning, causing considerable weakness. During the day this diarrhœa ceases, the patient feels gradually stronger as the day advances, and towards the afternoon he usually feels quite well. In this way he may neglect his condition entirely for a period of many months, during which time he is gradually but steadily losing strength and weight. Sooner or later, but sometimes at the beginning, the motion is more characteristic of the disease, consisting of the discharge of large quantities of a pultaceous mass, frequently of a putty or slate colour, sometimes pale yellow, sometimes brown. During periods of aggravation this large pultaceous discharge may contain an admixture of minute thread-like portions of a whitish substance. The motions have always a tendency to be frothy. When they consist of the abundant putty-coloured pultaceous mass, the frothy appearance on the surface is often found covered with air-bubbles of various sizes, as if a process of active fermentation were going on. Stools of this latter quality are characteristic of the fully developed stage of the disease. In cases that do badly, the motions, during this stage, may vary considerably from time to time, sometimes being of a watery or a dirty brown colour, and at other times of a light yellow, with intervals of the return of the pultaceous stool, which is found to contain, if carefully examined, portions of whatever food the patient is taking passed quite unchanged. Even when allowance is made for the large quantity of watery discharge in the motions, the quantity passed is out of proportion to the amount of nourishment taken, showing habitual deficiency of absorption in the intestine.

Early in the disease, and simultaneously with the disordered condition of the bowels, the patient becomes conscious of a tenderness in the mouth. At first there may be simply intolerance of hot food (as regards temperature), or of hot condiments, or of alcoholic drinks. Pepper, sherry, &c., burn his mouth, the tongue particularly. At the same time the tip of the tongue is felt to be tender when pressed against the teeth. This tenderness may lead to a slight defect of articulation. In the early stages the tongue may be observed to be covered with a shining white fur, which is deficient at certain parts, showing patches of a bright red; the tip particularly, as well as the sides, being of a bright rosy red colour. When the tongue is tilted up, the under-surface is seen to be redder than usual, and generally with some parts redder than the rest. As the disease progresses the fur gradually disappears, large papillæ being prominent for a time. While this process is going on, there may develop on any part of the tongue, but more usually on the tip and at the sides and under the tip, characteristic superficial ulcers, which, while they destroy the investing epithelium, do not extend into the subjacent tissue. These painful superficial ulcerations may vary in size from a pin's head to a threepenny piece, or sometimes even larger, the larger ones being usually found in the mucous membrane of the cheek. The gums may become swollen, tender, and prone to bleed. Sometimes one large solitary ulcerated patch may exist on the cheek or lip. Eventually the fur completely disappears from the tongue, which becomes apparently entirely denuded of epithelium, no papillæ being visible, and the whole surface presenting a dull red colour, more or less traversed by longitudinal and transverse furrows, the portions between these furrows being smooth. In some cases, in the advanced disease the tongue is very red, dry, glazed, and shining, and may or may not present cracks and crevices. The extreme anæmia which sometimes becomes a prominent symptom[1] produces a peculiar appearance in the tongue, the part towards the tip being of a pale tallow-like colour. At this stage the mucous membrane of the cheeks, lips, and palate (where not the seat of superficial ulceration) is of a dull, very pale yellow colour. There are rare cases in which the affection of the tongue is almost the only symptom present, the patient being unconscious of any diarrhœa, although the motion when examined will be found to be slightly altered in colour or consistence. The patient in these cases complains bitterly of the irritability of the mouth and soreness of the tongue, but does not otherwise feel especially distressed.

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[1] The anæmia in this disease possesses peculiarities that well merit further attention. In a man, aged thirty, under the writer's care, in whom the disease was well marked, but not in an advanced stage, Dr. Wethered found the number of red corpuscles reduced to 2,000,000 per cubic millimetre,

The rawness is not always confined to the tongue. The passage of hot food or drink may be painfully felt in the whole course of the gullet, the tender condition of this tube sometimes rendering the swallowing of solid morsels extremely painful and difficult, and giving rise to prolonged and painful hawking, vomiting, and sometimes coughing. This condition occasionally develops early, and may be out of all proportion to the other symptoms, the patient sometimes requiring to get up five or six times during the night to rinse his mouth with water in order to relieve the dry hot sensation from which he suffers.

At an early stage of the disease dyspeptic symptoms develop, and sometimes give rise to much distress, the patient being troubled with flatulence, heartburn, and sour eructations. He suffers from a capricious appetite, sometimes characterised by a craving for meat. After the disease has lasted some time, and when the will is weakened from the progressive debility, frequently the patient cannot be restrained from indulging in various kinds of highly indigestible foods, which are found in the stools absolutely unchanged, and which increase his sufferings and weakness by exciting considerable diarrhœa.

The mental condition of the patient is noteworthy. He is irritable, frequently depressed, and towards the later stages of the disease often extremely difficult to manage, refusing to acknowledge the gravity of his condition, and insisting on indulgence in foods which he cannot digest.

COURSE AND TERMINATIONS.—The disease is essentially a chronic one, being unattended by fever. The urine is usually free from albumen. The liver gradually shrinks in size, and eventually it becomes very small; but there is no reason to believe that this organ is primarily at fault. Such *post-mortem* evidence as has been obtained negatives the idea that the frequent paleness of the motions is due to any affection of the liver.

The abdomen, except at the very beginning and the very end of the disease, is usually tumid, bulging in the epigastrium, tympanitic, giving a soft doughy feeling to the touch; the tumidity being more noticeable as the patient progressively emaciates. The disease, which may last for a period of years, is attended with general atrophy and anæmia, the subcutaneous fat gradually disappearing till the patient reaches an extreme stage of emaciation, which, combined with the projecting eyes, pearly conjunctiva, and extreme pallor, give rise to a peculiar and characteristic appearance. In the later stages, and whilst recovery is still possible, there may be considerable œdema of the legs, with a rough harsh skin. In fatal cases the patient usually sinks with great slowness, death being mainly brought about by his being essentially starved to death, the processes of digestion and absorption having been for a considerable time almost entirely annihilated.

DIAGNOSIS.—This disease might possibly be mistaken for dysentery by the inexperienced, and is apt to be confounded with various forms of diarrhœa which are common in the tropics. In chronic dysentery, the mucus in the stools, the evidence of local irritation in the colon, inclination to strain, and the previous history of the attack, together with the absence of the characteristic symptoms of psilosis, ought to be sufficient to prevent any confusion between the two diseases. At the beginning of the malady it might be difficult to distinguish psilosis from other forms of diarrhœa, but after a time the condition of the tongue, mouth, and gullet, and the characteristic pultaceous stools which have been described, ought to be sufficient to establish the diagnosis. In simple diarrhœa of the tropics there is not present the peculiar local changes in the epithelium of the tongue and mucous membrane of the mouth, nor are the symptoms in the gullet present which are characteristic of psilosis; and those who are experienced in both affections should have little difficulty in distinguishing the frothy pultaceous masses of the latter disease. The peculiar changes in the mouth and throat are typical and distinctive. In the last stages of psilosis and of prolonged tropical diarrhœa the symptoms of exhaustion and emaciation are much the same; and in chronic exhausting diarrhœa the tongue may become bare and raw, with a formation of numerous aphthous spots in the mouth, which still further tends to obliterate the lines of distinction between the diseases in the fatal stages. In such cases it is necessary to take into account the previous history of the case.

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the proportion of white corpuscles to red being 1 in 160. On the other hand, notwithstanding this great diminution of the red corpuscles, there was 68 per cent. of hæmoglobin. (By Fleischl's hæmometer.) After a month of milk diet the red corpuscles had increased to 3,580,000 per cubic millimetre, the proportion of white corpuscles to red being 1 in 190, whilst the hæmoglobin was 65 per cent. There was thus, in this case, with an extraordinary diminution of the red corpuscles, a comparative increase in the percentage of hæmoglobin.

Prognosis.—Psilosis is always a grave disease, its gravity increasing in proportion to the age of the patient. In the earlier stages it is very difficult to get the sufferer to realise the serious nature of his malady. Patients under forty, who are willing to undergo the self-denial of suitable treatment, will probably recover, particularly if they remove to a temperate climate; but relapses are apt to occur for one or two years after recovery is apparently complete, particularly if the patient returns to a country where the disease is endemic. In patients who are middle-aged, and particularly those who are over fifty, the gravity of the disease is much increased; but even at this age, if the constitution has been naturally strong, permanent recovery may take place in cases in which the disease has lasted over a considerable period. In all cases, even the slightest, it is advisable to point out to the patient and his friends that the gravity of the case is out of proportion to the mere amount of diarrhœa present.

Treatment.—The treatment which has been found on empirical grounds to answer best is in accordance with what has been recently ascertained in connexion with the morbid condition of the small intestine. The object is to give the weakened bowel (ileum) as complete rest as possible. The patient should be instructed to keep his bed for several weeks, after which time the probable improvement of the symptoms usually permits his spending part of the day on the sofa or in an easy chair; but experience has shown that there is great advantage in maintaining the recumbent posture for some time. A flannel bandage should be applied to the abdomen. An exclusive milk treatment is then begun. Pure fresh milk should be given tepid, at intervals of an hour or even less from early morning to late evening, the quantity given each time being calculated in accordance with the total quantity allowed. A small person will do very well for a time on four pints a day. This is about the minimum quantity given in the writer's experience. In the case of a man of ordinary size, he begins with five to six pints daily, and in a large person even more. From three-quarters to one tumblerful is found to be the usual quantity given each hour. In favourable cases the improvement begins to be evident within a few days; the soreness disappears from the mouth; the motions become gradually more consistent, until eventually they become solid, the colour remaining for some time white and creamy-looking.[1] When the motions become solid, the quantity of milk is gradually increased until eight or even nine pints or more are given. After a few weeks there is usually considerable constipation, giving rise to pain and soreness, and necessitating frequently the use of an enema. At this period rhagades are apt to form at the anus, and require to be touched with nitrate of silver. After the bowels have remained regular for several weeks, gradual additions are made to the diet; but here we find much difference in the idiosyncrasies of individual patients. Arrowroot is usually first given in small quantities in addition to the milk, and beef-tea is usually well borne. After these have been added for a week, if there be no return of the symptoms, one or two raw eggs a day may be tried; but there are cases in which eggs disagree. At the same time, stale bread soaked in hot water, pressed, and eaten with milk and sugar, is usually well borne, and greatly adds to the patient's strength. After a week or a fortnight of this diet, the patient may be tried cautiously with boiled white fish—whiting, haddock, or sole. The next change in diet should be a few ounces of chicken or partridge, and after some days this may be alternated with boiled mutton, after which time cauliflower may be tried. About the same time that fish is given fruit may be tried, bananas or grapes, the skins and seeds being rejected. In connexion with all these articles of food, it is important to bear in mind that any one of them may in some patients cause a relapse of the symptoms. When a relapse occurs the patient should be at once put back on milk diet, and kept on it for four or five days, when the additions to diet may be again begun, this time avoiding the particular article of food that had been found to disagree. The writer has known relapses produced by eggs (which are usually well borne) after recovery had begun. Although fish is usually well borne, he has known a relapse brought on by boiled whiting, and so on with almost every article of food he has tried, with the exception of milk. Unfortunately, there are cases, although very rare, in which milk cannot be borne, and indeed seems to aggravate the symptoms, in which case koumiss or simply aërated milk should be tried; and if these also fail we must fall back on the expressed juice of raw meat, strong beef-tea, chicken jelly, and such-like substances. On account of the tendency to relapse, the patients require to be encouraged and reassured, as in well-managed cases the relapses usually do not last more than four or five days. When the patient has been able to digest solid food, and there is no return of the distinctive symptoms, he should be allowed to go out; but he must for a long time avoid fatigue. A chill will at any time, for months after he has apparently recovered, produce a relapse. Drugs have no effect on the disease, although a slight temporary improvement may sometimes be seen after the exhibition of a small dose of rhubarb. For a severe diarrhœa with pain, which occurs occasionally, particularly in the relapses, a moderate dose of laudanum is useful, but opium has no curative effect on the malady. The patient should not return to the country where the disease occurs if he can avoid doing so, as experience shows that relapses are common in these circumstances. Where the return is unavoidable, if possible a whole year should be allowed to elapse after complete recovery, before leaving again for the East. Patients who remain at home, and who have made a good recovery, usually enjoy fairly good health; and several patients who were seen by the writer some years ago, suffering severely from this disease, are now able to lead active lives in England, their recovery and good health being completely sustained. G. Thin.

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[1] In a paper by the writer, which has been published in the 75th volume of the *Medico-Chirurgical Transactions*, it is shown by chemical analysis that the whiteness of the motions, which may continue over long periods during convalescence, is not due to absence of bile, and that colourless stools may exist whilst the functions of both the liver and the pancreas are active.

PSOAS ABSCESS.—Synon.: Fr. *Abcès du Psoas*; Ger. *Psoasabscess.*

Definition.—An abscess within the sheath of the psoas muscle, almost always of spinal origin.

Ætiology.—Caries of the lower dorsal or lumbar spine is the cause of psoas abscess, and these being the regions of the spine most commonly diseased, this is the commonest form of spinal abscess. The caries is almost always tubercular. Syphilis and actinomycosis are very rare causes. Rarely, too, an abscess starting from the hip-joint makes its way into the sheath of the psoas, and travels upwards in it, even to a lumbar transverse process, as the writer has seen in a case of pyæmic suppuration in both hip-joints. It is said that a suppurative inflammation may arise within the psoas sheath, unconnected with disease of bone or joint, but supposed to be consequent upon strain or exposure to cold.

Anatomical Characters.—The disease may begin on the surface of one or two vertebræ: a tubercular periostitis results and generally spreads over several bodies (*anterior caries, caries without curvature*), a form occurring chiefly in adults, specially liable to end in abscess, and formerly regarded as exceptionally fatal. An abscess from such a source lifts up the anterior common ligament, and all structures in front of it, such as vessels, pillars of the diaphragm, and so forth; these become matted together in dense fibrous tissue, and form the anterior wall of the abscess cavity. More commonly the disease appears in the body of one or two vertebræ close to an intervertebral disc, because, as is supposed, it is here, at the junction of bone and cartilage, that the slight injuries which so often precede and predispose to tubercular disease take effect. The result of the settlement of bacilli is the formation round about them of an inflammatory infiltration, which may be small and circumscribed or, more rarely, diffused throughout the body of the vertebra as a general osteitis. In either case, as a rule, it tends to spread, making its way towards the surface, usually the antero-lateral: a periostitis is now excited. As the infiltration spreads it caseates and dies in its older portions. The infiltration ordinarily eats away the cancelli, and, under the influence of pressure, the part above the eroded area sinks down on to that below it, and a 'Pott's boss,' or projection of the spines, is thus developed. With a less acute infiltration sclerosis of bone results, and a subsequent exacerbation of the inflammation or caseation of the products will lead to the formation of considerable sequestra of dense bone. Smaller sequestra are frequent, and result from caseation of an infiltration which still contains particles of uneroded bone (*caries necrotica*). Having reached the surface and excited a periostitis, the disease may spread to neighbouring vertebræ, skipping over the discs, and destroying them by eating away the bone on each side of them rather than by direct attack; and as body after body is eroded the curvature increases. The disease may be arrested, and often is so under suitable treatment. But in many cases, especially among the poorer classes, and among adults in all classes, the caseous material 'softens,' *i.e.* becomes mixed up with a quantity of fluid in which the fatty cells and their *débris* float. This mixture constitutes the 'pus' of chronic abscesses; it is thin and watery, quite opaque, pale yellow-white, often contains visible and sometimes large masses of fattily degenerated cells, and bony and calcareous particles may be numerous when the abscess springs from bone. This fluid, as it increases, presses onwards in the direction of least resistance. Starting from the lower dorsal spine, it may pass through the diaphragm with the aorta, but much more commonly it extends laterally beneath the pleura so as to reach the highest digitation of the psoas rising from the lower edge of the twelfth dorsal vertebra. With this slip it passes beneath the internal arched ligament of the diaphragm, and thus enters the sheath of the psoas. Pus from lumbar vertebræ may enter the sheath at once, if the disease reaches the surface at a point from which one of the slips of the psoas arises; otherwise the subperiosteal abscess travels on the front of the spine and extends laterally until, perhaps, it raises one of these slips of origin from the bone and thus enters the sheath. The aperture of communication between the psoas sheath and the cavity in front of the diseased bone is often very small; there may be more than one. Having thus entered the sheath of the muscle, the pus by its constant pressure and irritation causes atrophy of the muscle-cells, and inflammation, which leads to thickening of the connective tissue into a capsule for the pus; this capsule is lined with a thick layer of very loosely adherent granulation-tissue, which, no doubt, adds its quota to the fluid and solid contents of the cavity. It is speedily infected from the contents, and cheesy points in it are numerous. Crossing the interior of the cavity are more or fewer bands, some containing vessels, others nerves of the lumbar plexus; pain referred to their distribution is therefore not to be wondered at. Pressing on, the pus may so distend the psoas that it will reach out to the anterior iliac spine; but, usually, fluid as far out as this lies beneath the iliac fascia, with which the psoas fascia is continuous on its outer side. An abscess filling the iliac fossa and not passing beneath Poupart's ligament is called an 'iliac abscess;' it is a stage of a psoas abscess. But from the iliac fossa it is said that pus may pass out over the crest through Petit's triangle, which involves its bursting through the strong iliac fascia. This certainly takes place when the pus makes a way to the surface through the muscles of the abdominal wall just internal to the anterior iliac spine. With or without filling the iliac fossa, the pus usually passes down behind Poupart's ligament, lying external to the femoral artery; then, taking the profunda for its guide, it runs inwards beneath the main vessels, over the pectineus and adductor brevis, between the adductors longus and magnus, to the inner side of the thigh. Rarely do we see an abscess of such extent nowadays; but formerly they occasionally ran even down to the internal malleolus. It is common for diverticula to pass from the cavity along branches of the profunda, especially along the internal circumflex, which conducts the pus to the face of the quadratus, and the swelling indicating it presents on the buttock beneath the lower fibres of the gluteus maximus. Besides this, there may be no other perceptible swelling in the thigh; it must not be mistaken for an abscess pointing through the great sacrosciatic notch.

Pus from lumbar vertebræ may pass beneath an arch of origin of the psoas over the side of a vertebra; then, taking the lumbar artery and its posterior division as its guide, the pus runs back internal to the inter-transverse ligament, and issues beneath the latissimus, having escaped from between the erector and quadratus. This is the 'lumbar abscess' of spinal disease. Rarely pus from lumbar caries may run down along the great vessels into the pelvis.

Symptoms. — At first the symptoms are those of spinal disease. If an abscess is forming quickly, and much tension within the muscle-sheath is developed, full extension of the hip causes pain, and persistent flexion is consequently maintained; but in less acute cases there is often no history of pain, lameness, or flexion. There may be pain along the line of one or more branches of the lumbar plexus. Even the ordinary symptoms of spinal disease are not very rarely absent, and a swelling in the groin is the first thing noticed. It often seems to have appeared suddenly; lies external, and perhaps also beneath and internal to the vessels; is smooth, rounded, more or less tense, and more or less fluctuant; is covered by normal skin; is not tender; has a distinct impulse on coughing; and disappears more or less completely in the recumbent position or on pressure. Fluctuation is obtainable between a fulness above Poupart's ligament and the swelling below it. Though the former may be slight, it is generally considerable, and may actually distend the abdomen up to the ribs. Sooner or later, either above or below Poupart's ligament, the abscess points; the skin then reddens, thins, and finally gives way. This may take place with some acuteness.

Diagnosis.—There is no difficulty when the abscess is typical, and spinal disease marked. But a swelling like an iliac or psoas abscess may be present without obvious spinal disease. The probability is that it is of spinal origin, and searching inquiry must be made for occasional pain in the back or in the stomach; for disinclination for active exercise (especially jumping), and early fatigue; for any tendency to use the arms to take off part of the weight of the body from the legs; and for slowness or difficulty in performing such movements as rising from the stooping or sitting posture being noted. The spine should be carefully examined for any slight prominence; and, if any is found, percussion and heat must be employed here to strengthen the suspicion excited.

The surgeon should cause the patient—stripped to the hips—to execute before him all the movements of the spine (bending forwards, backwards, and to each side, and rotation towards each side), and should note whether they are *completely*, *sharply*, and painlessly performed, and if all the spines seem to separate, or whether certain ones retain their distances, indicating that a length of spine is held fixed. But it is not always possible to establish a certain diagnosis, as cases in the writer's experience show.

Failing to find evidence of spinal disease, it becomes necessary to seek for other possible causes of psoas abscess: the hip-joint must be proved healthy, the renal region must be explored, the urinary history gone into, and the urine examined; the possibility of empyema pointing in the groin must be excluded; in case of iliac abscess, abscess from disease of the ilium, perityphlitic abscess, abscesses following on pelvic peritonitis and parametritis, soft rapidly growing tumours, and serous and hydatid cysts of the iliac fossa, must be thought of.

Prognosis. In pre-antiseptic days this was grave, and surgeons advised their patients to 'thank God for every day that such an abscess remained closed.' Under present treatment the prognosis is good. Its gravity increases, so far as the abscess is concerned, with the size and number of branches of the abscess, and with the age of the patient. The gravity of the case is greatly increased if the abscess cavity becomes septic; children are much more likely than adults to survive this complication.

Treatment.—*Simple rest* has its advocates, who maintain that under such circumstances these abscesses often dry up. How often this occurs is questionable; when it does, an infective caseous mass is left—a constant source of danger. *Repeated aspiration* may lead to a similar result. In spite of antiseptic precautions (which are most necessary), sooner or later a puncture generally fails to heal, inflames, and a permanent aperture is established—probably owing to infection of the skin as the needle is withdrawn. *Free antiseptic drainage* has yielded good results; but for weeks and months a sinus was kept open, and septic infection was more or less frequent according to the skill and care of those in charge. Further, a quantity of infective material is left when healing results from this treatment. To destroy the infective lining of the cavity, Billroth aspirated or tapped the cavity, washed it out with an antiseptic solution, and finally injected a mixture of glycerine and iodoform, which was left in. In France, after aspiration a solution of iodoform in ether was injected—a method which is both difficult to carry out and painful. By himself and others Billroth's original method has been fully developed; and the writer believes it to be the best at present known. The object in view is to remove as completely as possible the contents and the lining membrane of the cavity.

The danger of this treatment, the details of which will be found in treatises on surgery, is very slight; but at least one case has died (in an unaccountable way) very shortly after operation. The writer thinks that a psoas or iliac abscess should be thus treated as soon as it is discovered. If it is not yet presenting in the groin, it should be opened in the loin through an incision passing outside the erector and through the quadratus on to the psoas, as suggested by Mr. Treves.

Stanley Boyd.

PSORIASIS (ψώρα, scurf).—Synon.: Lepra; Alphos; Fr. *Psoriasis*; Ger. *Schuppenflechte.*

Definition.—A chronic inflammatory disease, occurring chiefly on the extensor aspect of the limbs, and consisting of discoid patches with scaly crusts on a red base.

Varieties.—There is really only one kind of psoriasis, but the older writers gave names to the different phases of the disease founded upon (1) the size of the patches, using such qualifying terms as punctata, guttata, nummulata; (2) the extent of the disease—diffusa, universalis; (3) the covering of the patches—rupioides, empyodes; (4) their shape—circinata, gyrata; (5) their duration—inveterata, &c. Scaly syphilides also are often spoken of as syphilitic psoriasis, but modern dermatologists avoid all these artificial and ambiguous varieties, which are of no practical importance and in the syphilides are misnomers.

Ætiology.—Psoriasis attacks equally both sexes and all classes. It is rare before three years of age; on the other hand, it seldom begins after fifty years, but those previously subject to it may go on having it up to any age. It is hereditary in a large number of cases, but not very strongly, as it is not often that more than one or two in a large family are affected. The general health is often quite good, but depressing influences, whether of mind or body, will often determine an attack in those predisposed to the disease. Gout is a predisposing factor in adult life, but only in a small proportion of cases. Spring and winter are the most common seasons for a new outbreak.

Anatomical Characters. The true pathology of psoriasis is still unknown, but few dispute that the process itself is one of moderate inflammation in the papillary layer of the corium, producing cell-infiltration and vascular dilatation, chiefly round the hair-follicles and sweat-ducts. The layers of the rete are enormously and rapidly increased, especially over the papillæ, but with a great tendency to premature hornification and exfoliation. The papillæ are much enlarged by the down-growth of the interpapillary processes. A few pathologists hold that the change in the rete, which they call 'keratolysis,' is the primary condition, to which the inflammatory phenomena are secondary.

Description.—No part is absolutely exempt from attack, but the disease generally appears first and in its most typical aspect on the extensor surface of the limbs, especially the elbows and knees, and the parts below; and it is often confined to these regions, the flexor aspect being actually free or only affected in a minor degree. Next in order of frequency are the scalp, trunk, the back more than the front, the face comparatively seldom, but more frequently in women and children than in men, while the palms and soles are rarely attacked. The disease is in the main symmetrical in its distribution.

A well-developed patch, which may be from a half to two or three inches in diameter, is well defined at the border, contrasting sharply with the healthy skin, and consists of a brightly reddened disc more or less concealed by silvery scales adhering into a spongy crust. When this is removed, the under-layer being generally firmly attached, bright red, easily bleeding points are brought into view, which are the tops of the enlarged papillæ. The amount of scaliness varies with the acuteness of the process. When slowly formed, the scales are closely adherent to each other and to the plaque, while in acute cases they flake off too quickly to form crusts, and the intensely hyperæmic base is freely exposed. On the back of the hands and the face the scales get washed off. On the scrotum the natural moisture has the same effect, and there is often fissuring and great irritation. On the palms and soles patches are seldom seen, but the epidermis is dry, thickened, and cracked, imparting a worm-eaten appearance to the part. In the scalp the hair is dry, but seldom comes out much, except in acute cases. The nails are, however, often discoloured, pitted, furrowed, and brittle.

Development and Course.—Each lesion begins as a pin's head sized papule, surmounted almost from the first by a scaly cap; this speedily enlarges to a small disc, which continues to spread peripherally until a patch of two or three inches diameter may be formed. Larger areas are produced by coalescence of adjoining patches; but, however extensive they may be, there are always some areas of healthy skin. When regression takes place it commences in the centre, and when this is clear a circle is formed, or, if the patches have previously coalesced, a gyrate contour. Occasionally, however, on the trunk gyrate and circinate patches are primarily formed from the disease attacking the hair-follicles only, and following therefore their arrangement; this is the lepra of Willan. As further absorption occurs the circular border is broken up, and ultimately the fragments also disappear, leaving a transitory red stain, or a long-lasting yellowish-brown one when the disease has been treated for some time with arsenic. Itching varies much: it may be absent, or very slight, but as a rule is present in a moderate degree, and is only rarely as intense as in eczema.

Diagnosis.—The characteristic features of psoriasis are the position of the patches chiefly on the extensor aspect of the limbs, and especially on the elbows and knees; the borders of the patches being well-defined; the scales being white and adherent into crusts, but without inflammatory exudation. When the crusts are removed, bright red, easily bleeding points are visible. The presence of all these features renders the diagnosis inevitable. Lichen planus, eczema, pityriasis rubra, tinea circinata, and squamous syphilides in some phases, are the diseases most likely to be mistaken for psoriasis.

The patches of lichen planus are roundish, well-defined, and scaly, but they do not choose the special seats of psoriasis; the scales are scanty compared to psoriasis; the colour is violet red instead of bright red. They leave deep pigmentation behind them, and there are almost always some of the characteristic flat papules in the neighbourhood of the patch. Scaly patches of eczema are seldom defined at the borders; the scales are in a single layer or mixed with inflammatory exudation, or there may be a history of discharge; there are no bright red points when the scales are removed; while eczema is much more common on the flexor than the extensor surface of the limbs, and even on the extensor aspect does not specially choose the elbows and knees. In pityriasis rubra, confusion could only arise before the disease became truly universal, which psoriasis never does. Pityriasis rubra is diffuse, not in patches; the border is less defined; the colour is an intense bright red; the scales are large, thin, and papery, do not conceal the ground colour, never adhere into crusts nor over their whole surface, and are thrown off almost as rapidly as they are formed. It must be remembered that pityriasis rubra sometimes develops from a pre-existing psoriasis, but the change is usually acute, and there will be a history of previous chronic patches.

In tinea circinata, the small number of non-symmetrical patches coming in any part of the body, the very scanty scales and the at first papular border, ought to lead to microscopic examination of the scales for the fungus, if a positive conclusion cannot be arrived at without it.

Secondary scaly syphilides are rarely acquired before adult age, while psoriasis is a common disease of childhood; on the other hand, psoriasis is rare under three years, and does not therefore clash with congenital syphilides. The scaly syphilide is in small patches, with scanty, dirty-looking scales on a dull red base; does not specially affect the extensor aspect of the limbs; is often associated with other forms of eruption; leaves fawn-coloured pigmentation behind; and is nearly always accompanied by the other symptoms of syphilis. In the circinate scaly syphilide the same distinctions in position, colour, scales, and concomitant symptoms hold good. In the tertiary scaly syphilide the resemblance may be rather close, but position will again assist: the face is often affected; the number of patches is usually small; they are not symmetrically arranged; the edge is more raised, the centre more depressed; ulceration is common; and scarring and pigmentation follow the disappearance of the lesion.

Prognosis.—It is always possible, but often difficult, to remove the lesions of any one attack, but recurrence at some time or other takes place in 90 per cent. of cases, the interval of freedom varying from weeks to years. Sometimes psoriasis disappears spontaneously, but more often continues for years with remissions and exacerbations, which may at any time assume a severe form with widespread distribution.

Treatment.—Combined external and internal treatment is the most rapidly efficacious method of removing the eruption of psoriasis, cases of moderate extent requiring from three weeks to three months. The general health being in a majority of cases undisturbed, specifics find their most fitting opportunity, of which arsenic claims the first place. The soundest principle, however, is to carefully search for any departure from the highest standard of health, and to endeavour to rectify it, if found, before resorting to the routine treatment with arsenic.

Conditions depressing vitality are the most common: overwork, anxiety, suckling, or any prolonged drain upon the system may be determining factors. Gout and rheumatism take a more subordinate place, but if present require appropriate treatment; and only when these difficulties have been removed or met should arsenic be called in. This drug may be given in either a solid or liquid form; and although practitioners have their fancies for this or that salt, practically arsenious acid for pills, and Fowler's solution for mixtures, meet all requirements.

The solid form is often the most convenient, as it interferes least with the patient's avocations. The following are useful formulæ: Arsenious acid one grain, extract of hop ʒj.; mix thoroughly, and divide into 30 pills. Take one three times a day after meals. The well-known Asiatic pills are stronger, containing nearly $\frac{1}{12}$ of a grain of arsenic in each, and are much used abroad: Arsenious acid 66 grains, powdered black pepper ʒix.; gum arabic and water a sufficiency; mix, and divide into 800 pills. Take one three times a day after meals. When the patient is tolerant, and the disease obstinate, the dose may be increased until the limit of his endurance is reached, griping and diarrhœa being obviated by combining opium; of course, the effect on the patient as well as on the disease should be watched. But while the pills will always hold a place on account of their convenience, where practicable Fowler's solution is preferable, as it can be freely diluted, and the irritant effect on the stomach more likely to be avoided. Beginning with 3 to 5 minims, it may be pushed up to 10 or 12 minims or more, three times a day, always after meals.

Improvement is not manifested at once; often the full physiological effects of the drug must be reached before the scales cease to form; then the older ones drop off, the patch begins to clear, first in the centre and then gradually over its whole area. Arsenic is contra-indicated when the eruption is very hyperæmic, or is coming out acutely, or when there is acute or chronic irritability of the alimentary canal. It will often make acute cases spread faster, and increase the itching very considerably. Even in suitable cases, however, this increased itching may also be excited at first; but it subsides in a week or two, and the patches begin to clear up.

The local treatment consists in removing the scales by alkaline baths or soft soap, and then rubbing in stimulating and antiseptic applications, in the form either of lotions, liniments, or ointments. The local applications may be placed in three divisions, in the grade of their stimulating effect, although that probably is not their sole mode of action, as they are all more or less antiseptic. In the first division may be placed the mercurial preparations, of which the ammonio-chloride, the nitrate, and the yellow oxide are chiefly employed; either may be used as an ointment, in the proportion of ʒj. to the ℥j. of lard or other base. They should not be used over a very large area, nor be rubbed in night and morning continuously. This applies to all stimulating methods of treatment. In the next division come the tarry preparations, naphthol, and thymol. Preparations of tar have long been the classical treatment for psoriasis. They are very numerous, but oil of cade and oleum rusci pyroligneum or birch-tar oil are the least objectionable for ointments or liniments, and are used in various strengths from ♏x. to ʒij. to the ℥j.. or even stronger. For a lotion the alcoholic solution called liquor carbonis detergens, from ℥ss. to ℥ij. to ℥viij. of water, sponged freely over three times a day, is often very useful. β-Naphthol and thymol are generally used as ointments: ʒj. to the ℥j. is an average strength, the addition of ʒj. of prepared chalk facilitating the preparation of the ointment. They have the advantage of being cleanly and free from disagreeable odour. In the third division are the strongest stimulants, such as turpentine, pyrogallic acid, and chrysarobin. Turpentine is used as a liniment from 1 to 4 up to equal parts of it and olive oil. Pyrogallic acid and chrysarobin may be used as ointments, gr. xx. to ʒj. to the ℥j. Pyrogallic acid stains linen, and dangerous absorption may ensue if used over a large surface. Chrysarobin also stains both skin, hair, and linen, and may excite an erythema with œdema resembling erysipelas; it soon passes off when the drug is stopped. In suitable cases it is the most rapidly efficacious of all local remedies. These are only a tithe of the remedies suggested for this obstinate disease, and they may be combined in endless variety and strength. The guide in the selection of a remedy is the amount of hyperæmia present in the patches. The more acute the process, the less stimulation is required; and if very acute, soothing applications, such as olive oil, simple or combined with calamine and oxide of zinc and lime water, may be bandaged on continuously. The patient's circumstances and occupation, as well as the position of the eruption, are also to be taken into account in choosing the remedy and mode of applying it, and considerable experience is requisite to form a correct judgment on all these points.

H. Radcliffe Crocker.

PSOROSPERMIA.—This term was applied by J. Müller in 1841 to a parasitic affection of the skin, muscles, kidneys, and bladders of fish and frogs. It is derived from the Greek ψώρα or ψώρη, signifying a cutaneous disease, itch, scab, or mange. The French use the word *psore* as a generic title for vesicular and pustular maladies of the skin.

The term 'psorospermosis' is applied to lesions in the human subject characterised by the presence of minute cysts or saccules containing bodies, in shape and structure similar to the *coccidium oviforme*, which frequents the bile-ducts of rabbits.

In 1858, Gubler (*Mém. Soc. Bio.* 1858) recorded the case of a man forty-five years old who suffered from disordered digestion and anæmia; the liver was enlarged, and a spherical tumour could be made out in the neighbourhood of the gall-bladder. The anæmia increased; violent pains occurred in the body, accompanied by fever, vomiting, collapse, and delirium; and the case terminated in death. The liver contained twenty tumours, some of the size of chestnuts, others as big as eggs, in addition to the large tumour felt during life. These encapsuled tumours contained thick fluid and countless egg-like bodies, which were regarded as the ova of *distoma lanceolatum.* Leuckart has since pointed out that these bodies were coccidia.

Similar cases have been reported in Germany. In 1883, Dr. Hadden exhibited before the Pathological Society of London some of the viscera of a gentleman, thirty-eight years of age, who died after fourteen days' illness. The chief symptoms were drowsiness and fever, followed by low muttering delirium and partial unconsciousness, and ending in death. The parietal layer of the pericardium, muscular tissue of the heart, parietal layers of the pleuræ, omentum, capsule of liver and spleen, kidneys and convex surface of the brain, were dotted with minute nodules. Some of the nodules were submitted to Cobbold, who pronounced them to be psorospermial sacs.

Subsequently, several examples of this disease have been brought before the Pathological Society of London, from which it would appear that psorospermosis in man has a great tendency to attack the kidneys and ureters. Psorosperm saccules occur in the mucous membrane of the ureter as nodules of the size of hemp-seed; these sometimes aggregate in clusters near the vesical orifice of the ureter, and give rise to hydronephrosis. When a saccule is suitably prepared and cut for the microscope, it will be found to contain oval bodies as in fig. 122.

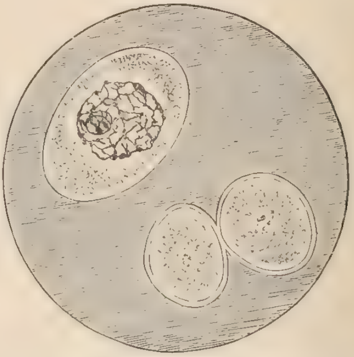

Fig. 122.—Three Psorosperms (two shown in section) from a Ureter. (Leitz, obj. $\frac{1}{20}$ in., Zeiss, oc. 2.) (After J. J. Clarke.)

In the few cases of psorospermosis of the urinary organs of which the clinical histories are forthcoming, it would appear that the disease runs a rapid course (two to three weeks), and gives rise to hæmaturia, anæmia, frequent micturition, and death. So far all the cases have occurred in adults, and the disease attacks women and men equally.

In addition to the viscera, psorospermial bodies occur in the skin. In 1889, Darier made a communication to the Société de Biologie to the effect that these bodies are present in the disease known as chronic eczema of the nipple. This observation was fully confirmed by Wickham (*Arch. de Méd. Expérimentale*, January 1890), and in this country by J. Hutchinson, jun. (*Trans. Path. Soc.*, vol. xli. p. 214). These researches would appear to decide the much debated question of the cause of chronic eczema of the nipple. As this disease is known to be followed in a large proportion of cases by mammary cancer, it naturally followed that the presence of these bodies in cancerous lesions would be suspected, and attempts have already been made to connect psorosperms with mammary cancer; as yet the evidence is far from convincing.

Although most of the observers who have devoted attention to psorospermosis hold the opinion that the gregarine-like bodies found in the saccules met with in man are similar to the coccidia of rabbits, yet there are differences in size and other features, indicating at least specific distinction; there are also slight differences in psorosperm bodies associated with chronic eczema of the nipple and those which are found in the viscera.

Up to the present time we are ignorant

of the origin and development of coccidia and psorosperm bodies in general, nor have we any knowledge of the mode by which they gain entrance into the body. So far all attempts to cultivate them artificially have failed.

J. Bland Sutton.

PSYCHOSIS.—*See* Sycosis.

PSYDRACIUM (dim. of ψύδρακες, blisters).—A small blister, or pustule, without inflammatory base; a cold pustule, in contradistinction to *phlyzacium* or hot pustule.

PTOMAÏNES (πτῶμα, a dead body).—Synon.: Cadaveric Alkaloids; Fr. *Ptomaïnes*. Ptomaïnes are alkaloids produced by the decomposition of animal substances. The word *ptomaïne* was at first restricted to alkaloids produced by cadaveric decomposition, but it is now also employed to designate alkaloids of animal origin formed during life, as a result of chemical changes induced by some agency or other acting within the organism. The term *leucomaïne* has been introduced to particularise the animal alkaloids formed during life from those produced by decomposition of dead animal matter; but it would be preferable for the terms *ptomaïnes* and *leucomaïnes* to be abandoned, and to class these bases of animal origin in one category as *animal alkaloids*.

History.—It is now known that the power of manufacturing alkaloids is not restricted to plants, but is shared by animal organisms. In 1822 Gaspard and Stick extracted a venomous principle from corpses. In 1856 Panum detected a very active poison in putrid matter. In 1866 Dupré and Bence-Jones found an alkaloidal substance, resembling quinine in some of its properties, in the liver. In 1868 Bergmann and Schmiedeberg obtained from putrid beer a nitrogenous crystalline substance, which they called *sepsine*, and which was subsequently thought to be discovered in septicæmic blood. In 1871 Selmi, examining the dead body of a person supposed to have been poisoned, extracted an alkaloid which he was unable to identify with any known body, and was led to suspect that it had been produced after death; and in 1877 the same observer, by subjecting pure albumen to putrefaction, produced and separated two new alkaloids. Since then Gautier and Brieger have made extensive researches, resulting in the discovery of several animal alkaloids.

Creatinine, discovered in urine by Liebig and Pettenkofer, was the first body of animal origin acknowledged to be an alkaloid. Later on, Liebrich detected the already known vegetable alkaloid betaine in normal urine. In 1880 Pouchet detected carnine in the urine of man; and this was confirmed in 1881 by Gautier, who showed that it possessed the general properties of a ptomaïne. In 1882 Bouchard demonstrated that not only were alkaloids present in appreciable quantities in normal urines, but that they augmented notably in the course of certain maladies—typhoid fever, for instance; and, later, Lepine and Aubert concluded that these alkaloids in the urine increase in quantity until the crisis of the disease is reached, after which they diminish.

Ptomaïnes of known composition.—The common ancestor of alkaloids, whether animal or vegetable, is albumin, the complex albumin molecule being split up, either by bacterial agency or otherwise, into several less complex molecules, among which are the animal alkaloids. The following is a list of the principal ptomaïnes that have been extracted from putrefying animal matters, and submitted to ultimate analysis:—

Collodine, $C_8H_{11}N$, from putrefying horseflesh and mackerel.

Parvoline, $C_9H_{13}N$, from putrefying horseflesh and mackerel.

Unnamed base, C_{1}[illegible]H[illegible]N, from putrefying fibrin of bullock's blood.

Hydro-collodine, $C_8H_{13}N$, from putrefying horseflesh and mackerel.

Putrescine, $C_4H_{12}N_2$, from human corpses.

Neuridine, $C_5H_{14}N_2$, from human corpses, and from putrefying fish and cheese.

Cadaverine, $C_5H_{16}N_2$, from human corpses.

Neurine, $C_5H_{13}NO$, from cadaveric putrefaction.

Choline, $C_5H_{15}NO_2$, from cadaveric putrefaction.

Muscarine, $C_5H_{13}NO_2$, from putrid fish.

Gadinine, $C_7H_{16}NO_2$, from putrid cod-fish.

Tyrotoxicon (diazobenzene butyrate), from decomposing cheese, milk, and cream.

Animal alkaloids are also a necessary product of vital physiological processes, and have been extracted from the secretions of living beings, and from fresh animal tissues. The following is a list of the principal animal alkaloids so obtained:—

Creatinine, $C_4H_7N_3O$, from urine.

Pseudo-xanthine, $C_4H_5N_5O$, from urine and flesh.

Sarkine, $C_5H_4N_4O$, from urine and flesh.

Xanthine, $C_5H_4N_4O_2$, from urine and flesh.

Crusocreatinine, $C_5H_8N_4O$, from fresh meat.

Xanthocreatinine, $C_5H_{10}N_4O$, from fresh meat.

Guanine, $C_5H_5N_5O$, from flesh and guano.

Carnine, $C_7H_8N_4O_3$, from fresh meat.

Betaine, $C_5H_{11}NO_2$, from urine.

Mytilotoxine, $C_6H_{15}NO_2$, from poisonous mussels.

Ptomaïnes and Disease.—Animal alkaloids are being incessantly produced within our bodies as a result of the normal physiological processes, and they are eliminated by the bowels, kidneys, liver, skin, and lungs; but if from any cause these eliminating organs fail to perfectly fulfil their excretory functions, then an accumulation of these alkaloids in the system occurs, and a toxic action is exerted by them on the nervous centres. In this way can be explained the headache resulting from constipation, and the more serious nervous symptoms resulting from deficient excretory action of the kidneys in certain diseases of those organs. The removal of these animal alkaloids is, however, not only effected by the excretory organs, but, in addition, a powerful agent for their destruction is at work in the oxygen of the blood, which is continually oxidising and burning them up; and it seems probable that this combustion to a large extent occurs in the liver. If, the excretory organs remaining sound, there is excessive production of animal alkaloids, but inadequate elimination and destruction—a condition which is obtained in all forms of over-exertion, as in a prolonged march—then accumulation of material elaborated in excess and imperfectly eliminated or destroyed occurs, and an auto-infection, a temporary poisoning of the system, results, the poison affecting the nervous centres, and producing the fever of over-exertion, the fever of prostration.

As regards the infectious fevers, it is probable that after the admission of the specific micro-organisms into the body, and provided they find the conditions suitable, they live and multiply, and that, as a result or a residuum of their vital activity, a powerful alkaloidal or other poison is produced, the toxicity of which is the cause of the symptoms of the disease. If so, each infectious fever is the result of a fermentative decomposition of albuminous matter within the body, induced by a special micro-organism, manufacturing its own peculiar poison for each disease. The following is a brief *résumé* of the work that has been done in support of this view:—

Pouchet has extracted from the fæces of a cholera patient an alkaloidal body, which, injected into animals, produces slowing of the heart and, later, death, followed quickly by *rigor mortis*. Pouchet, Nicati, and Rietsch have obtained from cultivations of Koch's cholera bacillus traces of an alkaloid which appeared to be identical with the preceding one. From cultivations of the typhoid bacillus Brieger obtained a small quantity of a poisonous alkaloid which he named *typhotoxine*. From the abdominal and thoracic organs of a patient who died from typhoid fever, during the third week of the attack, Dr. Dixon Mann extracted a small quantity of an alkaloid, which gave all the reactions of a ptomaïne; and from the organs of a patient dying of septicæmia, of unknown origin, Dr. Dixon Mann also extracted a small quantity of a ptomaïne. The writer has extracted small quantities of a ptomaïne from the urine of typhoid-fever patients; and also another ptomaïne from the urine of scarlet-fever patients. These ptomaïnes are present in the urine during the height of the fever, and disappear as the fever declines. Griffiths has found a ptomaïne in the urine of a case of mumps. From the urine of a case of pernicious anæmia Dr. William Hunter extracted three ptomaïnes—one identical with putrescine, another identical with cadaverine, and a third which is probably a new diamine compound. Bourget isolated several ptomaïnes from the viscera of a woman who died of puerperal fever; and from the urine of patients suffering from this disease he obtained similar bases. Udransky and Baumann detected the ptomaïnes cadaverine and putrescine in a case of cystinuria. Brieger, from cultivations of the tetanus bacillus, extracted four ptomaïnes, all of which when injected into mice produced tetanus. In addition to the diseases mentioned, it seems probable that in many non-contagious diseases abnormal chemical changes may take place, independent of bacterial agency, and may result in the formation of poisons which exert a toxic influence on the organism within which they are produced. The toxic agent of expired air is probably a volatile ptomaïne, or mixture of ptomaïnes.

The chief medico-legal interest attaching to the ptomaïnes arises from their liability to be confounded with some of the vegetable alkaloids, and hence to the possibility of their leading to mistakes in medico-legal practice. There are no chemical reactions by which the ptomaïnes as a class may be distinguished from the vegetable alkaloids.

For a description of ptomaïnes in connexion with food poisoning, *see* POISONOUS FOOD.

ARTHUR P LUFF.

PTOSIS (πτῶσις, a fall).—A drooping or falling of the upper eyelid, with inability to raise it, due to paralysis of the third cranial nerve. *See* THIRD NERVE, Diseases of.

PTYALISM (πτύαλον, saliva).—A synonym for salivation, or excessive flow of saliva. *See* SALIVARY SECRETION, Disorders of.

PUBERTY, Disorders of.—SYNON.: Fr. *Troubles de la Puberté*; Ger. *Störungen der Pubertät.*

Of the various periods into which existence is divisible, certainly not the least important, in its pathological aspect, is that intervening between childhood and maturity, when the reproductive powers become developed, and which is known as *puberty*.

This epoch occurs earlier in warm climates, sanguine temperaments, and highly cultivated and luxurious states of society; it is retarded by the opposite conditions. In these islands it generally commences between the ages of thirteen and fifteen in females, and a year later in males. Under the age of fourteen, a male is legally supposed incapable of committing a rape; and a female under sixteen is held to be incapable of consenting to sexual intercourse. By the Roman law, the period of the commencement of puberty was identical with that at which the individual became liable to military duty. Thus Hadrian commenced his service at the age of fifteen.

Puberty cannot, however, be estimated by age alone. Even in this climate, the period of the commencement of puberty varies widely. The writer has seen instances of menstruation in children under ten, and has assisted at the delivery of a girl of fourteen years of age. More frequently, however, puberty is postponed beyond the ordinary period, which may be also modified by family or hereditary peculiarities, and the influence of various diseases.

In the first stages of life, the functional differences between the sexes are comparatively slightly marked; but on the approach of puberty these suddenly become prominent, and so obvious does the influence of the uterine system become, that *propter uterum est mulier* is then almost literally the case.

The accession of puberty in the male is attended by a characteristic alteration of the voice, from 'the thin childish treble' to 'the deep manly bass,' owing to the development of the *pomum Adami*, and the elongation of the thyroid cartilage and thyro-arytænoid muscles. About the same time occurs growth of hair on the face, pubes, and other parts of the body. Before this there are observed the development of the male genital organs, the enlargement of the testes and other parts of the sexual apparatus, the secretion of the seminal and other accessory fluids, and the first outburst of the sexual instincts and feelings. So slowly do the successive changes proceed, which mark the occurrence of puberty in the male, that they are not completed until full age has been passed.

In the female, on the contrary, when puberty is reached, the individual passes at a bound, as it were, from childhood to womanhood, although the structural and functional changes involved in the transition are infinitely more complex and important than is the case in the other sex. Thus the enlargement of the external genital organs is accompanied with a still greater change of the internal organs of generation—the development of the uterus, ovaries, and mammæ, and the commencement of that periodic sanguineous discharge *per vaginam*, the recurrence of which at regular monthly intervals marks the period within which woman is capable of reproduction.

The writer has found it less easy to discover the true date of first menstruation than have some authorities whose tables are generally relied upon. In the great majority of cases the statements of those questioned were so indefinite as to be practically valueless, whilst in only 497 instances did he get any approach to accurate data on this point; and in these the mean age of the commencement of that epoch was the sixteenth year. Excluding all cases of so-called infantile menstruation, the results of these inquiries may be thus summarised:—

Under	12	years	of age	4	menstruated	for	first	time
At	12	,,	,,	17	,,	,,	,,	,,
,,	13	,,	,,	59	,,	,,	,,	,,
,,	14	,,	,,	94	,,	,,	,,	,,
,,	15	,,	,,	138	,,	,,	,,	,,
,,	16	,,	,,	105	,,	,,	,,	,,
,,	17	,,	,,	65	,,	,,	,,	,,
,,	18	,,	,,	10	,,	,,	,,	,,
Over	18	,,	,,	14	,,	,,	,,	,,

Generally speaking, therefore, between the ages of thirteen and fifteen in our climate, the human female undergoes the change from childhood to puberty; the essential characteristic of this change consisting in a periodic sanguineous discharge *per vaginam*, resulting from ovulation.[1] The process of menstruation is invariably productive of more or less general constitutional disturbance and mental irritation from its commencement in ovarian hyperæmia, and the maturation and rupture of a Graafian follicle resulting in the discharge of an ovum, its transmission along the Fallopian tube, its transit through the congested uterus, its expulsion thence, together with the disintegrated endo-uterine mucous membrane, or of its epithelium only, and a consequent hæmorrhagic exudation from the denuded uterus, varying in amount, under normal circumstances, from four to eight ounces, and the discharge of which extends over a period of from three to five days at each recurrent monthly epoch. Hence no woman can be properly said to enjoy perfectly the *mens sana in corpore sano* whilst menstruating. When this function has become regularly established, the accompanying constitutional disturbance may be so slight as to be practically unrecognisable. But on the first occurrence of ovulation, few, if any, escape some sympathetic constitutional derangement, and more especially one or other of the protean forms of hysteria. Hence, under the guise of nearly every disease that may affect a girl at the age of puberty, whether it be spinal, cardiac, pulmonary, or any other disorder, the practitioner must look carefully that he has not to deal with some variety of hysteria, directly resulting from the complex process, affecting the ovaries, Fallopian tubes, and uterus, by which puberty is accompanied.

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[1] The connexion between ovarian action, or ovulation, and uterine denudation, with menstruation, as described in the above paragraph, was up to a recent period almost universally admitted. Within the past few years, however, some doubt has been thrown on the accuracy of this doctrine by the researches of Mr. Lawson Tait, Drs. Engelman of St. Louis, A. Johnstone, Mr. Bland Sutton, and other authorities. Thus, as the result of his large experience of the pathology and surgery of the uterine appendages, Mr. Tait, speaking of the causation of menstruation, says: 'In fact, the ovaries have nothing to do with it at all; and the (Fallopian) tube has this at least—it is the subject in which the initial phases of the phenomena occur.' Nevertheless, as this question is far too wide for adequate discussion in the present article, and is still *sub judice*, the writer has not thought it necessary to modify materially his previous account of the function of menstruation, to which he still adheres.

Undue importance is attached to the non-appearance of menstruation, as the supposed cause of all the ills that female flesh is heir to. In the majority of cases of delayed menstruation the amenorrhœa is the result of some constitutional disease or general condition, to the rational treatment of which, and not to any utero-ovarian stimulation, should the efforts of the physician be directed. At the same time, the part played by the development of the reproductive system in either sex, in the transformation from childhood to maturity, is unquestionably of the first importance. The morbid influence of the premature indulgence of the newly awakened sexual appetites at the age of puberty, and the many forms of disease by which the vice of masturbation is avenged by outraged nature, are subjects the medical importance of which it would be difficult to exaggerate, and which it would be impossible to discuss in this article.

Many of the ailments common about the period of puberty are but accompaniments or forerunners of the functional and organic changes then commencing. More especially is this the case in the female sex. Hence the physician must bear in mind that the headaches, palpitations, symptoms of disordered nervous action, and many of the cases of hæmorrhage from various organs at that epoch, which create so much alarm, are, as Sir Henry Holland long since observed, but evidences of 'new balances struck in the allotment of the blood to different parts; and in the course of such changes, congestions and discharges are prone to occur, the latter relieving or preventing the former.' It is hardly necessary to point out the necessity for careful diagnosis between symptoms thus caused, and the evidences of actual disease; for in the former, the active treatment required by the latter would be not only unnecessary, but positively injurious, by interfering with the progress of those natural functional or organic changes on the establishment of which these symptoms will cease. The circulation is now vigorous; not only is the amount of blood in circulation greater during this period, but also its relative proportions of fibrin and red corpuscles are larger, and hence the roseate hues and plump outlines of early youth.

It is therefore not surprising how well young persons at this period bear hæmorrhagic discharges, with which, when due to menstrual causes, the experienced physician will be slow to interfere, lest by their arrest he may bring on more serious consequences. Many of those cases of hæmoptysis which excite so much alarm, as supposed evidences of pulmonary disease, and the subsidence of which is ascribed to the particular treatment adopted, as well as not a few cases of hæmatemesis occurring in girls about this epoch, are merely symptomatic of the changes consequent on puberty, and require little in the way of repressive treatment.

There are few practical subjects more neglected by physicians than the moral, hygienic, and physical management of puberty. The effect of the evolution of puberty, as the occasional exciting cause of insanity, has been briefly alluded to by Dr. Maudsley and some other writers on mental disease. The influence of excessive mental stimulation during puberty, as an occasion of the increasing proportion of nervous and cerebral disorders now observable, is a subject, however, deserving of more consideration than it has yet received. At that period of life the present cramming system of education frequently predisposes to insanity, the organ of the mind being goaded into premature activity, and overstrained in the effort to pass some competitive or other examination, deemed essential to entrance on official, commercial, or professional life. Thus the mental powers are worn out and exhausted before they have attained their perfection. In other respects also the prevailing educational system is hurtful to the mind; for nowadays, when education is too often divested of that moral restraint and control formerly held to be essential, 'it proves injurious,' as Dr. Copland foretold would be the case, by giving rise to forced, unnatural, overreaching ambitions, and unprincipled states of society; and these states, in proportion as they are developed, are the parents of crime, insanity, and suicide.

THOMAS MORE MADDEN.

PUBLIC HEALTH.[1]—Such care as communities took for the protection of their health was in early times taken under the auspices of religion or morality; it was hardly until the present century that attempts were made, as matters medical, to understand the conditions for health and disease among communities. Although many old statutes and provisions of the common law may be shown to have their bearing upon public health, organised legislation in England for the promotion of this object may be said to date from the Public Health Act. 1848. The country had by this time, under the system of registration inaugurated in 1837, and by the aid of Royal Commissions, learned something about the causes of death in the population. It had been discovered that year after year far more lives were being forfeited to home-grown epidemics than had been lost during the foreign epidemic of 1831-32. By 1848, the threat of fresh invasion by Asiatic cholera had become near and loud. The time for sanitary action was auspicious. It had come to be seen that communities, as such, had duties towards their members and towards other communities, in respect of matters affecting health; and with this enlarged sense of public responsibility it was felt that adequate organisations should be provided, in order to instruct, direct, and even coerce ignorant or wilful members of each community. Needless to say, this function of legislation speedily asserted itself more definitely and in fresh directions; until the present system of sanitary observation and administration has grown up.

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[1] This article will deal with medical considerations respecting health and disease in communities. In its plan it will follow Dr. Parkes's article in the original issue, but matters of *Sanitary Law* and the application of *Vital Statistics* will be relegated to separate articles. *Bacteriology*, and many other subjects which have concern for individual as much as for public health, are treated under their several headings.—G. B.

Considering, first, the area of a country in its broader aspects, and always with more particular reference to England and the public-health arrangements of England, we note the influences exerted by the *condition of open lands, forests, and rivers.* The drainage of land, so as to carry off water readily and thus to make both ground and air drier, has a great effect on public health. Ague, so common formerly in England, has greatly lessened; and dysentery, which so often went with it, has in consequence of drainage almost disappeared.

The movements of the ground-water which, by its rises and falls, influence the moisture and the amount of air in the soil, and, through these conditions, alter the amount and rapidity of decomposition therein, have been supposed also to influence health, and to be especially connected with the development of typhoid fever and of cholera. A moist ground is also believed, on tolerably strong evidence, to be favourable to the production of destructive lung-diseases; and there is no doubt that rheumatism and catarrhal affections are more common on damp soils. Although the influence of the ground-water in cholera is questionable, and it is not always active in the production of typhoid fever, it is certain that lowering the level of the ground-water when it is near the surface is often followed by the best results on the general health of the people, and in hot countries malarious diseases have been greatly diminished, even when the lowering of the ground-water has not exceeded a few inches. Recently a noteworthy relation has been observed between the autumnal diarrhœa of children in towns and the earth-temperature under certain circumstances of ground-water.

The regulation of irrigation operations also has become an important matter for systematic study and, if sewage irrigation farms continue to increase in number, for regulation by the State. These farms should not be situated near to houses (not within five hundred yards if possible), and the lands should be properly prepared and drained so that there is no stagnancy of the water. If properly arranged, it seems clear that sewage irrigation farms are not hurtful to the health of their neighbours; but their proper relation to streams that may have to supply an adjacent population with drinking-water still remains in question.

The regulation of forests ought to be considered a State matter, as the climate of a country and, therefore, health are greatly influenced by them. The removal of forests produces a variety of direct effects. Greater movement of air over the earth is permitted; the soil is rendered hotter in all temperate and hot countries, colder in northern lands; the air is drier everywhere, because the rainfall is lessened, the ground is drier, and the evaporation from leaves is lessened; the ground is drier, because there is not only less rain but freer evaporation, and the roots of the trees no longer obstruct the movement of the ground-water, which flows off more rapidly. These direct effects have a varying sanitary significance, according to circumstances: for example, increased movement of air may be injurious, if malarious air be no longer kept away from a town, as is supposed to be the case with the Roman Campagna; again, in hilly countries where the trees have been too much cleared off, there occurs aridity of soil as a rule, and greater rapidity in the amount of water passing into rivers during rains, and thus leading to floods. In this island the regulation of forests is not a matter of much national importance: it is otherwise in Germany and France, where laws exist which restrain private action; and in Italy, Greece, and Turkey the condition of the forests requires grave consideration as a matter of public health, as well as of climate and rainfall. In India this is also the case, and there are several important sanitary aspects under which the operations of the Forest Department need to be regarded.

The regulation of rivers, such as the embankments, narrowings, deepenings, and removal of obstructions, has generally been concerned with little else than navigation or the prevention of accumulations; but rivers are equally important as they may influence the outflow of the land-water from their drainage areas, and in that way may affect the dryness of the soil. In this regard the condition of all watercourses is a matter of importance, and seems obviously a case for State control. It is not, however, usually included in the subjects of public health; and when any large watercourse is out of order, and inundations from the river or from the sea are dreaded, the Crown usually appoints, on the application of the proprietors of the adjoining lands, a Commission of Sewers, or a Drainage Board, under the Land Drainage Act, to consider what should be done.

In another way the regulation of rivers is of importance. They supply the drinking-water of the community to a large extent, and freedom from contamination is, therefore, necessary. For years this has been seen to form one of the most difficult questions of public health, and for some years a Royal Commission was engaged in inquiring into the causes and remedies of the pollution of rivers. A new Commission has recently presented its Report in special relation to supplies of drinking-water for London. The chief causes of contamination are the dirty water and sewage coming from towns, and the refuse of trade operations. The former can in some measure be met by irrigation or by filtration through land, though the immense quantity of water to be purified, and the price or position of land, may cause difficulty. The admixture of trade refuse-water presents, however, the greater difficulty; yet to prohibit the flow into streams would sometimes be to prohibit the trade works. At present there is no settled standard of purity for either town or trade water before its discharge into streams. Such standards were suggested by the Rivers Pollution Prevention Commissioners, but they have never been accepted either by Parliament or the public, and it is probable that for actual working the standard must vary with the place and trade, and must depend first on the demands made upon the river for drinking use; and, for the rest, on the purity of the river water into which the dirty effluent is discharged, and the comparative volumes of dirty and clean water thus mixed together—*i.e.* upon the extent of the dilution of the impure with the pure water. The number and kind of fish living in the river water are also to be taken into account, effluents of the highest obtainable purity only being admitted into trout or salmon rivers. Thus it will be seen that, at present, little progress has been made in the prevention of the pollution of rivers in England, the interests involved in the continuance of the polluted condition of streams being exceedingly strong, and the enforcement of the law being in the hands of authorities who are often the greatest offenders against its provisions. The new County Councils, however, have been empowered to enforce its provisions, and much is hoped for from the action of these bodies, who will to a great extent be free from the trammels of petty and local interests.

Of conditions operative upon the health of the individual and of the community, the one that falls most conspicuously within the province of *Local Sanitary Authorities*, as of the Legislature which created them, is the condition under which people have their dwelling—the state and circumstances of their *habitation*, both in the particular and in the aggregate. So true is this, and so strongly is this consideration felt in practice, that, for the rest, it will be convenient to arrange the subject-matters of the present article with the notion of condition of habitation in the foreground; and to regard each subject as it principally concerns communities inhabiting a larger or smaller place, or as it concerns the particular habitation. Thus, the general subject of public health will, with little exception, be here discussed with reference, first, to collections of houses forming cities, towns, and villages;[1] secondly, to separate houses.

Cities, Towns, and Villages.—The health of the inhabitants of English towns, as judged of by the annual rate of mortality, is not so good as that of the people of rural districts. The mean annual mortality at the present time differs in different towns from 16 or 17 to 29 and 30 per 1,000 of population, while during certain periods it may be much more. In rural districts the mortality is from 12 to 19 or 20 per 1,000.

—	Death-rate per 1,000	
	Town Districts	Country Districts
1851–60	24·7	19·9
1861–70	24·8	19·7
1871–80	23·1	19·0
1881–90	20·3	17·5

Referring for definition of town and country districts to the Registrar-General's annual reports, the above table shows the differences between urban and rural death-rates in England. It will be seen that the difference has been less of recent years than it was twenty or thirty years ago. The town death-rate has decreased more rapidly than the rural, giving *primâ facie* ground for a belief that the towns have derived more advantage from sanitary measures than have the country districts, where sanitation has been far less progressive.

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[1] There is no official definition of what constitutes a town as opposed to a village, but the reader may have in mind a population of 2,000 or more, not widely scattered, as being here regarded as a town rather than a village. Let it be observed that the term 'urban sanitary district,' while it applies to the majority of English towns, can also apply to petty hamlets of two, four, or six hundred inhabitants. Some specialities of village and rural sanitation will be considered in the sequel.

The causes of the difference are various. In some degree, no doubt, the more rapid improvement observed in urban death-rates is to be attributed to the increasing migration from country into town of adolescents and young adults, whose contribution to the death-roll of any community is small compared with that of people at lower and higher ages. But, this consideration apart, we may be confident that the more rapid improvement in urban death-rates does in truth represent larger sanitary progress in town than in country. We have only to observe the larger scope for such progress afforded by urban populations.

In towns there is greater crowding of houses, with a higher degree of impurity in the air of the houses, more of complete destitution, a greater prevalence of infectious diseases, and greater exposure in unhealthy trades. The urban inhabitants are also on the whole more intemperate, feeble at birth, and have less active exercise in the open air than the rural population. In towns, compared with the country, it is especially the mortality of children under five years old which swells the death-rate, since it is the ages of infancy which suffer most from bad and improper food and from the impure air of the houses of the poor. In all cities there are districts, inhabited by wealthy people, where the mortality will bear comparison with healthy country places, even if age be compared with age in the population which yields the death-rate. It ought to be possible, therefore, to raise the health of the inhabitants generally towards the standard of these favoured parts; and the object of the local government should be, by thought and contrivance, to overcome, as far as may be, the difficulties that poverty puts in the way of health.

Hygienic Conditions of Cities, Towns, and Villages.—These are conditions referable to:

1. The site and soil.
2. The arrangement and building of houses.
3. The water-supply.
4. The removal of refuse-water and of dry refuse.
5. The removal of excreta.
6. The conservancy of the surface.
7. The supply of food, including the regulation of slaughter-houses, dairies, and bakehouses.
8. The regulation of trades.
9. The arrest of infectious diseases.
10. The disposal of the dead.
11. The supervision of nuisances.

1. *The Site and Soil.*—The sites of old cities were fixed by reason of war or commerce, or of vicinity to water-supply; when modern cities arise, it is often in consequence of the development of new industries, such as depend on coal and iron, or such as cotton or woollen works, where the site is determined by convenience of manufactures. In England new towns and villages spring up without regulation, and when they attain a certain size, and some sort of municipal government is formed, it is often too late to consider the wholesomeness of the ground or to attend to the arrangement and construction of houses. It were to be desired that the Legislature should secure for towns, during their period of growth and extension, adequate attention to such matters. For too often in the case of old towns Local Improvement or Health Acts are found to be needed, in order to remedy slowly and laboriously the errors of bygone times.

In respect of the *site* it is necessary to dry the ground if it is at all damp, and to keep it from being contaminated by injurious or offensive effluvia. It is one of the advantages of sewering towns that the ground is thereby drained; and brick sewers were formerly laid so as to admit subsoil water and drain the ground as well as to serve as channels for house-waters. For the former object of drying the soil, every town ought to have a system of pervious sewers; and for the second object, it is best to have a system of impervious sewers combined with the deep drainage of the soil. There should be no cesspits or middens, or manure heaps, in uncemented holes; every refuse of this kind ought to be removed and never allowed to soak into the ground. The ground ought in fact to be secured against every source of contamination. Paving of all streets and courts, so as to prevent surface impurities from soaking in, and great care in the construction of the public sewers, will keep the soil of a city free from those impurities which, under the influence of heat, water, and air, generate injurious effluvia that may be sucked into houses. It is necessary also to have rules about 'made ground.' Inequalities in the surface of the ground are often levelled by filling in with refuse of all kinds; house and chemical refuse, and dredgings from rivers, with other rubbish, are sometimes used. Decomposition goes on in such soils, and eventually, if not too foul, they purify themselves, but for this time is required. In the 'cinder refuse' of Liverpool, which is tolerably free from impurities, at least three years are required for the disappearance of the more easily decomposed animal and vegetable matters. In other made soils it may be longer; and when soil is very impure, as in the case of old graveyards, it is uncertain how long it is before it would be safe to build upon it. Every made soil should be well drained, so that air and water may freely pass through it, and the best should have been laid down for three or four years before being built upon.

The leakage of coal-gas from pipes is a point to be guarded against, and the ease of preventing this would be much increased by the use of subways.

With respect to the means of covering the sides of city streets for foot passengers, good stone paving or the like is essential; for it greatly increases the ease of cleaning the surface. Full powers are given to Sanitary Authorities for this purpose.

The question of the best kind of road for horse and carriage traffic is not quite so easily settled; there are four principal plans: macadamising, granite blocks, wood, and asphalte. As a mere matter of health the two last are preferable; there is less *débris*, greater ease of cleaning, and less noise. Both macadamised and granite-block roads soon get worn into fine mud, which is made up of finely comminuted stone mixed with droppings from horses, and the like. In wet weather this is washed into the sewers, which it aids in obstructing, and it forms a useless part of the sewage. In dry weather it becomes pulverised, floats in the air and is one of the ingredients of city air, from which it is deposited as dust. Wood and asphalte break up much more slowly and are more easily cleaned both by rain and by washing.

2. *The Arrangement and Building of Houses.*—The arrangement of houses and streets in towns is influenced by many circumstances. A good return for money, facility of locomotion, and beauty, are the chief considerations in new towns. In old cities questions of defence and of materials have especially regulated the size and direction of their streets, and the height and compression of their houses. Many considerations will always influence the formation of streets, but a free passage of air to all parts of a town is a cardinal point, which should receive the utmost attention. The more numerous and the wider the streets are, the less impeded will be the air-flow; in no case should a street be less in width than one and a-half times the height of a house.[1]

There should be open spaces, arranged to allow ready movement of air through them at the back of the houses, and all 'back-to-back' building should be illegal. The erection of narrow lanes and alleys should be prohibited in all new towns, and the back courts so common in our older towns ought to be gradually removed. Additional open spaces should be provided at intervals. Wide straight streets are useful for ventilation, and are best for the laying of pipes and tramways. Straight lines are by some not considered beautiful, but for the most part they are certainly most convenient.

Powers are given to Urban Authorities to make by-laws regulating the width of new streets, providing for sewerage, foundation of houses, spaces for air about houses, the drainage of buildings, and other points. As regards existing towns, these Authorities are enabled to purchase dwellings in order to improve streets, to set back houses when rebuilt, and in cases where only the front of a house in a street is taken down they may prescribe the line of the new building. Larger powers of demolition and reconstruction, moreover, are given by the Artisans' Dwellings Act and various local statutes. It has been said that due provision should be made beforehand for the proper construction of the many new towns which must needs spring up in the course of another century. The case seems clear for the community at large to regulate. Matters so important as these for the general health of the population are proper for Imperial legislation to deal with to a greater degree than has been yet recognised in any Act.[1] In their principles at least, such matters should not be relegated to Local Authorities, for them to accept and to use according to the local caprice of the moment.

An important point to determine is the height of the houses. In England a large proportion of our towns consists of low brick houses. If these are not too crowded they give a good distribution of the inhabitants, and oppose little obstacle to the movement of air. When the houses are very lofty the air-currents must be much more impeded, and therefore the streets ought to be much wider, and open spaces behind and about them ought to be more carefully secured. It is not possible to state with any precision the number of persons who may be located on an acre—this will depend in the main on the construction of the individual houses; but it may be laid down as a general rule that, however small be the size of the houses, the amount of ground not occupied by them in any given acre should be as great as the amount actually taken up by houses, and such a rule should *à fortiori* be maintained in the case of more populous houses. Where the houses of a town are intended, each of them, for the lodgment of several families, and consist (with the name of 'flats' or 'mansions') of a number of separate dwellings piled up on the top of each other, it is of even greater importance that the relation between inhabited and uninhabited area should be properly regulated.

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[1] In some local Acts the width of a street is fixed at the height of a house, but this is too small.

[1] As an instance of the necessity of this State interference, the case of Liverpool may be cited. More than seventy years ago the Corporation was warned by the medical practitioners of Liverpool that the houses then being erected, and their arrangement, must prove unhealthy dwellings. No regard was paid to this, and now Liverpool will have to undo, at enormous cost, what might at the time have been put a stop to with ease. Numerous papers by Dr. Russell, Medical Officer of Health, of Glasgow, exemplify the same thing in a most striking manner, by the case of Glasgow.

Such flats or mansions ought, for the sake of air and light, to be provided with exceptional arrangements for space about them, with, concurrently, abundant ventilation of streets and provision of open spaces. They may serve to illustrate the foregoing contention as to the need for central control over the arrangements of streets and houses; for Local Authorities can hardly be expected to know the misfortunes that have befallen Paris and Edinburgh through want of due regulation of houses of this class. The construction of the separate houses cannot be altogether a matter of control absolute by a municipality; and certain rules as to ground-plan, foundations, and arrangement of closets, and the thickness of party walls are habitually enjoined by the State upon Local Authorities desirous of regulating their new buildings; while sufficient liberty is afforded to the requirements and tastes of individual owners and architects.

So in all houses, whether urban or rural, there should be means of ventilation for every room; no inhabited room should have a borrowed light, but should have a window opening directly on the external air; every window should open, and especially at the top; every room should be of good height, not less than nine feet in the smallest, and ten and eleven feet in larger rooms; the closets ought to be arranged in such a manner that, in addition to ventilation of the closet itself, there should be thorough cross ventilation into the open air between the closet and the rest of the house, and this is best accomplished by having projecting portions of the building to contain the closets; every house should be provided with closets in due proportion to its population; there should be proper water-supply, with easily inspected storage, if house-storage is permitted, and easy methods of carrying off the dirty house-water; there should be proper arrangements for the collection and temporary storage of dry house refuse; and house drains and pipes should be constructed and ventilated on the principles that will presently be set forth.

All these matters are easy to regulate without interfering too much with the plans of the architect.

3. *The Water-supply.*—In a town with sewers and water-closets it is generally considered that the supply of water per head daily should not be less than 25 gallons; and if there are trades using large quantities of water, from five to ten gallons additional (reckoned per head of population) are wanted for the town. If there are no water-closets, from 14 to 20 gallons per head daily appears to be the amount usually considered sufficient in large English towns.

The sources of supply are natural lakes, artificial lakes and gathering grounds, rivers, springs, and wells. In towns of any size superficial and shallow wells are always suspicious sources. Local Authorities have powers to undertake the public supply of water, and to protect water-supplies; also to close wells, tanks, cisterns, or pumps if the water be polluted.

The following are the matters of chief importance in towns: (*a*) The supply should be taken from sources capable of affording a quantity adequate to the present and proximate wants of the town, with such approach to constancy as may be attainable. In quality, the great points are to ensure that the water is clear or is easily or completely freed from sediment by sand-filtration, and is well aërated, pleasant to taste, and without smell; that it contains no injurious animal constituents, and cannot become contaminated with excreta of men or animals, or with foul water from houses; that it contains no injurious amount of vegetable matter (not more than 2 or 3 grains per gallon), and that its mineral constituents are of moderate amount, not exceeding 60 grains per gallon as a maximum, and consisting of such mineral matters as are not likely to be injurious. With respect to lime especially, much discussion has taken place as to whether soft or hard (from calcium carbonate) water is best for a town; the soft water is preferred for many trades and is probably best for health, though it has been found impossible to prove this by statistics; it is certain that the inhabitants of numerous towns using a good chalk water have excellent health, and it would seem in fact that the question between water hard from calcium carbonate and soft water is not an important one. When water is hard from calcium chloride and sulphate it is thought to be objectionable to health. The great point in choosing water is, in practice, its freedom from any chance of contamination with excreta, or with refuse matter from habitations.

The duties of a medical officer of health should include the supervision of the sources of supply, so as to detect and prevent any possible contamination.

The water when supplied, except in the case of deep well waters, most commonly needs to be stored and filtered. The reservoirs of our towns contain from one to three months' supply, or less if the supply is very uniform in quantity. The reservoirs require to be placed so as to be clear of trees, and protected from danger of anything being thrown into them. Filters are usually made of sand about 3 feet in depth resting upon gravel, and the water is passed through at the rate of from ½ to 1 gallon to every square inch of surface in 24 hours. The upper sand of the filters requires frequent cleaning, and should be regularly inspected. This plan acts well, but constant supervision is necessary.

After filtration the water is distributed by means of pipes, usually by iron pipes, tarred or concreted inside, for the larger conduits, and then by lead pipes, or, what is better, tinned-lead pipes, for the smaller. Both iron and lead, and especially the latter, are dissolved by some waters, and the question whether lead is so dissolved has often to be answered; in examining into this matter the water should be taken after it has been in contact with the pipes for some hours.

Carried down the public pipes, the water is either delivered at intervals to house cisterns, or, what is far better, is supplied on the constant plan without house-storage. If it be not possible to dispense with house-cisterns, they should be well made of slate, stoneware, or galvanised iron, should be able to be easily inspected and cleaned, and their overflow pipes should always end in the open air, never go into any sewer. The greatest care should be taken that the cistern water shall run no risk of contamination by absorption of foul air or by soakage into the cistern, which should be well covered to prevent dust getting in.

If the 'constant system' is in force, it should be truly constant, for if the water is cut off at intervals and the house-pipes are then emptied, or if leakages take place in the street mains, air must be drawn into them, and this air may be foul; it has even happened that dirty liquids have been sucked into water-pipes, as where a closet service-pipe direct from the house-main has been connected with a choked closet-pan, and in this way excreta have not only passed into these house-pipes, but have even got into the mains. In a similar manner, when sewers are laid in the same trenches as water-mains, liquids escaping from leaky sewers may find their way through bad joints or fissures in water-pipes. This is most liable to occur during intermissions in the water-service; but the same insuction into water-pipes may occur while the pipes are full, if the water be running through them with great velocity. This fact is not sufficiently recognised, even by water-engineers; yet it has been concerned in the distribution of enteric fever broadcast in a community.

Under a constant system and under an intermitting system alike, small service-cisterns are needed for water-closets and for kitchen-boilers, and precautions have to be taken with these cisterns equally with larger storage-cisterns. In fact, too great care cannot be taken in thoroughly guarding water-pipes and cisterns in every way.

The sources of contamination of drinking-water are very numerous, and may affect the water at its source, in its flow, in the reservoir, or during distribution. If stored in houses it is especially exposed to risk; and this is the grand argument for constant service, that the water may be delivered immediately after filtration. The plan of cistern-storage, indeed, lessens those risks that are incidental to intermissions; but this plan demands that cisterns be properly made and placed, and be regularly cleaned. For low-rented houses these conditions are very difficult of attainment, and therefore the constant service is peculiarly adapted to the houses of the poor.

In all towns the service should be at high pressure, so that water may be carried to every floor and thus labour be spared, and the freshness of the water be secured. In places where the water is not carried into the houses, but is fetched from pumps or from 'hydrants' in the street, it has to be stored in the houses in buckets, and runs many chances of impurity.

A town requires water for public purposes, such as for public baths, washhouses, flooding and washing streets, flushing sewers, and putting out fires. Statutory powers are given for carrying out these objects.

4. *The Disposal of Dirty House-water and Dry Refuse.*—After being distributed and used in houses or trades, the water with the impurities it has gathered must be carried out of the town. The inhabitants should have no difficulty in getting rid of their dirty water, or else dirty water will come to be used improperly several times over. Houses ought to have convenient sinks discharging by trapped pipes opening outside the house, not into a drain, but over a drain-grating. From hence it must go along pipes or sewers, and be disposed of at the outfall in some way. House-water, besides other impurities, invariably contains some portion of urine. It is not fit to be at once discharged into streams, but as its fertilising powers are considerable it is well adapted for irrigation on land. The plan involving the least expense appears to be to filter it by intermittent filtration on a small area of properly prepared and drained ground, and then to carry it into the nearest stream.

The dry refuse of houses consists of cinders and ashes, remains of food, dust from sweepings, and various other used-up articles of house life. In some towns there is little difficulty in disposing of this refuse. After being carted away it is sorted, and every article finds a sale. In other towns, however, the disposal of the house-refuse is a matter of difficulty and expense. A system of destroying the refuse by fire in destructor furnaces has of late years come largely into use in various towns. The refuse contains a sufficiency of combustible material in the shape of cinders to ensure its complete destruction in a properly designed furnace, and the waste heat may be utilised for various municipal purposes, *e.g.* for converting the contents of pail closets into a dry manure, or for generating steam in boilers for driving electric-lighting machinery. The clinkers, when withdrawn from the furnace, can be ground down in a mortar-mill and converted into mortar, bricks, or concrete. Sanitarily considered, the destruction by heat of dust-bin refuse is far preferable to the old-fashioned sorting method. In some places the dry refuse is placed every day by the inhabitants in front of the houses and is removed by scavengers. In other places there must be storage of refuse on the premises for a varying number of days; if this is requisite, every house should have a properly prepared dust-bin, well-paved to prevent soakage, well-covered so as to be kept dry, and so placed as to be away from the house, though convenient for the house as well as for the town-scavengers. In the building of any house the arrangements for the position of the dust-bin are almost as important as those for the closets. Of late, galvanised iron pails with tight-fitting lids have come largely into use to replace brick dust-bins for the storage of dry house-refuse, and being non-absorbent they are far more cleanly and suitable receptacles than brick structures ever could be. The removal ought to be frequent and regular, but the frequency has to be fixed by special circumstances. As far as possible organic refuse (food scraps, &c.) should be burnt in the kitchen fire, and not stored on the premises to await removal by the scavengers.

5. *The Removal of Excreta.*—The excreta of the skin and lungs are got rid of by ventilation and washing, so that this heading refers only to the solid and liquid excrements. These average respectively (for both sexes and all ages) about 2½ ounces avoirdupois of solid excrement and 40 fluid ounces of urine *per diem.*.

The excreta ought not to soak into the earth, or to remain near dwellings. The common privy and the 'midden' of northern towns can only with difficulty be brought to fulfil these conditions. In towns above 10,000 inhabitants it now seems clear that there is no possibility of using the earth-closet system, on account of the expense of preparation and transport of dry earth. Therefore, for towns, two or perhaps three plans only remain: (1) The dry plan with frequent removal, with perhaps such deodorisation as the ashes of the house may give; the so-called 'pail system' is one form of this dry plan. (2) The water system, the excreta being carried off from the house along drains and sewers, by the aid of water. (3) The air or pneumatic systems of Captain Liernur and M. Berlier, in which the excreta, unmixed with water, are sucked through pipes into a central reservoir by an air-pump, worked by a steam-engine. These last plans of removal will not be further considered here: they are as yet unfamiliar to us, and are perhaps not altogether well suited to English habits; they are now being fully tried on the Continent.

It would not be possible to discuss here the relative value and the technical details of the pail and the water systems. Both are largely used in England. The pail system, as the most adaptable (among dry systems) to the conditions of a town, has been used in towns where proper sewers cannot be made or water is deficient, or where land cannot be obtained for irrigation or filtration, owing to the expenses involved. It has the disadvantage of keeping the excreta for some days near the house, besides being sometimes attended with nuisances in the working. But, on the whole, it is capable of keeping a town clean when it is properly carried out, and it is an immense advance over the old midden and cesspool systems, which retained the excreta in the filthiest receptacles for long periods in the very midst of the people. It is of the essence of the pail system that the removal of the excreta should be frequent, that is, if practicable, every day. After removal, the excreta are applied at once to the land, or are made into poudrette. In some towns the house-ashes are thrown on a wire screen, so as to allow the fine ash to fall on the excreta—this is sometimes called the 'ash plan'; in other cases deodorants are used. The 'Goux system' is to place some absorbent material round the interior of the pail to absorb the urine.

The water system is more elaborate, and probably more expensive, but if properly carried out is more effectual. If a town can make good sewers, and can find water for flushing and land through which the sewer-water can be passed (by filtration or irrigation, or both), the water system is the best for health.

There cannot be many towns deficient in the quantity of water needed for the proper use of a water system. By some simple contrivances waste water—the water that has been put to other domestic purposes—can be made use of for washing out the closets. Slop-closets and trough-closets, in which these contrivances are used, are found to work efficiently, and to economise water in places where there is but scant supply.

The drainage of every house that discharges its excrements by the water system should possess the following arrangements for disconnecting the drain-air from the air of the common sewer, and for dispersing the foul air of its own particular drain: (*a*) near the junction with the sewer the house-drain should be provided with a 'siphon-trap,' through which all the liquids of the house must pass, and which, therefore, must always be charged with water while the house is inhabited; (*b*) an opening from the house-drain to the outside air, made on the house side of the siphon-trap, to provide for the escape of any sewer-air that may force the trap: the habitual function of this opening, however, is to serve as an inlet to the house-drainage ventilating system; the outlet of this system being (*c*) a pipe in continuation of the farther end of the drain carried up 'full-bore' to the roof, its end at this spot being left open.

It is essential that sewers should be well constructed; they should allow no deposit; and they should be thoroughly ventilated. Deposits are prevented by having egg-shaped sewers with a proper fall, easy means of access for inspection and cleaning, and a regular flow of water, with periodical flushing. The ventilation of sewers, which is now enforced by law, is best effected by having numerous openings—as many, in fact, as can be made—so as to allow constant and free interchange between the sewer-air and the atmosphere. These openings may be by street-gratings or by special shafts, according to circumstances. Ventilation through furnace chimneys is inadvisable, and is of no avail for distant portions of the sewers. For the dead ends of sewers and in narrow streets and courts, shafts of not less than 6 inches diameter, carried up from the crown of the sewer to above the roofs of the houses, should be provided. But in whatever way the ventilation is carried out, the rule must be to have the freest communication between the sewer-air and the general atmosphere. This free ventilation occasions no offence if the sewers are properly made and kept; while, if the air of sewers at the ventilators is found offensive, the ventilation will at least have provided against the more dangerous discharge of the foul air into houses.

Sewers have been objected to on account of the occasional spread of typhoid fever and diarrhœal affections, and perhaps of cholera and diphtheria, by their agency; but, if properly arranged, and with disconnexion between the sewer and houses, there would be no danger; and it is difficult to see how sewers can be displaced, or any other plan be substituted for them, in a town. The house-water must be carried off, and it is impure even if no excreta are allowed to flow in. Even if the pail or other system for excrement disposal be adopted, there must still be town sewers for dirty house-water, and all the precautions above alluded to must be enforced. Sewers, then, whether or not they receive the excreta of a town, are a necessity, and with proper construction and management they certainly ought to be solely beneficial to the public health. It is certain that when a town is well sewered the prevalence of enteric fever is lessened even to the point of extinction, and diarrhœal affections have appeared to be more uncommon. Drying of the soil by sewers also lessens phthisis. It is to a certain extent a question of engineering detail whether the sewers carrying the house-water should also carry off the rain-water; but there would seem to be very considerable sanitary advantages in the 'separate' system by which different channels are provided for house-sewage and rain-water; the chief, perhaps, being that under this system impermeable pipe sewers of small diameter may be used to convey the sewage, preventing by this means the soakage of foul liquids into the soil. The sewer-water also on this separate system is less in amount, more regular in flow from day to day, and richer in fertilising properties. Wherever towns situated on moist grounds have adopted a system of impermeable pipe sewers for conveying away house waste-waters and excreta, means should be taken to dry the subsoil by laying porous drains at a sufficient depth. The rain and surface waters may be carried off by surface channels and gutters, where the levels permit, or in other cases by the subsoil drains.

With regard to the disposal of the sewer-water, three plans can be followed in the case of towns which cannot discharge at once into the sea or into a large river. First, precipitation at the outfall with a chemical agent such as lime, sulphate of alumina, protosulphate of iron, clay, &c., used either singly or in combination. A great number of chemical agents have been proposed, and several clarify the water fairly, but none yield a deposit which pays the expenses as manure, for the suspended matters of sewage which are deposited in the settling tanks only form about one-eighth of the valuable manurial matters of sewage, the remainder escaping in the effluent water. Precipitation must, however, be had recourse to when land cannot be obtained. Second, broad irrigation—one acre on an average being sufficient for the excreta of about one hundred persons. Third, intermittent filtration, where one acre is sufficient for from 2,000 to 3,000 persons, when the land is of a light and porous nature, or is otherwise suitably under-drained, more especially also when the sewage is clarified by a preliminary precipitation; the land should be subdivided into plots, each plot receiving water six hours out of the twenty-four. There can be little or no profit from intermittent filtration, as the extent of land to which sewage can be applied is usually too small to produce crops in any quantity. In broad irrigation, enormous crops of grass and roots can be grown on the sewage land, but the realisation of a profit will largely depend upon the demands of the local markets, and such crops may at times be produced in excess of the demand. Some method of land treatment, however, appears to be the only one which is capable of satisfactorily purifying the sewage, producing an effluent of sufficient purity to be admissible into any stream, and at the same time utilising to some extent the valuable manurial ingredients of the sewage, so that these are not utterly wasted as they are in all precipitation methods.

It appears certain that neither irrigation sewage-farms nor filter-beds, when properly managed, and at reasonable distance from houses, are anywise injurious to the public health.

6. *The Conservancy of the Surface Area.* The cleansing of the surface area of towns has long been a function of the public Authority. The sanitary importance of thorough surface-cleansing is obvious; the mud and dirt of towns and refuse of all kinds, wetted by rain and exposed to heat, soon decompose and give out injurious effluvia, especially in narrow courts and lanes where the movement of air is impeded. The excellent effect on health of paving a town has been often observed. Public streets of all kinds can be easily kept clean, but want of paving and consequent foulness on private premises require to be sought out. Especially this is of importance where (as in the case of pigsties and stables) neglect of surface-cleansing may give rise to nuisances injurious to health.

7. *The Supply of Food, including the Regulation of Slaughter-, Cow-, and Bakehouses.*—A very important duty of a municipality is to supervise the food of the people. While the price and quality must be left to the ordinary operations of commerce, the responsibility of preventing falsifications, and of ensuring that the article shall not be injurious to health, is devolved upon County Councils and on Sanitary Authorities. It is to these latter bodies that the regulation of slaughter-houses and knackers' yards is entrusted. Private *slaughter-houses* are licensed, and can be visited and subjected to bye-laws. They are often constructed out of buildings intended for other purposes, are not fitted with proper appliances, and are generally placed in the densest part of the town. The evils attending them are gradually being removed by the erection of public slaughter-houses, where abundant air, water, good sewers, and means of cleansing are provided. The custom of slaughtering in the country and then sending the meat to cities is increasing, and this again renders private slaughter-houses less necessary.

The transport of cattle and sheep to towns is a matter of very great importance as respects both the goodness of the meat and the comfort of the animals. Space in the trucks, supply of water and food, length of journeys, and other matters, require regulation.

Cow-houses are now inspected by Sanitary Authorities, in pursuance of the powers of the Dairies, Cow-sheds, and Milk-shops Order of 1885. This order contains provisions for the registration of cow-keepers, dairymen, and purveyors of milk; for regulating the lighting, ventilation, cleansing, drainage, and water-supply of dairies, cow-sheds, and milk-shops; and prescribes the precautions that must be taken to guard milk against exposure to infection or contamination. These latter precautions are especially necessary in the light of the knowledge we now possess of the spread of epidemics of enteric fever, scarlet fever, and diphtheria among human communities by the agency of milk; and it is gradually becoming more and more certain that if these disease outbreaks are to be effectually limited, not only must the sanitary arrangements of dairies and cowsheds be under constant supervision, so that the milk may receive no impurities from water or air, but that the animals themselves must be periodically inspected; for there is now evidence to hand that diseased conditions of the cows themselves may be the means of imbuing the milk with infective properties. It will be sufficient to mention two diseases alone, namely, scarlet fever and tuberculosis, as having been connected on very strong evidence with the consumption of milk from cows suffering from, on the one hand, a peculiar disease now known as the 'Hendon' cow-disease, which is closely similar in character to human scarlet fever, and on the other hand from tuberculosis with deposit of tubercles in the teats and udders.

Bakehouses are required by law to be kept in a cleanly condition, to be properly ventilated and protected from effluvia, and not to be used as a sleeping-place.

The inspection of the chief *articles of food*, in respect of their wholesomeness, is entrusted to Sanitary Authorities, and has reference to meat, game, poultry, fish, fruit, vegetables, corn, bread, flour, and milk.

The following are the chief sanitary points in each case:—

Meat.—Much doubt exists as to the extent to which the condemnation of meat exposed to sale should be carried. There is no doubt that meat sufficiently decomposed to be discoloured and to have a putrid smell, and meat with abscesses and suppurations, should be condemned, but the difficulty arises with meat apparently sound or not very obviously otherwise, but which is derived from diseased animals.

Though opinions differ on this point, it may perhaps be said that meat derived from animals slaughtered in the early stages of inflammatory diseases and of epidemic pleuro-pneumonia may be used, but that beef from cattle dead of cattle-plague and anthrax (malignant pustule), mutton from sheep with small-pox and splenic apoplexy, and pork from pigs with carbuncular diseases, hog-cholera, hog-typhus, and scarlet fever, should not be used, although it is not easy to give conclusive evidence against all these diseases, as injuring the health of consumers of the meat. Cattle-plague meat, for example, has been largely used without injury. Opinions are much divided as to whether the flesh of braxy sheep, or of cattle dead of foot-and-mouth disease, should be used or not, but at present the evidence is rather against the view that such flesh is injurious.

In the case of the parasitic diseases of animals the question is easier. It is of course highly dangerous to use pork with trichina. Cysticerci in pork, beef, and mutton should also be a valid ground for not permitting the sale, for it is not enough to expect the destruction of the parasite by the cooking that the meat will receive. If it be contended that the prohibition would affect supply, the answer is to be found in the consideration that breeders and salesmen would take greater care in preserving the cattle from parasitic infection; and that this can be done, by supplying pure water and clean food, is shown by the experience of Upper India.

Flukes in the liver do not constitute a valid ground of rejection of the meat, though the liver ought not to be eaten.

On the whole, it may be said that it is certainly wiser to condemn all meat which is derived from diseased animals, even when the animals are slaughtered, and most certainly when they have died of disease, for there are possible risks in the consumption of such food, and the State is warranted in interfering to prevent the individual being exposed to any such dangers. In the very important case of meat derived from tuberculous animals, medical opinion is now inclined to advocate the prohibition of sale of the carcasses for food, arguing that there is always a possibility of tubercles having been deposited in those parts which are used as human food. The question is at the present date under consideration by a Royal Commission.

Some very remarkable examples of an acute specific disease of peculiar characters have recently been observed among consumers of meats derived from the pig; where the sole evidence of disease in the meat has been the presence of a cultivable bacillus or of a poisonous ferment generated by it. Whether or not these morbid elements have been acquired during storage of the meat (more usually than from the animal furnishing the meat) is at present undecided. There would seem to be no doubt of the occurrence of cases where meat has received its poisonous quality during storage. *See* POISONOUS FOOD.

Sausages when musty and strong-smelling should be rejected, but, owing to the spices used, decomposition is not easily made out. The peculiar 'sausage-poison' has not been identified.

Wheat-flour and bread.—The chief points are to ascertain that there is no ergot, no fungi, nor acari; that alum has not been used; and that other grains or mineral matter are not mixed with it.

Of *Milk*, the chief falsifications consist in addition of water or removal of cream. Falsification in other ways is not common. Milk may also be improper for use owing to the presence of blood, lacteal casts, and pus; and unquestionably it will be dangerous if it have been derived from cows affected with the diseases before mentioned. Yet there are no ready means of discerning this dangerous quality, and therefore it is greatly to be desired that English people would adopt as their invariable rule the custom of many Continental countries to boil all milk before it is used as food. This, however, cannot be ensured by legislation.

Other foods are not often concerned in the production of disease, except in so far as they may have undergone decomposition. Accordingly they less often come under the cognisance of health officers than of the analysts appointed under the Sale of Food and Drugs Acts. It may be defined as the business of these analysts to determine whether or not an article really is what it professes to be; to detect the presence and amount of foreign substances, or of decomposition and putrefaction; and sometimes to show whether or not a given specimen reaches a certain appointed standard of value. The law permits mixtures to be sold in some cases, if the admixture is stated on a label.

8. *The Regulation of Trades.*—Trades are affected by the law under two aspects: 1st, irrespective of the nature of the particular trade, the *place where it is carried on* is regulated under the Mines, Factories, and Workshops Acts, and by the Public Health Act of 1875. Urban Authorities can make bye-laws regulating offensive trades, such as blood and bone boiling, fellmongery, soap, tallow, and tripe boiling, &c. The object of these Acts, among other things (such as restriction of labour at certain ages), is to provide that the common conditions of health are not violated. This is a very necessary point, for many workshops are deficient in light and air, are badly ventilated, or are rendered unhealthy by gas burnt for light. Many small workshops are owned by men of small capital, who would sacrifice the health of workmen by compelling them to work under very unfavourable conditions. Happily the faults are usually easily remedied by a little common sense and simple appliances, and in this respect the Workshops and Factories Acts have done great good. One special fault in many workshops is, however, still common, namely, the burning of gas in large quantities in dark shops, without proper means of carrying off the products; the very great influence of this condition on the lungs was long ago pointed out by the late Dr. Guy.

2nd. The other point in the regulation of trades is to prevent any of the *processes being nuisances* or injurious to the health either of the workpeople or the inhabitants of the surrounding districts. This is an extremely wide subject. Trades may annoy and inconvenience the public, as by offensive effluvia, black smoke, or acid vapour which destroys vegetation, yet may not be distinctly injurious to health. On the other hand, without being notable nuisances in the above sense, they may be hurtful to health, especially those (and they are very numerous) which give rise to dust in the air of any kind. Cotton and woollen *débris*, filings and grindings, particles of size, clay, dry paints, and many other substances, come under this head. There is no doubt that the inhalation of all solid particles, no matter whence derived, is highly injurious to health. Much debate has taken place as to whether certain gases, such as chlorine, iodine, sulphuretted hydrogen, sulphurous acid, or the fœtid vapours given off from catgut, gelatine, manure, and other trades, are or are not injurious to the health of the workmen, or persons living near the factories. In many cases the discussion is not closed, and fuller inquiries are necessary; but at present it seems as if these gases and fœtid effluvia, in such proportions as they are met with about factories, are not proved to be unhealthy (though their innocuousness cannot be asserted), however disagreeable they may be. On the other hand, some really dangerous gases, such as carbonic oxide, are not offensive to the smell. Phosphorus fumes escaping into the air have affected the jawbones of persons exposed to them; this happens now much less than formerly, owing in large measure to the increased use of red or 'amorphous' phosphorus in the manufacture of lucifer-matches.

The spread of *infection by trade operations*, as of anthrax among wool-sorters, and of small-pox among paper-makers, has recently come to demand recognition.

There is one article, the sale of which gives rise directly and indirectly to a large amount of sickness, and the trade in which certainly requires better regulation, if the public health is to be regarded. This is *alcohol* in its various forms. Owing to peculiar social customs, and to the insufficient recognition of the immense amount of harm produced by excess of alcohol, the laws of this country have not only legalised the sale of a dangerous article of diet, but have actually encouraged the sale, until an evil so gigantic has been produced that no one has yet suggested a reasonable remedy. Yet the sale of alcohol is so distinctly a source of disease and of injury to the State, that it must be considered by those who have charge of the Public Health, and in some way must eventually be restricted. One source of the error seems to be that alcohol is regarded by the State, not only as a source of revenue, but as the one indispensable article of 'refreshment.' There is, of course, no question that the public must be supplied with houses where they can obtain proper refreshments, such as meat, bread, vegetables, milk, coffee, tea, or other articles of the kind; and 'public-houses' were intended to supply articles of this description as well as the alcoholic liquids which enter into the ordinary diet of most people. Yet, unfortunately, a system has grown up by which our public-houses have become places where little else than alcoholic liquors are sold, and this system is defended on the ground that such liquids constitute 'refreshments.' The amount of temptation which has been put in the way of our working classes by the heedless multiplication of these drinking-shops during the last forty years accounts for much of the drunkenness which so deeply affects our national life, and injures the health of the people. A remedy ought and must be found for this state of things, or else legislation will continue to present the absurd spectacle of raising up one huge mischief to the public health, while it is all anxiety to rid the community of every other.

9. *The Arrest of the Contagious and Infectious Diseases.* — Small-pox, scarlet fever, measles, whooping-cough, diphtheria, enteric fever, typhus, and relapsing fever will here be considered. Among other contagious diseases syphilis and gonorrhœa must be referred to.

Of late years, since the recognition of the fact that each of these diseases possesses a *materies morbi* of its own, and spreads under conditions which have become more and more definable, the prevention of the infectious diseases has become much easier, even though the exact conditions and the natural history of the morbific material be not yet completely known. The general principles on which the prevention is based are—(1) The recognition of the places of origin and conditions of formation of the morbid agent, with recognition, also, of the processes to which it gives rise, alike in structures of the human body and in substances outside and independent of the body, with further question as to the nature of these substances, structures, or processes; the more fully these points are known, the more it is to be expected that the formation of the agent can be prevented or the agent be made harmless. (2) The recognition of the means of spread of the agent, after its first formation, that is, whether it spreads directly through the air, and, if so, through what distances and under what conditions; or whether it is carried in drinking-water or in food, or is transferred directly from one person to another: in proportion as this recognition has been gained, the carriage of the morbid agent may be stopped. (3) The early removal of the person affected from among the community, so that the risk of spreading in any way may be lessened. The system of compulsory notification of infectious disease has rendered it possible for the local authorities of towns to keep infected children out of schools, and by other like means to limit the opportunities of infection; and also to secure the isolation of infectious cases as they arise or are imported into the town, and thus at once to stamp out an impending epidemic. By the exercise of due vigilance and proper sanitary precautions it may now be hoped that epidemics of the more serious infectious fevers will be very largely held in abeyance.

In the case of each of these diseases the preventive measures are different, and it is impossible here to go into so large a subject as the specialities of each. The measures include a continual supervision over the conditions of origin, introduction, and spread, as far as they are known.

Two points must, however, be noted more particularly. The first is the isolation of persons ill with any disease which directly or indirectly can spread from one person to another. In the crowded houses of towns some diseases, such as typhus, scarlet fever, measles, and relapsing fever, spread with great rapidity, and the only means that we at present possess for checking them are to remove the sick at the earliest moment from such houses, and to prevent persons ill with infectious diseases from exposing themselves in public places and conveyances. For this purpose Sanitary Authorities have powers to remove persons ill with infectious diseases to a proper hospital in special conveyances; to prevent sick persons frequenting public places or conveyances; and to deal with infected rooms, houses, and clothing. Hospitals for infectious diseases can also be built, and are now being constructed in many towns. It would appear *primâ facie* to be desirable to make them simple, cheap buildings of wood or iron, able to be thoroughly cleaned, or after a term of years to be destroyed and replaced; but the objection to hospitals of this class is that authorities habitually postpone the provision of them, so that they are seldom in readiness for the reception of the earliest cases of an infective disease. Isolation hospitals should provide an air-space of 2,000 cubic feet, with a floor-space of 140 square feet, for each patient, and efficient separation between patients suffering from one and another infectious disorder. The freest ventilation, supply of water, and means of disinfection are essential.

The second point that needs special care from Sanitary Authorities is the provision of due means of disinfection for the community. They are empowered to erect a proper place for disinfecting clothing and bedding; and disinfecting chambers (heated by hot air, steam, or gas, and in which a heat of 240° F. can be reached) are now provided in most towns for the immediate disinfection by heat of all soiled clothes taken from patients with infective diseases. High-pressure steam, in an apparatus contrived for the intermission of its pressure, is found to give the best heat-penetration to large non-conducting articles such as bedding; and disinfecting chambers on this principle are to be commended for public use.

The disinfection of infective excreta and discharges from sick persons, together with any articles that may have been soiled by such matters, and disinfection of rooms that have contained infectious patients, have also to be secured. The poison of typhoid fever can be destroyed by strong chemicals added to the intestinal discharge; and the spread of typhus has been also lessened and perhaps arrested by aërial purifiers, especially nitrous acid fumes.

Small-pox is controlled by vaccination, and for this there are special laws and a special organisation. It has been expected that by following the lines indicated by the experience of vaccination, the community will hereafter gain some like means of control over other epidemic diseases; as well as over other diseases, also, of which the infective character has only lately been established.

The prevention of syphilis and gonorrhœa by periodical inspection of prostitutes, and removal of them to Lock Hospitals when diseased, was until recently carried out in this country in certain military and naval stations, where the effect has been to lessen primary syphilis by nearly one-half, and to abate its virulence. The operation of the Contagious Diseases Acts upon the women, in respect not only of curing them but of influencing them for good and of reclaiming them, was very remarkable. In Germany, France, and Belgium precautions against venereal diseases have been carried out among the entire population for many years, with the effect of greatly lessening the amount and virulence of syphilis. Although the Contagious Diseases Acts have not been actually repealed, they are not now enforced, either in the home military stations or in India. The result has been that venereal disease has increased enormously in the army. In 1887, out of 63,000 European troops in India, 23,000 were admitted to hospital for venereal disease (equal to a rate of 361 per 1,000 of strength); of the 23,000 admissions no less than 10,000 were for various forms of syphilis. When the Acts were in force in India the admission-rate was only about 180 per 1,000, or half of the present rate. A similar increase has been noted amongst the home troops at those stations where the Acts were formerly in operation. Put on the lowest ground, considerations of economy would appear to dictate a revival, for the army and navy, of these Acts—of course, with such modification of their provisions as experience may have indicated.

A variety of cogent objections against the application of these statutes to the civil population of the United Kingdom has been advanced, principally by Simon. Nevertheless, having regard to the extensive and most mischievous operation of syphilis upon the community, it is greatly to be hoped that the Legislature may before long give its attention to this subject, and endeavour to reduce by acceptable measures, primarily in the interests of children, the amount of syphilis which now afflicts the people.

10. *The Disposal of the Dead.*—Two points are involved in the disposal of the dead, both in towns and villages.

In this country, where so many families live in single rooms, and where the custom of keeping the dead five or even six days before burial is usual, it constantly happens that a corpse is kept for days in the room where all the family life is carried on. As decomposition, especially in some diseases, commences early, it cannot be doubted that an unfavourable effect on health must be often produced. To avoid this detention, mortuary chapels ought to be constructed in all towns and villages, and to these all corpses should be removed from the houses of the poor within thirty-six hours after death.

Power has long been given to Local Authorities to provide mortuaries, and to remove, when necessary, corpses from rooms where persons live and sleep. Very little has as yet been done in this way, and England is in this respect far behind some of the Continental States.

The other point is the disposal of the corpse. The law of England now allows no burial-grounds in large cities, nor burial under churches, and consequently cemeteries are provided at convenient distances from towns. These cemeteries ought to have a dry soil, so that the ground-water shall never rise high enough to wet the corpse or to float it up in the vault, as sometimes has happened; they should be as far from houses as practicable, and a limit of 200 feet is contemplated as a permissible minimum. There should be good drainage, and the water should not run into any well or watercourse from which drinking-water is taken; the site should be well ventilated and well planted, so that the roots of plants may absorb the decomposing matters. The kind of soil will, of course, depend on the locality; in many cases there is no choice; but if there be a choice, a marly soil, not too stiff, but allowing free permeation by air and free flow of water, should be chosen. Gravelly soils act pretty well, but are said to form a compact mass round the body, which prevents access of air and moisture; the lime and chalk soils act better, and especially if the soil is alkaline; very stiff clay preserves bodies longer than less compact soils.

Bodies decay in very various times, according to soil, access of air, amount of pressure, &c. In some cases a corpse may be destroyed in three years. When ground has to be used over again, a period of from five to thirty years is allowed in different countries before the second use. Bodies should be buried deeply (4 to 6 feet) in order to lessen the chance of contamination of the air, though it is supposed that when the graves are shallower, decomposition is more rapid; the graves should not be bricked, but the earth allowed to rest on the coffins.

It has been proposed to use not coffins, but sheets or wicker-baskets, so as to let the earth at once come in contact with the body; and, in fact, in many villages in England it was formerly the custom to carry the corpse in a coffin to the churchyard, but then to remove it from the coffin and place it in the ground in a sheet. If the coffin is not made too strongly, it is probable that it does not much delay decomposition; so that this point does not seem very material.

The decomposition of bodies occurs by putrefaction, with rapid disengagement of effluvia; or by a sort of insensible decomposition, the products undergoing further change by the action of the earth, as soon as they are formed. In other instances the decomposition is by 'saponification.' This last condition is said especially to occur if the earth is too closely pressed on the body.

As in some cases conveniently situated and proper land cannot be obtained, a discussion has lately arisen whether burning, or, in the case of seaboard towns, burying the body in the sea, might not supersede burial in the ground.

There being no law to prevent it, numerous cremations are now carried out every year in this country. If precautions are taken to prevent any possibility of the burning of the bodies of persons who have met their death from criminal means, there cannot be any medico-legal objection to cremation. On sanitary grounds cremation must be held superior to earth-burial with its actual abuses in the shape of overcrowded cemeteries, and appears to offer an alternative solution to a difficulty which presses more and more heavily as population increases in density, and suitable land in the vicinity of towns becomes less easy to obtain.

11. *The Supervision of Nuisances.*—The word 'nuisance' has been adopted into sanitary law, without any fixed idea of the relation of the word to health or disease. 'Nuisances' are defined as being a number of enumerated conditions, some of which have to be 'injurious to health,' while others need not be injurious to health (but have only to be obnoxious), in order to bring them within the provisions of sanitary law. The confusion thus arising has been such that the

primary object of sanitary legislation has sometimes been obscured. So much, indeed, has this been the case that, in comparatively recent times, it has been contended that a given condition which habitually does harm to health, but which had not yet, in the particular instance, succeeded in effecting actual disease, is not a 'nuisance injurious to health' within the meaning of a Public Health Act. The contention, however, has not been adopted by the Courts.

It is the duty of every Sanitary Authority to cause inspection to be made of their district to discover 'nuisances,' as enumerated in sanitary statutes; and a certain procedure for the abatement of 'nuisances,' and for the prevention of their recurrence, is appointed by sanitary law. For the performance of these functions the Authority is required to appoint one or more Inspectors of Nuisances, to whose office certain powers are attached.

The work of nuisance-inspection in its everyday concern with conditions injurious to health cannot be properly performed without the constant and intimate relation of the Medical Officer of Health with the Inspector; and those districts are unquestionably best served as to sanitary inspection where the Authority has devolved on the Medical Officer the duty of instructing the Inspector and of supervising his work.

Specialities of Rural Sanitation.—While the objects to be gained by sanitary action are of course the same in town and country, the methods of attaining them in rural places must needs depart in some measure from those which are available in towns; and accordingly sanitary law in its administrative aspects recognises rural as distinguished from so-called 'urban' districts. Rural Sanitary Authorities, constituted in 1872, can now exercise considerable powers; and where properly set in action by their Medical Health Officers and Inspectors of Nuisances, a great effect is being gradually produced upon the rural labouring class, whose condition had long been neglected. The Rural Sanitary Authority may provide water for public use, may make public cisterns or baths, may protect water-courses, may construct sewers and dispose of sewage matter; must take care that no closet or privy is a nuisance; may clean ditches and remove refuse; and may make regulations as to cellar-habitations and common lodging-houses. Much increased power of securing proper water-supply in the particular house within rural districts has been given, and there are few urban powers which cannot be acquired, if wanted, by any locality that can make a claim for consideration as a 'contributory place.' All powers possessed by urban Authorities as to trades, sale of unwholesome food, removal of nuisances, providing mortuaries and hospitals for infectious diseases, are now also possessed by the rural Authorities.

At present, however, comparatively little sanitary progress has been made in rural districts; and unquestionably there are some obstacles, inherent in the case, to any rapid progress. The difficulties arise from the houses in the rural districts being, in a great number of cases, old, dilapidated, unsuited for dwellings, and destitute of proper conveniences. When new houses are built, the Sanitary Authority can enforce certain provisions, though it has far less control over building operations than is possessed by urban Authorities. In the case of houses already built, however, its power is, from circumstances, even more limited. There is very little money available for improvements; the poor-rates are already often heavy, and guardians hesitate to increase them. The small number of houses in villages also, in comparison with the outlay needful to supply sewers and water, renders the cost per head much greater than in towns. In addition to bad construction and dampness of houses, the most frequent sanitary defects of rural places are as follows: The water is too often drawn from shallow wells or from small streams polluted by soaking, or even from stagnant pools or ditches, and its supply is limited. Often there are no means for carrying away the dirty house-water, and it is thrown on the ground and soaks into the soil close to and under the cottage; the excrements are generally thrown into an ash-pit near the house, or pass into a cesspit, from which they gradually soak, in such way as to pollute both ground and water. These difficulties, however, are being gradually overcome in districts which have secured the services of a first-class Officer of Health, who has sought, by means adapted to the special local conditions, to obtain the same sanitary advantages that are got in town districts by the use of more organised sanitary operations. Attempts are now being made to purify and then to guard the wells; to collect rain-water in proper tanks when other sources are not available; or to store the water collected (in the manner recommended by Mr. Bailey Denton) from the surface-soil of some area secure from drainage, manuring, or like impurities. For the disposal of the slop-water, open or partially closed surface drains leading to ditches, or underground drains that shall allow the water to flow into the soil, and other plans, have been proposed. It is, on any plan, important—but especially if shallow wells or the surface soil is to furnish the drinking-water—to carry off to a distance all the slop-water by drains of some kind. For the removal of excreta (as sewers are generally out of the question) a pail system, with or without the use of dried earth or charcoal, according to circumstances, has to be used.

If the cottages have gardens, then the simplest dry-earth plan, with proper storage and the subsequent digging into the gardens at intervals of not more than three or four weeks, seems to answer well; yet it is very difficult to get peasants to attend even to this simple matter. A plan of conjoint action in the procuring, drying, and distributing the earth, and in the removal of the mixed earth and excreta, answers well when care is taken. In other cases a pail system, with weekly removals, and without the use of earth or other appliance, has been employed, and may answer, as the manure has some value.

These seem at present the directions in which the opinions of Medical Officers of Health are tending where villages and labourers' cottages are concerned, and where larger works cannot be undertaken. The object, of course, is to obtain for the rural community by simple means, and at not too burdensome a rate, the sanitary requirements of pure soil, of pure air, and of pure drinking-water.

Houses.—The inside of a house is supposed to be beyond the control of the public health Authority, and is so to a large extent, but not altogether. The law takes cognisance of the existence of *nuisance* inside, as well as outside, a house; and has special provisions for securing wholesomeness of habitation in the following cases:—

1. *Common lodging-houses* have been regulated since the great Public Health Act of 1848, the authors of which were evidently profoundly impressed with the great evils of overcrowding. The definition of a common lodging-house that is now usually accepted is that given by the law-officers of the Crown in 1853—namely, a house in which persons of the poorer class are received for short periods, and, though strangers to one another, are allowed to inhabit one common room. These houses are registered and inspected; the number of lodgers is fixed; and ventilation, cleanliness, and water-supply are now attended to. A certain cubic space per head in the sleeping-rooms of these houses is generally fixed by the Authority. In the Metropolis (where Acts administered by the police remain in force) 240 cubic feet, in Dublin and many other towns 300 cubic feet, are required for each adult inmate.

2. *Cellar-habitations.*—Since 1848 it has been unlawful to use cellar-habitations, unless they are in accord with certain conditions of space, height, window area, and drainage. By the Public Health Act of 1875 it is made unlawful to use any cellar as a dwelling (that is, a place where any person passes a night) which has been built or rebuilt after the passing of the Act, or which was not lawfully in use when the Act was passed. A cellar is defined by various statutes to be any room of a house, the surface of whose floor is more than three feet below the surface of the footway of the adjoining street; and it has to fulfil a number of conditions before it can be legally inhabited.

With the supervision that has been given to common lodging-houses during the past thirty years, they have become much healthier and more decent habitations. During the same period the number of cellar-dwellings in our towns has much decreased, and the condition of those still used has notably improved.

3. '*Houses let in lodgings*,' or occupied by members of more than one family. These are distinguished from *common* lodging-houses, and would more conveniently be termed *tenemented* houses. Sanitary Authorities have various important powers conferred on them in respect of this large class of houses where two or more families live in the same house. But, for these powers to arise, the consent of the Local Government Board is required.

4. *Overcrowding.*—This condition, so dangerous to the health of the inmates, is to be regarded—no matter in what house it is observed, or whether the inmates be of the same family or not—as a nuisance, and is to be dealt with as such. The question arises, what is overcrowding, and usually the common lodging-house rules are taken, namely, an air-space of 300 cubic feet per head. But there is no legal definition, except in Scotland, where the General Improvement and Police Act of 1862 enacts that children under eight years of age shall have 150 cubic feet, and persons over that age 300. Obviously, the standard of space per person adopted as the minimum in the *bedrooms* of common lodging-houses, where the occupation is by night only, is too small for those who have to occupy the same room both by day and night, as is usually the case, where the question of overcrowding arises in the dwellings of the poor. It would be very desirable to raise the minimum (at all events for persons over ten years) to 400 cubic feet, and this is really little enough.

Although public authority does not extend to all the conditions which are next to be passed in review, it will be convenient to consider together the various causes of unhealthiness of houses.

Causes of Unhealthiness of Houses.

1. *Dampness.*—Dampness arises from a damp soil, water rising into walls, rain beating through walls or coming from a leaking roof, or blocked water-pipes. Paving, concreting, damp-proof courses, hollow walls, &c., are the remedies. Damp houses are unhealthy, it would appear, by reason of the lowering of warmth helping to catarrhal

and rheumatic affections, and probably by reason of increased bacterial life due to the constant presence of moisture.

2. *Excessive coldness of air from draughts or from insufficient warming.*—Although an airy house is the healthiest, there may be excessive or irregular movement of air, so that strong currents are caused, with consequent undue skin-evaporation; whereby the body-temperature may be lower than is good for health, even if persons are well-clothed. The draughtiness is matter of construction, and is obviated by improvement in the methods of ventilation. Then, as to warming. Our present English use of fireplaces is both inefficient and expensive. It might have been expected that, in towns, this plan of warming houses would long ago have been abandoned for some more general use of hot-water or steam pipes. The supply of warmed fresh air is a very simple proceeding when these pipes are used, and thus not only can houses be better warmed, but better ventilated and less draughty. The greater convenience of a furnace serving to heat several houses is not at present appreciated in England; but here and there this consideration has probably contributed to the use of 'flats' in place of separate houses.

3. *Impurity of the air.*—This arises from the following conditions: from the air being drawn from the ground into the house, or passing over impure earth or deposits; or by the air in the house becoming contaminated by effluvia from closets and drain-pipes; from combustion; from respiration and skin-transpiration; from uncleanliness of persons, clothes, walls, floors, and furniture.

Each of these conditions has to be examined into and rectified according to the usual principles laid down in works of hygiene. A few remarks may, however, be permitted on some of the headings.

The removal of respiratory impurities can only be accomplished by constantly removing the air of rooms and supplying fresh air. This is *ventilation*; and, if we include in the definition that the supply and removal of air shall be tolerably uniform, ventilation presents a mechanical problem of no little difficulty. The amount of air required for an adult, in order to keep the air free from any odour, is 3,000 cubic feet per hour; or if the carbonic acid derived from respiration be taken as a measure of respiratory impurity, it should not exceed ·2 per 1,000 volumes of air. Practically, the amount most persons get is not more than 600 to 1,200 cubic feet per hour, if so much, and the air of their rooms smells fusty from organic effluvia. In cold times of the year, the entering air must be warmed, if the change is to be so rapid as is implied in the supply of 3,000 cubic feet of air per hour, equivalent to a change of air in the air-space three, four, or even five times per hour. When warmed to nearly the temperature of the surface of the body (80° to 90° F.) considerable movement of air is borne without difficulty, but if the temperature be much lower a correspondingly slighter movement is felt. Ventilation in this climate is therefore inextricably mixed up with warming, and thorough ventilation of our rooms is impossible so long as we trust to radiant heat alone for warmth. The problem, therefore, which engineers have to solve in warming and ventilating our rooms is, what is the cheapest and most constant plan of introducing warm air, of a temperature of some 80°, into our houses in cold weather; the conditions of the problem being a supply of 3,000 cubic feet per head per hour, at a rate of movement imperceptible to the feelings of the persons in the room.

The second point is connected with the impurity of the air from drains. The first thing is to be certain that the air of the house-drain is so thoroughly disconnected from the air of the public sewers that no reflux from them is possible; and therefore, that, if there is any drain-air polluting the atmosphere of the house, it is not the air of the common sewer. That point having been settled, it will follow that drain-smell in the house must come either from the ground or from the house pipes or closets themselves. If from the ground, there is probably (if the ground itself be clean, or if the smell be of new production) a leaky drain-pipe somewhere, and the air is penetrating through the leakage and is drawn into the house. If not from the ground, the smell may be from some pipe in the house; this arises from imperfect junction, especially when metal pipes are joined on to earthenware, or from the pin-hole eating-away of metal pipes. Or a drain-pipe may be choked (generally through 'settling' at a joint occurring in an ill-laid and badly bedded pipe), and decomposition be going on in its retained contents. Or there may be a clogged or imperfect trap, with the water either sucked out of it or becoming thoroughly charged with fetid effluvia. In the latter cases, there is a presumption that the ventilation of the house-drain is not what it should be. Every house should have a plan of its drainage, so as to facilitate the search for a broken pipe.

In order to detect any of these conditions it is necessary that builders should alter their habits in regard to house-plumbing arrangements. At present they try to conceal everything, so that, without pulling a house to pieces, it is impossible to examine if pipes and traps are in order. Instead of this, every pipe above the ground should be kept out of walls; and if cased with wood, the case should be merely bolted, and not nailed. If a drain must be carried under a house, it should have inspection chambers built upon it at every change of direction, so that the drain which runs in a straight line from one manhole chamber to the next can be inspected and cleared of obstructions or deposit without breaking into it. The sewage and foul-water arrangements of our houses will never be satisfactory till these matters are attended to, and till the examination of every pipe about the house can be made without difficulty, and clogging or leakage of air or water from pipes can be readily detected.

In closets, the chief points of leakage are in the more horizontal pipes and in the traps. In all cases the soil pipe should be ventilated by pipes carried to the open air at some points away from windows.

Another matter to be guarded against, whether there be drain-smell or not about a house, is the immediate opening of the cistern overflow-pipe, or of the usual rain-water pipe, into the sewer or house-drain. The common practice, until recently, has been to connect them directly with the house-drain, perhaps with an S trap at the foot of each pipe, these traps, however, being usually dry. Then sewer-air passes up and enters the cistern, or into rooms which happen to be near the top of the rain-water pipe. All these pipes should open in free air over a grating; and if every householder would insist on the builder attending to these matters, the chances of inflow of sewer-air into houses would be much lessened.

Another, third, point of importance is the way in which the products of gas-combustion are allowed to pass into the air of rooms. Nothing can be worse than the usual arrangement; and, as gas-lights might be made a valuable means of ventilation if tubes were arranged to carry off the burnt gas, the present arrangement of chandeliers is not only hurtful, but involves an ignorant waste of useful force.

4. *Impurity of the water.*—Water delivered to a house may become impure on the premises, usually from uncleaned uncovered cisterns, absorption of air from drains by the surface of the water, and sometimes by more direct leakage from pipes into cisterns. Lead may also be taken up. The remedies for these conditions are obvious. Reference has already been made to extensive epidemics of enteric fever due to the insuction of matter from sewers into public water-pipes, through fissures in those pipes while running full. It is probable that obscure cases of disease in particular houses are not infrequently due to an unsuspected pollution by similar means of the water-service of the house.

5. *Impurities from uncleanliness of the house.*—Walls and ceilings all absorb impurities which are given out again to the air, and often become highly impregnated with organic matters. The chinks of floors allow matters to collect below them, and then impure air rises into the room.

Of all parts of a house where cleanliness is of importance, there is probably none more important than *larders* and other places where food is stored. It would appear certain that in some cases of food-poisoning the injurious quality has been obtained by storage in places that received sewer-air or other morbific matter. Yet not infrequently any dark unventilated closet is made to serve the purpose of a larder.

The custom of re-papering walls without removing the old paper, the decomposition of paste and paper on damp walls, and the use of arsenical pigments, may give rise to impurities of one and another kind in the air of houses. In the houses of the poor which are not regularly whitewashed, the half-crumbling plaster is often highly charged with animal material.

These matters are to be avoided by original good construction and by constant cleanliness. It is a great desideratum to make walls of impermeable material, so that they may be washed without difficulty; but, at present, this is an expensive matter.

If these various points, which are really questions of purity of air and water, and of temperature and movement of air, are properly dealt with, houses will be healthy. These are conditions which are not difficult to secure if they are clearly understood and if their importance is not underrated. The great point is to have the house-air pure, so as in no way to injure or depress the great function of respiration.

While we look to the Municipality or Local Sanitary Authority to keep the outer air pure, the task of doing the same for the house-air must necessarily fall on the inhabitants of the house.

Duties of the Medical Officer of Health.—It behoves the residents of every district to assist the Sanitary Officers to the best of their ability; and to aid towards such endeavours, this article may usefully conclude by an enumeration of the duties which are imposed upon the Medical Officer of Health for districts in England. They are extracted from an Order of the Local Government Board, dated 1891.

'The following shall be the duties of the Medical Officer of Health in respect of the district for which he is appointed :—

'1. He shall inform himself as far as practicable respecting all influences affecting or threatening to affect injuriously the public health within the district.

'2. He shall inquire into and ascertain by such means as are at his disposal the causes, origin, and distribution of diseases within the district, and ascertain to what extent the same have depended on conditions capable of removal or mitigation.

'3. He shall by inspection of the district, both systematically at certain periods, and at intervals as occasion may require, keep himself informed of the conditions injurious to health existing therein.

'4. He shall be prepared to advise the Sanitary Authority on all matters affecting the health of the district, and on all sanitary points involved in the action of the Sanitary Authority; and in cases requiring it, he shall certify, for the guidance of the Sanitary Authority or of the Justices, as to any matter in respect of which the certificate of a Medical Officer of Health or a Medical Practitioner is required as the basis or in aid of sanitary action.

'5. He shall advise the Sanitary Authority on any question relating to health involved in the framing and subsequent working of such by-laws and regulations as they may have power to make, and as to the adoption by the Sanitary Authority of the Infectious Disease (Prevention) Act, 1890, or of any section or sections of such Act.

'6. On receiving information of the outbreak of any contagious, infectious, or epidemic disease of a dangerous character within the district, he shall visit without delay the spot where the outbreak has occurred, and inquire into the causes and circumstances of such outbreak; and in case he is not satisfied that all due precautions are being taken, he shall advise the persons competent to act as to the measures which may appear to him to be required to prevent the extension of the disease, and take such measures for the prevention of disease as he is legally authorised to take under any statute in force in the district, or by any resolution of the Sanitary Authority.

'7. Subject to the instructions of the Sanitary Authority, he shall direct or superintend the work of the Inspector of Nuisances in the way and to the extent that the Sanitary Authority shall approve, and on receiving information from the Inspector of Nuisances that his intervention is required in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall, as early as practicable, take such steps as he is legally authorised to take under any statute in force in the district, or by any resolution of the Sanitary Authority, as the circumstances of the case may justify and require.

'8. In any case in which it may appear to him to be necessary or advisable, or in which he shall be so directed by the Sanitary Authority, he shall himself inspect and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk, and any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, exposed for sale, or deposited for the purpose of sale or of preparation for sale, and intended for the food of man, which is deemed to be diseased, or unsound, or unwholesome, or unfit for the food of man; and if he finds that such animal or article is diseased, or unsound, or unwholesome, or unfit for the food of man, he shall give such directions as may be necessary for causing the same to be dealt with by a Justice according to the provisions of the statutes applicable to the case.

'9. He shall perform all the duties imposed upon him by any by-laws and regulations of the Sanitary Authority, duly confirmed where confirmation is legally required, in respect of any matter affecting the public health, and touching which they are authorised to frame by-laws and regulations.

'10. He shall inquire into any offensive process of trade carried on within the district, and report on the appropriate means for the prevention of any nuisance or injury to health therefrom.

'11. He shall attend at the office of the Sanitary Authority or at some other appointed place, at such stated times as they may direct.

'12. He shall from time to time report in writing to the Sanitary Authority his proceedings, and the measures which may require to be adopted for the improvement or protection of the public health in the district. He shall in like manner report with respect to the sickness and mortality within the district, so far as he has been enabled to ascertain the same.

'13. He shall keep a book or books, to be provided by the Sanitary Authority, in which he shall make an entry of his visits, and notes of his observations and instructions thereon, and also the date and nature of applications made to him, the date and result of the action taken thereon, and of any action taken on previous reports; and shall produce such book or books, whenever required, to the Sanitary Authority.

'14. He shall also make an annual report to the Sanitary Authority, up to the end of December in each year, comprising a summary of the action taken, or which he has advised the Sanitary Authority to take, during the year, for preventing the spread of disease, and an account of the sanitary state of his district generally at the end of the year. The report shall also contain an account of the inquiries which he has made as to conditions injurious to health existing in the district, and of the proceedings in which he has taken part or advised under any statute, so far as such proceedings relate to those conditions; and also an account of the supervision exercised by him, or on his advice, for sanitary purposes over places and houses that the Sanitary Authority have power to regulate, with the nature and results of any proceedings which may have been so required and taken in respect of the same during the year. The report shall also record the action taken by him, or on his advice, during the year, in regard to offensive trades, to dairies, cow-sheds, and milk-shops, and to factories and workshops. The report shall also contain tabular statements (on forms to be supplied by us [Local Government Board], or to the like effect) of the sickness and mortality within the district, classified according to diseases, ages, and localities.

'Provided that, if the Medical Officer of Health shall cease to hold office before the thirty-first day of December in any year, he shall make the like report for so much of the year as shall have expired when he ceases to hold office.

'15. He shall give immediate information to us of any outbreak of dangerous epidemic disease within the district, and shall transmit to us a copy of each annual report and of any special report. He shall make a special report to us of the grounds of any advice which he may give to the Sanitary Authority with a view to their requiring the closure of any school or schools, in pursuance of the Code of Regulations approved by the Education Department, and for the time being in force.

'16. At the same time that he gives information to us of an outbreak of an infectious disease or transmits to us a copy of his annual report or of any special report, he shall give the like information or transmit a copy of such report to the County Council or County Councils of the county or counties within which his district may be situated.

'17. In matters not specifically provided for in this Order, he shall observe and execute any instructions issued by us, and the lawful orders and directions of the Sanitary Authority applicable to his office.

'18. Whenever we shall make regulations for all or any of the purposes specified in section 134 of the Public Health Act, 1875, and shall declare the regulations so made to be in force within any area comprising the whole or any part of the district, he shall observe such regulations, so far as the same relate to or concern his office.'

EDMUND A. PARKES. GEORGE BUCHANAN.

PUERILE (*puer*, a boy).—This word is associated in medicine with the respiratory murmur when it is exaggerated, possessing the characters heard over the lungs in a healthy child. *See* PHYSICAL EXAMINATION.

PUERPERAL DISEASES. — The diseases associated with parturition, which fall for consideration in the present article, are: (1) Puerperal Convulsions; (2) Puerperal Fever; (3) Puerperal Peritonitis; and (4) Puerperal Thrombosis and Embolism. Certain other pathological conditions of equal importance, occurring during the puerperal state, are more conveniently discussed under their several special names. *See* PELVIC ABSCESS; PELVIC CELLULITIS; PELVIC PERITONITIS; and PHLEGMASIA DOLENS. Puerperal insanity is described in the article INSANITY, Varieties of.

1. Puerperal Convulsions.—SYNON.: Puerperal Eclampsia; *Eclampsia Gravidarum, Parturientium, vel Puerperarum*; Fr. *Convulsions des Femmes Enceintes et en Couche*; Ger. *Eklampsie in der Schwangerschaft und im Wochenbett.*

DEFINITION.—A peculiar kind of epileptiform convulsions, characterised by loss of consciousness and sensibility, together with tonic and clonic spasms; occurring in the later months of pregnancy, during labour, or after delivery; and causing great danger to the lives of both mother and child.

ÆTIOLOGY.—The frequent association of this disorder with albuminuria had till lately given rise to the belief that it is the result of uræmia; and notwithstanding that cases have been observed in which albumen was present in the urine in large quantity without convulsions occurring, and others in which the eclamptic attacks took place without any albumen, or a mere trace only, being present, it is probable that *insufficiency of the kidneys* is by far the most frequent, if not the invariable cause. The writer has no doubt that twin pregnancy is a not infrequent cause of albuminuria, from the many cases of it which have come under his personal observation.

Traube and Rosenstein have referred the causation of the convulsions to acute cerebral anæmia, resulting from changes in the blood incidental to pregnancy, the watery condition of the blood being associated with increased tension of the arterial system. The late Dr. Angus Macdonald, of Edinburgh, pointed out that he had discovered by *post-mortem* examination extreme anæmia of the cerebro-spinal centres, with congestion of the meninges, without œdema. He attributed the convulsive attacks to irritation of the vaso-motor centre, from an anæmic condition of the blood, produced by the retention in it of excrementitious matters which should have been eliminated by the kidneys. In 1889 M. Emile Blanc found in the urine of eclamptic patients a microbe with intense pathogenic effects and well defined. He extended his researches to the albuminuria of pregnancy, and examined and made cultures of the blood and urine. These researches demonstrated a microbe in the form of a short bacillus having at its two extremities depressions analogous to nuclei. With 45 minims of a culture furnished by the blood of an eclamptic, a rabbit eighteen days pregnant was inoculated. She died in twelve hours with intense convulsive phenomena, having dropped one or two of her young dead.

Symptoms.—Puerperal eclampsia is happily not of common occurrence, its estimated frequency being about once in 500 cases. Occasionally the outbreak occurs without warning, but usually there are premonitory symptoms. The most frequent of these is œdema of the feet and legs, which may extend to the vulva, abdomen, face, and upper extremities, and should at once suggest an examination of the urine, which will almost invariably be found to contain albumen in more or less quantity, with a diminution in the amount of urea which should be excreted. Sometimes casts may be found. The writer has had under his observation a case in which œdema of the feet and ankles occurred without a trace of albumen in the urine, though later it appeared in abundance, and the patient died of eclampsia during labour. Other premonitory symptoms are headache, generally frontal, but occasionally limited to one side; vertigo; loss of memory; and derangements of vision, such as amblyopia, and flashes of light before the eyes.

When the convulsive seizure occurs it cannot be mistaken. The eyes first become fixed, and rapid contraction of the muscles of the face occurs, with rolling of the eyeballs, the pupils being lost under the upper eyelids. The face becomes turned first towards one shoulder, then towards the other. The convulsions rapidly extend to the other parts of the body; after a short period of tonic contraction violent clonic spasms occur. The face becomes livid, the tongue is protruded, and, if care be not taken, it is lacerated by the teeth, colouring the frothy saliva which has been emitted at the angles of the mouth. The thumbs become clenched in the palms, and violent jerkings of the arms occur, whilst the muscles of the face give rise to a variety of contortions. Sometimes involuntary evacuations of the bladder and rectum occur during the fit. There is total loss of consciousness and sensation. After a few minutes the symptoms gradually subside; a longer interval occurs between the clonic muscular contractions; the face loses its lividity; and the breathing becomes more tranquil. When the first fit has passed off, the patient may recover her consciousness; but if another occur with rapidity, and very little time elapse between the paroxysms, complete coma resulting in death may soon supervene. Where there is a considerable time between the attacks, it may be many hours or days before consciousness is restored, and recovery takes place. A remarkable feature of this disorder is that when the patient becomes sensible, and is restored to health, she has invariably no recollection of what occurred, not only during her illness, but for some time preceding the fits.

Prognosis.—This depends upon the severity and frequency of the paroxysms. It is generally considered that one in every three or four cases proves fatal. The earlier the convulsions appear in labour, the more unfavourable the prognosis. The longer the labour and the more difficult the delivery, the deeper is the coma and the less the prospect of recovery. It is very rare for the convulsions to cease before the birth of the child. The mortality has probably diminished of late years, since indiscriminate venesection has been abolished, and other treatment adopted.

Treatment.—Recognising that 'prevention is better than cure,' we must first consider what is best to be done when premonitory symptoms arise. The occasional examination of the urine of pregnant women is always a wise precaution, but it is urgently called for whenever œdema of the feet or other parts is noticed. Slight traces of albumen are not infrequent, and are of no importance; but persistent albuminuria to any considerable amount calls for most careful watching and treatment, and the amount of urea passed in the twenty-four hours should be ascertained. A milk diet, and the administration of diuretics and iron, with mild laxatives, should be tried; but, if little or no improvement takes place, the question of induction of premature labour should be discussed, and the writer from his own observations is very strongly in favour of it. He has in a large number of cases adopted it without the occurrence of eclampsia, both mothers and children being saved; whereas he has seen instances in which, after consultation, it was decided to leave it till labour took place naturally, and the result has been eclampsia and death.

If convulsions arise, chloroform should be administered at once, and should be repeated at each succeeding attack, while an enema of thirty grains of chloral and the same amount of bromide of potassium may be given to lessen the amount of chloroform subsequently needed. If the labour proceed well, it should be allowed to take its own course; but if it be tardy, and the forceps can be applied, it should be employed to expedite delivery, though caution should be exercised not to extract the child in too great a hurry. The hypodermic injection of pilocarpine has been employed, in the hope that the diaphoresis produced might relieve the arterial tension; but the results are anything but encouraging, and it cannot be recommended. Venesection, which used to be the universal treatment, is now very rarely adopted. There are, however, cases in which it is undoubtedly called for: in women of plethoric habit, with congested face and full pulse, showing much arterial tension, it will probably be found of great benefit.

When the convulsive attacks occur or continue after labour, hypodermic injections of morphine, although condemned by some writers on account of the renal condition, have been found to act well.

2. Puerperal Fever.—SYNON.: Childbed Fever; Puerperal Septicæmia; Fr. *Fièvre Puerpérale*; Ger. *Puerperalfieber*; *Kindbettfieber.*

DEFINITION.—A continued fever of a contagious character, occurring in connexion with childbirth.

PATHOLOGY AND ÆTIOLOGY.—Numerous theories and hypotheses have been suggested in regard to the nature and relations of puerperal fever, but it is now generally accepted that it is a disease of traumatic origin, resulting from septic matter coming into contact either with the inner surface of the uterus, where, after delivery, dilated veins and lymph channels abound, or with some part in the genital tract where lesions exist, which are very commonly produced during labour. The septic virus, though generally introduced from without, may arise within the parturient canal itself, putrefaction going on in it (*auto-sepsis*); and retained portions of placenta or membrane may perhaps be concerned in this. In such cases the onset of the disease is not generally so violent as when the poison has been introduced from without, during labour, by those coming into contact with the patient, through the medium of their clothes or of their hands, or by means of sponges or instruments such as catheters. Other external sources may be the bedding, sheets, or diapers; or possibly the air itself may carry the poison to the wound, where septicæmia is present in the same dwelling as the parturient woman—in lying-in institutions, for example.

Semmelweis, in 1847, was the first to demonstrate how in the General Hospital, Vienna, those making *post-mortem* examinations and subsequently engaged in the midwifery wards conveyed infection to the patients through the medium of cadaveric matter on their hands. This led, at his suggestion, to the employment of antiseptics in midwifery practice; and there is no doubt that to this may be attributed in great measure the remarkable change that has taken place in the rate of mortality in the lying-in hospitals. The writer, in the *Lancet* of April 1, 1893, in a short paper on 'Antiseptic Midwifery,' pointed out how, in the City of London Lying-in Hospital, where the death-rate for a long period of years had averaged over 2 per cent., it had, since the antiseptic management had been properly carried out, fallen to 0·31 per cent., the average of the last six years; and that during a period which has just reached two years upwards of 950 women had been delivered in the institution without a single death from any source whatever. No stronger evidence could be adduced to show that lying-in hospitals, formerly regarded as dangerous to enter, may now be looked upon, under proper management, as the safest places to be *confined* in.

ANATOMICAL CHARACTERS.—Septicæmia may assume the lymphatic or the venous form, according to which of these channels it selects to diffuse itself through the body, and it may kill so rapidly as to leave no local manifestations of disease. But if the vagina is severely affected, the mucous membrane looks soft and infiltrated, and lacerated parts are usually covered by a discoloured membrane. The cervix uteri, which is so frequently the seat of injury during labour, may become inflamed, and suppuration occur in the cellular tissue which surrounds it. The interior of the uterus is often covered with a coagulated exudation. The pelvic cellular tissue probably becomes affected. The peritoneum is almost certainly involved, and a coagulated exudation or fluid pus is found in the folds around the uterus, in Douglas's pouch and elsewhere, or the peritonitis may be diffuse, and associated with pleurisy and pericarditis and effusions into the joints. If the absorption has taken place through the veins, broken-down thrombi will be found, and from these embolic foci and abscesses may occur in the lungs; the spleen is almost always enlarged, and embolic infarcts may be found in it, as well as in the kidneys. Endocarditis and meningitis may arise; and sometimes, though rarely, destruction of the eyeball.

SYMPTOMS.—In no disease do the symptoms vary more than in puerperal fever, depending upon the violence of the fever, and the localities attacked by the poison. The fever generally originates within three days after delivery, though sometimes later, very rarely after the fifth day. Occasionally there is, first of all, a feeling of depression, with headache; often the first symptom is a rigor. The pulse becomes rapid and feeble, 130 or more per minute. The temperature rises to 103° F., or higher. The skin is generally hot and dry. Vomiting frequently occurs early, the ejecta being like coffee-grounds, and of a peculiar odour. Diarrhœa is often very troublesome, and the evacuations are horribly fetid. The tongue soon becomes coated with a heavy fur, later on becoming dry and raspy; and sordes appear on the lips. There is often acute pain in the abdomen, with tenderness and swelling; but peritonitis with effusion may occur without any of these symptoms. Sometimes the swollen, tender uterus can be felt in the hypogastrium. The lochia are generally suppressed, and the secretion of milk arrested, though sometimes the mammæ are hard and painful. As a rule, the intellect is unimpaired, though low muttering delirium frequently precedes death. The breathing is short and hurried. Pneumonia, pleurisy, or pericarditis occasionally ensues. Jaundice or albuminuria may be present. The joints may swell and suppurate; and abscesses may form in any part of the body.

COURSE AND TERMINATIONS.—The disease, if of the lymphatic variety, begins very early, and generally runs a rapid course, terminating fatally within a week. The pulse becomes more and more rapid and feeble; the breathing more hurried and panting; tympanites sets in; a cold clammy sweat breaks out; finally hiccough, subsultus, and low muttering delirium come on, with frequently incessant vomiting; and the patient sinks from exhaustion. The venous variety generally shows itself much later, is of much longer duration, and is associated with erratic rigors, and an absence of abdominal distension.

TREATMENT.—(1) *Prophylactic.*—This is of the utmost importance. Keeping in mind the sources of the disease, it behoves the practitioner to avoid every means of communicating septic matter to the patient, either personally or by the nurse. If possible to arrange it, the genital organs should never be touched without the hands having been first thoroughly rinsed in an antiseptic solution of either carbolic acid, corrosive sublimate, or tincture of iodine. All sponges should be thoroughly cleansed before use in an antiseptic solution; so also all instruments, such as irrigation tubes, the forceps, or catheters. The catheter and vaginal tube should be made of glass or translucent celluloid, which enables one to see that no blood or clot is retained within them. Instead of cold cream, a preparation containing 1 drachm of absolute carbolic acid to 2½ oz. of benzoated lard should be employed for lubricating the examining finger, and it should be introduced into the vagina as seldom as possible. The utmost care should be observed to avoid the smallest piece of the placenta or membrane being left within the uterus. Subsequently all washings or syringings of the genitals should be performed with a solution of carbolic acid (1 to 40), or, what is still more reliable, a solution of perchloride of mercury of the strength of 1 in 2,000. It is a very good plan to give a vaginal injection of this at a temperature of about 115° F. in every case where it is practicable after the placenta has been removed, and before the binder is applied, and to repeat this night and morning during the two or three days following delivery. The practitioner should, when able, order all these preparations to be in the house previous to the expected time of delivery.

(2) *General.*—The general treatment varies with the character of the disease. At first active antiphlogistic remedies may be indicated; and in some cases local depletion by leeches, in other cases blisters. Drugs, such as veratrum viride (much employed in America), aconite, digitalis, or salicylic acid, may be useful in lowering the temperature. The internal administration of turpentine has been highly extolled; this drug is often very efficacious when applied on hot flannel to the abdomen, or used as an enema where there is much tympanites. Opium, or morphine, is invariably demanded to subdue restlessness, allay pain, and induce sleep. Laudanum, applied in poultices to the abdomen, is sometimes very grateful to the patient. When, however, there is much tenderness and distension, a paste composed of two parts of extract of belladonna to one of glycerine, brushed thickly over the whole abdomen, will be preferable. Quinine is often of great value in diminishing the fever; it may be given in doses of 5 grains or more every four or six hours. Warburg's tincture may answer still better. If the discharges are fetid, an intra-uterine antiseptic douche should be employed with great caution, usually only on one occasion, to be followed night and morning by the vaginal douche. In cases of a more chronic type, where diarrhœa is a prominent symptom, tincture of perchloride of iron in large doses, 20 to 30 minims, is sometimes very serviceable. One of the most important elements in the treatment of this exhausting disease is the frequent administration of nutritious food and stimulants—strong beef-tea, milk, eggs, champagne or brandy—in small quantities at short intervals. In cases of obstinate vomiting recourse must be had to nutrient enemata; and nutrient suppositories are often of great use, employed alternately. The most abundant supply of fresh air that can be admitted with safety should be secured.

It is impossible to map out any distinct line of treatment for puerperal fever. Each case must be combated according to its individual symptoms, and demands constant attention; for, though the disease is fearfully fatal, some of the apparently most hopeless cases recover.

3. **Puerperal Peritonitis.**—This, though one of the most frequent complications of puerperal fever, sometimes occurs independently of it, other symptoms than those consequent upon the local inflammatory attack being absent. It may arise from the rupture of a Fallopian tube distended with pus—a pyosalpinx; or from some uterine lesion occurring during labour.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances associated with puerperal peritonitis differ from those described in connexion with puerperal septicæmia only inasmuch as they are confined to the peritoneal cavity. There will probably be found an abundance of effused serum or sero-pus, and flaky lymph, and intense congestion of the peritoneum; and the abdominal viscera will here and there be glued together. The uterus will probably be found preternaturally soft.

SYMPTOMS.—Generally within a week following delivery a well-marked rigor occurs, followed by febrile disturbance. The patient complains of acute pain in the lower part of the abdomen, at first in one particular spot, but soon spreading over a larger area. The thighs become flexed on the abdomen to relieve the tension; the belly becomes much swollen, and excessively tender; and there is generally much tympanites, with obstinate constipation. The pulse is very characteristic, being quick, wiry, and incompressible. Vomiting soon sets in. If the disease do not give way, the abdomen becomes more swollen and tense, and no pressure upon it can be borne. Everything that is taken is vomited; the pulse becomes more rapid and feeble; the tongue is dry and raspy; the constipation gives way to diarrhœa; the skin becomes clammy, and the extremities cold; and the patient dies.

Treatment.—The application of leeches to the abdomen, immediately the tenderness is complained of, may be of much service in subduing the local inflammation and allaying pain. Opium is the drug of all others to be relied upon. Hot fomentations and counter-irritants, such as turpentine, often give great relief. In the first stage a copious enema of thin gruel with castor oil, to obtain a free action of the bowels, should be given. Where there is much tympanites, the addition of turpentine may be of benefit in dispelling the flatus. If vomiting prevent nourishment being taken by the mouth, it should be administered *per rectum.* Surgical treatment by abdominal incision, and flushing out the peritoneal cavity, may in some cases afford the best chance of recovery.

4. Puerperal Venous Thrombosis and Embolism.

Definition.—The occurrence of a blood-clot in the right side of the heart or pulmonary arteries, either formed *in situ* or conveyed there from a distance by the blood-current, often giving rise to sudden death after delivery.

Anatomical Characters.—The condition of the blood in pregnancy and the puerperal state renders it liable to form a coagulum, and this may occur in distant vessels. It is well known that in the later months of pregnancy the amount of fibrin in the blood is very greatly increased. Together with this, a diminution in the volume of the blood from uterine hæmorrhage produces a state of exhaustion, which causes a great predisposition to thrombosis. If, therefore, such having occurred in distant vessels, a portion of coagulum become detached, and be carried away till it reach the pulmonary arteries, embolism is the result, and this is one of the great causes of sudden death occurring after parturition. It has been shown, however, that pulmonary thrombosis may occur independently of embolism; large, firm, decolorised coagula have been found, on *post-mortem* examination, occupying the right side of the heart and the larger branches of the pulmonary arteries, which have evidently formed there, all traces of thrombosis elsewhere being absent.

Symptoms.—These are common both to embolism and pulmonary thrombosis. In the great majority of cases, the patient is suddenly seized with severe dyspnœa; she starts up and gasps for breath; the face in some cases has been described as pale, in others livid. She feels she is dying, and calls out for air; the pulse becomes almost imperceptible; and generally death occurs very rapidly. If the patient be examined during the attack it is probable that a murmur will be heard over the site of the pulmonary artery. In some cases in which the clot is not sufficiently large to entirely obstruct the circulation in the lungs, it appears that absorption may ultimately take place, and recovery ensue. Dr. Playfair has published some cases which support this view.

Treatment.—In almost every case so rapidly fatal is the seizure that there is no time to think of treatment. When, however, the attack is not so terribly rapid in its termination, every effort must be made to rally the patient, by the administration of stimulants, such as brandy, ether, or ammonia, if at hand. The most perfect rest must be enjoined, so as to prevent the coagulum from becoming dislodged, and to promote its absorption. Sir B. W. Richardson has recommended solution of ammonia in large doses, with a view of dissolving the fibrin.

Clement Godson.

PUERPERAL INSANITY. — *See* Insanity, Varieties of.

PULLNA, in Austria. — Sulphated waters. *See* Mineral Waters.

PULMONARY APOPLEXY. — A term for a certain form of hæmorrhage into the lungs. *See* Lungs, Hæmorrhage into.

PULMONARY DISEASES. — *See* Lungs, Diseases of.

PULMONARY MURMUR. — This word may be employed in two senses, namely, as signifying, first, the respiratory sound heard over the lung; or, secondly, a bruit heard in connexion with the pulmonary artery and its valves. *See* Heart, Valves and Orifices of, Diseases of; Physical Examination; and Pulmonary Vessels, Diseases of.

PULMONARY VALVES AND ORIFICES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of; and Pulmonary Vessels, Diseases of.

PULMONARY VESSELS, Diseases of.—The vessels of the pulmonary circulation, more especially the veins, enjoy a considerable immunity from disease. Primary affections of these vessels are of most exceptional occurrence, and the causes leading to their being secondarily involved are not numerous. It is not easy to account for this. The pulmonary arteries much less often present those diseased states which are of frequent occurrence in the arteries of the systemic circulation, and are not even as commonly affected as the systemic veins, with which they somewhat more closely agree in point of structure, and in the kind of blood carried by them. The portal vein, which is comparable to the pulmonary artery in other respects besides its plan of distribution, would appear to be similarly free. For these reasons affections of the pulmonary vessels are rather of pathological interest than clinical importance; in the majority of cases they are not to be recognised during life, or, if so, are beyond the application of any treatment. The trunk of the artery, and especially the orifice in the right ventricle, is singularly liable to present congenital abnormalities, which are treated of in the article HEART, Malformations of.

The diseases of the pulmonary artery will now be discussed in the following order: (1) Inflammation; (2) Degenerations; (3) Ulceration; (4) Dilatation and Aneurysm; (5) Stenosis; (6) Rupture; and (7) Embolism and Thrombosis.

1. **Inflammation.** — ÆTIOLOGY. — Acute arteritis affecting the pulmonary artery is of very rare occurrence, and usually co-exists with acute endocarditis. Previous to birth it seems to be more liable to exist than subsequently, and some of the congenital deformities of the pulmonary artery and its valve are to be attributed to it. After birth it is almost invariably associated with such acute blood-diseases as pyæmia, or with those pyrexial states which are apt to assume a septic character, as scarlet fever. Emboli, especially if of a putrid character, which have become lodged in branches of the vessel, are liable to set up inflammation in the contiguous walls. Chronic arteritis, leading to atheroma, though far less frequent than in the aorta, is not of very rare occurrence, and under very much the same conditions, namely, increased strain of the vessels, associated with obstruction to the pulmonary circulation, and an hypertrophied right ventricle. When the vessels have become much dilated, as from extreme mitral stenosis, the walls thus thinned are liable to undergo changes of a chronic inflammatory character. *See* ARTERIES, Diseases of.

ANATOMICAL CHARACTERS. — These correspond with the usual characters of arteritis. The process begins in the sub-epithelial layer of the inner coat, and results in the formation of a variety of connective tissue, which consists of fibres, fusiform fibre-cells, and homogeneous material; these constituents being developed in varying proportions, and forming patches of grey, gelatinous or semi-cartilaginous material. The new-formed tissue within the thickness of the walls tends to break down and form an atheromatous abscess, which, bursting into the lumen of the vessel, leaves an ulcerated surface, though this is far less common than in the aorta. Or the yellowish patches of atheroma may become calcareous. A peri-arteritis, consisting of a fibroid thickening limited to the adventitia, has been met with in the vessels of limited areas of the lung; it is perhaps of syphilitic origin.

This state is only demonstrable after death; during life it is not recognised, unless the valves be affected, by any known signs or symptoms, and a diagnosis of its existence has not hitherto been attempted. Under such circumstances no plan of treatment can be laid down.

2. **Degenerations.**—(*a*) *Fatty.*—Primary fatty degeneration of the deeper layers of the intima, without any previous inflammation, occurs in the pulmonary, as in other arteries. It appears to be commoner when there is obstruction to the circulation through the lungs, and when considerable in amount forms yellowish irregular spots, which may subsequently involve the middle coat, and form in the thickness of the wall masses of softened fatty matter, which finally bursts into the vessel.

(*b*) *Lardaceous degeneration.* — This has been recorded as having been seen in the muscular coat of branches of the pulmonary artery.

3. **Ulceration.**—As already said, inflammation of the vessel-walls very rarely extends to ulceration of the inner coat, but owing to the extreme frequency of ulcerative destruction of the lung-tissue, the intra-pulmonary branches of the vessels are constantly involved. Phthisis, abscess, or gangrene of the lungs, may each in their progress invade the vessels, the walls of which, though offering considerable resistance to the destructive process, sooner or later yield, and may cause a fatal hæmorrhage, though very frequently a loss of blood is prevented by blocking up of the vessels with coagula.

4. **Dilatation and Aneurysm.**—ANATOMICAL CHARACTERS.—Varying changes of abnormal distension are not unusual, occurring in both sexes and in all ages beyond childhood, and are estimated as forming ·3 per cent. of aneurysms of all kinds. The dilatation may affect the trunk uniformly; and an extreme case has been recorded where the circumference of the vessel attained $6\frac{5}{8}$ inches, the normal average being taken at $3\frac{1}{2}$ inches. Or, limited in extent, the bulging forms a sacculated, or, more rarely, a dissecting aneurysm of the trunk or branches, from the size of a walnut to a pea, or even smaller, these latter being frequently multiple. The conditions which lead to these alterations in the normal calibre of the vessel are—(*a*)

Those causing a diminished resistance of their coats to the blood-pressure, especially if this be increased, which is often the case, by obliteration of some vessels, and consequent rise in tension in the remaining ones; or by general obstruction, such as mitral stenosis or emphysema would cause. (*b*) Those changes in the lung-structures which diminish the support of the vessels, and so allow of their yielding. The results of arteritis and atheroma will furnish the first condition, and ulceration and destruction of the pulmonary tissue will provide the latter. The trunk of the artery has been frequently found unduly dilated in anæmia. The walls of true aneurysms may be thicker or thinner than those of the healthy vessel, and it is remarkable that their contents are said to be never laminated coagula, even in the largest, but always fresh clots.

An extreme case of distension of the pulmonary veins is recorded (*Dublin Journal*, 1832), especially the left, where the vessels were dilated to four times their normal size, owing to extensive obstructions at their openings into the left auricle.

SYMPTOMS.—When the main trunk of the pulmonary artery is the seat of an aneurysmal tumour, there are the usual signs of pulsation and prominence in variable degrees, most marked to the left of the sternum in the second intercostal space; over the same area a systolic bruit of a superficial quality is to be heard, not conducted above the sternum or clavicles; and a systolic thrill is to be felt. There is also accentuation of the second sound, with the signs of hypertrophy of the right ventricle. Should the tumour be of any considerable size, it will give rise to those conditions which commonly follow an obstruction to the pulmonary circulation—namely, lividity, dyspnœa, cough, and general anasarca, with scanty, high-coloured urine; and symptoms of pulmonary embolism may result from detachment of fragments of clot from the sac. In an exceptional case, pallor of the face was noticed. Pain behind the sternum, and headache, also exist. Since the greater part of the artery is included within the pericardium, it is into that sac that rupture will probably occur. Uniform dilatation of the trunk of the artery may be accompanied with sufficient stretching of the cardiac orifice to cause regurgitation into the ventricle.

The small aneurysms of the intra-pulmonic branches give rise to no known symptoms until hæmoptysis indicates their rupture.

DIAGNOSIS.—An aneurysm of the trunk of the pulmonary artery may have to be distinguished from a similar affection of the aorta, or from a post-sternal tumour to which pulsation has been communicated. The tendency of pulmonary aneurysm to extend to the left side, and the non-conduction of the bruit to the vessels at the root of the neck, with the coincident signs of pulmonary obstruction, are grounds upon which to found a distinction, though the distinction from an aortic aneurysm is not always easy.

PROGNOSIS.—This is of necessity grave, whatever the size of the lesion, and many cases of fatal hæmoptysis are due to rupture of a small-sized sac.

TREATMENT.—How far such treatment as galvano-puncture, the administration of iodide of potassium, &c., as pursued in aneurysm of the systemic vessels, is applicable to similar affections of the pulmonary artery, is unknown. For the treatment of the hæmorrhage to which rupture of the smaller aneurysms gives rise, *see* HÆMOPTYSIS.

5. **Stenosis.**—A narrowing of the pulmonary artery may take place at the orifice, in the conus arteriosus, or more rarely in the trunk or main branches. In the former situations it is commonly congenital, the result of endocarditis or myocarditis, which, if developed within the first three months of fœtal life, is almost invariably accompanied by some compensating lesion, such as intraventricular communication; whilst if the affection of the heart be subsequent to the third month of development, the circulation is carried on through a patent foramen ovale and ductus arteriosus (*see* HEART, Malformations of). It is conceivable that stenosis of the conus arteriosus may be followed by secondary narrowing and closure of the pulmonary artery, and also that defective development of the lungs may cause a narrowed vessel. The condition is very rarely due to any acquired change in the vessel-walls, although a case is recorded of stenosis of the artery from cartilaginous thickening and calcification of its coats. The calibre of the tube may be diminished by the pressure of tumours, such as an aortic aneurysm or adenoid growths, or by the shrinking of cicatricial tissue in the adjacent lungs, or from arteritis following on direct violence.

When stenosis is developed at a very early period of fœtal life, the artery remains exceedingly narrow beyond the obstruction. When it occurs late, the vessel may be of normal capacity, and if insufficiency co-exist with the obstruction, it may even be dilated.

SYMPTOMS.—Whatever be the cause of pulmonary stenosis, there will be a deficient supply of blood to the lungs, producing dyspnœa, and the obstruction to the circulation will give rise to all the signs and symptoms of general venous congestion, although to a less degree than in affections of the tricuspid orifice. Hypertrophy of the right ventricle—as evidenced by increased transverse measurement of the area of cardiac dulness, and a forcible impulse felt at the epigastrium, a basic thrill, a systolic bruit, of maximum intensity over the heart's base, and conducted to the left of the sternum, but not audible along the course of the aorta and great vessels, and a marked accentuation of the second sound—is the most important result of this condition. Cyanosis is not a characteristic, and does not occur unless there be extreme venous congestion, or a communication between the two sides of the heart. The association of constriction of the pulmonary artery, both congenital and acquired, with tubercular phthisis, has now been too frequently observed for it to be regarded as a coincidence only, and their relation as cause and effect is generally admitted.

Treatment.—This affection is entirely beyond the reach of remedy.

6. **Rupture.**—Violent effort and great excitement have been followed by rupture of the pulmonary artery, either of the trunk or main branches, when degenerated. Death is often instantaneous, though it may be delayed even some hours. Aneurysms tend to burst sooner or later; those of the trunk usually opening into the pericardium, while the intrapulmonary dilatations commonly rupture into cavities in the lung. Ulceration, as said, is of very rare occurrence, but a case is recorded of its existence and extension through all the coats of the vessel, with a suddenly fatal termination. Rupture of the pulmonary veins has been recorded.

7. **Embolism and Thrombosis.**—The pulmonary artery is especially liable to become plugged, both by substances lodged in it from elsewhere, and by coagula originating in the vessel itself. Its relationship to the venous circulation explains this. Portions of broken-down clots developed in the systemic veins, from whatever cause; the contents of hydatid and other cysts that have burst into the venous current; fragments of cancerous and other new-growths, all of which readily travel onwards towards the heart, pass into the pulmonary artery, in the branches of which they become lodged, according to their size. Once located, the plug will increase in size by the deposition on it of successive layers of fibrin, sometimes to such an extent as to obliterate all traces of the original obstructing substance. Occasionally very large thrombi are detached in the systemic veins, and are arrested in the trunk and main branches of the pulmonary artery. The causes of thrombosis of the vessel are various. The rare occurrence of inflammation or degeneration of the artery renders obstruction of the vessel from primary thrombosis very uncommon; but the development of clots in the smaller branches, in association with pneumonia, phthisis, gangrene, and other destructive lung-diseases, is frequent. In certain septic states, in severe malarial states, in parturient women, and in conditions of extreme anæmia, especially with diminished heart-power, when the blood is prone to clot in the vessels, the pulmonary artery is a favourite locality for this to occur; though the not unusual occurrence of this condition in women after delivery is more probably embolic in character. Pressure on the pulmonary artery or its main divisions by aortic aneurysm, enlarged glands, or other mediastinal tumours, has been known to cause the formation of a thrombus in the vessel. Thrombi may commence in the right ventricle, or, as would appear, sometimes on the semilunar valves, and extend into the trunk and, for variable distances, into the branches of the vessel. Such obstructions are frequently developed during the last hours of life, when the circulation is enfeebled and slow. *See* Embolism; Heart, Thrombosis of; and Lung, Hæmorrhage into.

Symptoms.—The symptoms will, of course, depend upon the extent and completeness of the obliteration of the pulmonary circulation. If only the smaller branches be occluded, the symptoms may be those of pulmonary infarction, and the very moderate dyspnœa or slight hæmoptysis might be equally attributable to the phthisis or other lung-state which had determined the formation of the thrombi.

In another class of cases, when larger branches are blocked, very marked dyspnœa is developed, with such symptoms as are conveniently grouped under the term 'anginal,' such as pain in the præcordia, a sense of great distress and faintness, palpitation, gasping, lividity, and extreme pallor, with cold sweats, but no loss of mental faculties, though often inability to speak, an almost imperceptible rapid or irregular pulse, and jactitation of the limbs. The onset of such a condition may be gradual or sudden; in the former case it depends on the slow increase in size of a small thrombus; in the latter, on the sudden lodgment in some large branch of the artery of a solid substance that has entered the venous current. In some cases these symptoms are present to an extreme degree, and death follows in a few minutes; in fact, this lesion constitutes one of the causes of sudden death. The appearances are not those of asphyxia, and it is usual to attribute the very rapidly fatal result to syncope or shock, as it would seem to be connected in some way with an arrest of the nerve-governance of the heart. In that class of cases which do not terminate so quickly, it is usual to find that the symptoms abate somewhat, and may be followed at a variable interval of hours, days, or even months by a second or even several attacks, usually ending fatally. The *post-mortem* examination of such cases shows a thrombus of considerable extent, with indications of its having been formed at different times.

Examination of the chest reveals no diagnostic signs. There is very likely to be a basic systolic murmur conducted along the course of the pulmonary artery; but this is not constant, and the heart-sounds are oftener muffled and indistinct.

Diagnosis.—This is often very uncertain. The conditions in which thrombosis is usually met with, such as in anæmic or parturient women, are those in which breathlessness, cardiac pain, and discomfort, and even a pulmonary hæmic bruit, are of frequent occurrence. The symptoms, when not of extreme rapidity, are very similar to those caused by stenosis of the pulmonary artery, which in itself is difficult to diagnose; and, lastly, the suddenly fatal cases are almost identical in their manifestations with rupture of the heart or of a thoracic aneurysm, or even angina pectoris. The supervention of the above-detailed symptoms in a case of existing phlebitis, in a woman within twelve or fourteen days after child-birth, renders it highly probable that they are due to a clot in the pulmonary artery.

Prognosis.—This is to be looked upon as of the gravest character, if once symptoms arise which indicate the existence of a clot in the pulmonary vessels. The smallest plugs formed in branches which are being invaded by a progressive destructive change in the lungs, are protective in character, and prevent or diminish an hæmoptysis which erosion of the vessels might produce.

Treatment.—In the most rapid cases death takes place before anything can be done; but in the less severe cases two points have to be attended to, namely, absolute rest, and free stimulation by brandy, digitalis, ether, and ammonia, for by such means only can any hope be entertained of preventing an extension of the clot. Sinapisms over the cardiac region often afford relief, but opiates for the sleeplessness which is met with in some of the prolonged cases are very badly borne.

W. H. Allchin.

PULSATION (*pulso*, I beat).—Pulsation is a sensation of beating or throbbing, either objectively appreciated by inspection or palpation, or subjectively felt. It originates in the presence of a pulse or rhythmical rise and fall of blood-pressure, whether normal or abnormal, in connexion with the part where it is situated. In most instances this is either the heart or some large blood-vessel; but in other instances the pulsation has a different origin, especially when the phenomenon is abnormal. As instances of *normal* pulsation may be mentioned the cardiac impulse; the arterial pulse generally; the pulsation of the umbilical cord; and the beating of the fontanelles. *Abnormal* pulsation may be referable (1) to dilatation of a blood-vessel, as in aneurysm; (2) to vascular dilatation and cardiac enlargement, as in aortic incompetence; (3) to vascular dilatation and cardiac excitement, as in exophthalmic goitre; (4) to interference with the passage of blood through a vein, or even regurgitation into it, as in the jugular pulse of tricuspid disease; or (5) to the pressure of a tumour upon a large vessel, conveying the normal pulse unnaturally to the surface of the body, as in tumour of the pancreas or pylorus. Pulsation may also be present (6) in any part when it is the seat of inflammation, the small vessels being dilated; (7) in aneurysm by anastomosis; (8) in malignant disease of bone, which may closely simulate aneurysm; and (9) very rarely in connexion with empyema. *See* Pleura, Diseases of.

With respect to the characters of this phenomenon, it is of great practical importance to distinguish *true* expansile or eccentric pulsation from pulsation which is *communicated* only. In the former case the seat of pulsation expands rhythmically in all directions; in the latter case it is moved in one direction only, that is, it rises and falls under the influence of the motion conveyed to it.

The various pathological conditions which give rise to pulsation, and their treatment, are fully discussed under appropriate heads.

J. Mitchell Bruce.

PULSE, The.—Synon.: Fr. *le Pouls*; Ger. *der Puls*.—Each contraction of the heart, by throwing the contents of the left ventricle into the aorta, causes a sudden expansion of the systemic arteries, which is manifested by elongation and dilatation of these vessels. When the finger is placed upon an artery that runs on a resisting plane, such as the radius forms beneath the radial artery at the wrist, slight compression by the finger enables us to detect an increased hardness in the vessel at each cardiac contraction. It is this increase of hardness, or fulness, or, in other words, this change in the distension of the artery, which constitutes the pulse. In feeling the pulse the finger slightly compresses the artery, and thus flattens it; the cylindrical form is restored by each pulsation. The amount of pressure required to flatten the artery completely, is the rough-and-ready way of estimating its fulness or tension, and is best performed by compressing the vessel with the index finger, whilst the middle and ring fingers, placed more distant from the heart, check off the pressure required to stop the blood flow.

The movement of the artery perceived by the finger appears in most cases to be simple, but when registered by the sphygmograph it is found to be a compound of three waves, called the *summit wave*, the *tidal wave*, and the *dicrotism*. The *summit wave*, which caps the line of ascent of the trace, is due to the sudden oscillation in the blood-column, following immediately on the lifting of the aortic valves by the discharge of the contents of the left ventricle. The *tidal wave*, or predicrotic, or *first secondary wave*, as it is also called, is due to the distension of the arteries, following the increased pressure in the aorta and great vessels, from the reception of the ventricular contents. The *dicrotism*, or *great secondary wave*, is an oscillation of the blood-column, mainly, if not wholly, produced by the rebound of the blood from the closed aortic valves under the pressure of the aortic recoil. *See* Dicrotism.

A pulse-trace (fig. 123) consists then in a *line of ascent*, *a* to *b*, which ends in the *summit wave*, *b*, and corresponds to the first part of the ventricular systole; from the summit wave the tracing falls slightly, till it is again raised by the *tidal wave*, *c*. After the tidal wave a more marked descent occurs, called the *aortic notch*, *e*, and the line again rises, into the *dicrotic wave*, *d*. The *line of descent*, *b* to *a'*, is thus broken by two waves and two notches. The two waves have already been described; of the two notches one precedes the tidal wave, and indicates a slight collapse in the arterial wall after the oscillation called the summit wave; whilst the aortic notch, preceding the dicrotism, marks the fall of pressure in the arteries antecedent to the closure of the aortic valves. The moment these valves are closed the line of descent rises again. It is the bottom of this notch, marking as it does the closure of the aortic valves, which points out the termination of the ventricular systole. The remainder of the line of descent corresponds with the diastole of the ventricle, and is sometimes broken by smaller waves.

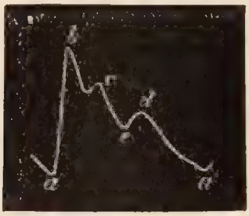

Fig. 123.—Typical Pulse-trace.—*a* to *b*, line of ascent; *b* to *a'*, line of descent; *b*, summit wave; *c*, tidal wave; *d*, dicrotic wave or dicrotism; *e*, aortic notch

The pulse-trace is modified in its chief features by the state of arterial fulness or tension. When the tension is high (fig. 124) the line of ascent is less lofty; the tidal wave is large, nearer to, and sometimes blended with the summit wave; the aortic notch is shallow, and high in the line of descent; the dicrotism is not much developed; and the line of descent is gradual. When the tension is low (fig. 125), the line of ascent is lofty; the summit wave distinct; the tidal wave small; the aortic notch deep and low; the dicrotism highly developed; and the line of descent sudden. These modifications are interfered with if the normal elasticity of the arteries be lost, as in arterial degeneration.

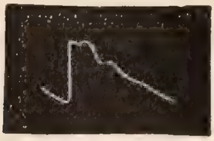

Fig. 124.—Trace of Pulse of High Tension.

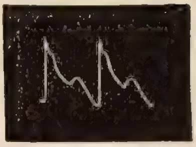

Fig. 125.—Trace of Pulse of Low Tension.

The pulse thus registered by the sphygmograph, or felt by the finger, is an oscillation of the blood-column, primarily caused by the heart, but greatly modified by the properties of the blood-vessels. On the heart depend the rate, the rhythm, and, to some extent, the force of the pulse; whilst on the vessels depend the mode of the blood-flow, and the ease of its passage. By virtue of their elasticity, the larger arteries convert the intermittent, jerky impulse, given to the blood by the heart-beats, into an even flow of regular waves; and the smaller arteries regulate, by their permeability, the ease with which the blood-stream flows onward to the veins, thus governing to a great extent the fulness or tension of the arterial system.

The art of feeling the pulse consists in discovering, from the sensation imparted to the finger, the state of the arterial wall and the condition of the arterial contents, as manifested by the frequency, rhythm, and force or tension of the pulse-beat. When the artery is felt to be hard and cord-like, rolling more or less rigidly under the finger, changes in the arterial coats, due to degenerative arteritis or senile change, are indicated, which may render the vessel so rigid as to be practically incompressible. The radial artery is sometimes congenitally anomalous, and a high bifurcation of the vessel or other peculiarity may account for the absence or smallness of the pulse on one or both sides. The finger, as above mentioned, also estimates the fulness of the vessel from its compressibility, and hence learns how the heart and arteries are acting as regards the tension of the pulse. The effects of their action on the form of the pulse-wave the sphygmograph records. In children the pulse may often be most accurately observed in the temporal artery during sleep. *See* Sphygmograph (which should be read with this article).

It will be convenient to consider in succession the *frequency*, the *rhythm*, and the *force* or *strength* of the pulse.

1. **Frequency.**—The frequency of the pulse depends on the rate of the heart's contractions. This rate varies with age, position, sex, stature, and a number of physical and psychical influences. In the newly born infant the heart and pulse beat some 130 to 140 times a minute. The rate gradually falls, and after the sixth year it is usually below 100; and a further decrease of 30 beats a minute gradually occurs before the rate of manhood (70 to 75 a minute) is reached. In old age the pulse rate often rises again slightly.

In the erect posture the pulse beats at some 10 a minute in the male, and 7 in the female, over the rate of the sitting, and some 5 more over the rate of the recumbent position. The female of seven years has some 10 pulse-beats a minute more than the male of the same age. As regards stature, we may say briefly that height diminishes the number of beats slightly, a man of six feet having a pulse of 3 or 4 slower than a man of five and a half feet.

Movement and exertion of all kinds quicken the pulse, and mental emotion or excitement in neurotic persons runs up the rate very high. In examining healthy people for life assurance, as well as in visiting patients, this must be taken into account. A good meal increases the fulness and frequency of the pulse, and so does the use of stimulants in health, though in acute diseases the reduction of the pulse-rate may be often the test of their beneficial action. The pulse is less frequent during the night and during sleep; it rises in frequency during the early hours of the day, and falls to a minimum about midnight.

Increased frequency.—Such are the conditions which affect the pulse-rate ordinarily in healthy persons. In disease increased frequency is one of the most common changes, as, for example, the frequent pulse of all pyrexial attacks. The pulse-rate and the pulse-form, as recorded by the sphygmograph, are closely connected with the temperature-elevation. The pyrexial pulse-trace shows important modifications in the dicrotic wave, which become more and more developed as the pyrexia increases. The aortic notch deepens, and when it reaches the level of the curve-basis (the line joining the commencement of each line of ascent) the pulse is called *dicrotous* or *fully dicrotous*; this form corresponds with a pulse-rate of over 100 per minute, and a temperature of about 102° F. When the aortic notch sinks below the level of the curve-basis, and the dicrotic wave is blended with the line of ascent of the next pulsation, the pulse is called *hyperdicrotous*, and the temperature is generally about 104° F. (*see* fig. 130). A hyperdicrotous pulse, when accelerated, loses the dicrotic wave wholly, and becomes monocrotous. The pulse-rate in many febrile cases becomes a prognostic sign of great value, sometimes, as in puerperal cases, being of more value than the temperature.

Increased frequency is also present in debility, and in certain organic and functional affections of the vagus and sympathetic, for example, exophthalmic goitre and the so-called hysterical cases of rapid pulse. In these latter there is generally a slight increase of temperature.

Diminished frequency.—A reduced pulse-rate is less commonly seen. It is usually associated with a condition of high tension from blood-impurity, as in renal disease. It is met with in jaundice, anæmia, and diabetes; in convalescence from pneumonia; in relapsing fever; in the earlier stages of typhoid; in fatty degeneration of the heart; and in some nervous affections, especially of the medulla. In one of these last cases the writer has observed a pulse of 24; and a rate as low as 14 a minute has been recorded.

2. **Rhythm.**—The rhythm of the pulse depends also on the rhythm of the heart; regular heart-action produces regular pulse, and *vice versâ*. Variations in rhythm are of two kinds, *intermittence* and *irregularity*.

Intermittence.—Intermittence means the omission of a beat from time to time. This omission may occur at regular intervals, for example, every fourth, tenth, or twentieth beat; or it may occur irregularly, so that every now and then a beat is missed. Intermissions are more rarely observed in the young than in the old, and may be associated with no other evidence of disease. The intermissions usually disappear during pyrexial attacks. In some cases nervous excitement or fatigue will produce them; in others they depend on hypochondriasis, dyspepsia, the excessive use of tobacco, gout, over-work, and on heart failure from degeneration or some neurosis of the heart. Effort, such as briskly walking across the room, or holding both arms above the head, will increase the intermissions or irregularity in cases of organic cardiac weakness, but have little effect in neurotic cases. Occasionally an intermittent pulse is the first indication of deep-seated malignant disease. Some patients are unconscious of the intermissions, while others feel the heart stumble in its work, as it were, at each lost beat. In many persons intermissions are habitual, and do not necessarily indicate disease, but they do impair the life-value. Intermittent action is often observed in old persons otherwise healthy.

Irregularity. — Irregularity, the other variety of disordered rhythm, presents itself in two forms, as irregularity in frequency, and irregularity in force. These two forms are frequently associated; of a number of pulsations no two may seem equal in force, and no two may succeed each other at equal intervals of time. In other cases a number of good, steady beats, regular in frequency and equal in force, may be followed by a disorderly series, unequal and irregular. These abnormalities are best observed in cases of mitral valve disease and in dilatation of the heart, although the pulse may be unequal and irregular in all forms of heart-disease at some period of their evolution. Mitral insufficiency affords the common examples of unequal and irregular pulse, though in this affection the pulse-beats may only be slightly unequal in size and form, but perfectly regular in the periodicity of their occurrence. In mitral stenosis irregularity and intermissions are generally associated with inequality. Some intermissions are what are commonly called *false* intermissions, the ventricular systole being too weak, or the wave of blood thrown into the aorta too scanty, to be perceived at the wrist. In such cases the sphygmograph records the wave which escapes the finger. In mitral cases irregularity and inequality are increased by exercise. *See* SPHYGMOGRAPH.

Inequality in the size of the pulsations often depends on respiratory influences. The curve-basis, or respiratory line as it is sometimes called, falls with full inspiration and rises with expiration. With low tension these variations are increased, with high tension they are scarcely apparent. In severe dyspnœa the curve-basis becomes undulatory. Thus deep inspiration, which normally reduces arterial tension, lessens the size of the pulsations, and quickens the pulse; while expiration raises the tension, increases the size of the pulsations, and slows the pulse. An exaggeration of these effects constitutes the *pulsus paradoxus* or *pulsus inspiratione intermittens*, first observed in indurative mediastino-pericarditis, but not limited to that condition. In some cerebral cases, and also in mitral affections, the regular succession of a large and a small pulsation is observed, constituting the *pulsus alternans*; when the pulsations go in pairs it is called *pulsus bigeminus*; when a series of three occurs, *trigeminus*.

In health the pulse may sometimes be noticed to be irregular on waking; and in convalescence from acute disease irregularity in force and time is not infrequent. Irregularity sometimes depends on reflex disorder from gastro-intestinal causes; tea and tobacco taken in excess are common causes of irregularity and palpitation.

The pulse may be occasionally *suppressed* in one or all the arteries. When general, this is due to cardiac weakness, and the sphygmograph will often record a small gradual pulse-wave, which escapes the finger. When partial, the suppression is due to either compression, thrombosis, or aneurysm of a main vessel.

The pulse in one radial occasionally is felt to occur later than in the other artery; this is called *retardation*, and usually indicates aneurysm.

3. **Force.**—The force of the pulse, which the finger estimates by the amount of pressure required to obliterate it, and which the sphygmograph measures by the weight or pressure required to develop to the full the main features of each pulsation in the trace, is the product, in the first place, of the heart's vigour. The distribution of the heart's force, however, depends on the peripheral resistance of the smaller blood-vessels. When these are relaxed and open, a vigorous heart has its force distributed quickly over the whole vascular area by the rapid onward passage of the blood. When, on the contrary, the arterioles are contracted, the heart's force is retained in the arteries for a longer time. In the first case, the pulse is soft and compressible, from the small quantity of blood retained in the artery; in the second case, it is hard and relatively incompressible, from the fulness of the artery with blood under high pressure. It may be well to point out here, that the size of the pulse and the amplitude of the pulse-trace are by no means precise indications of its force or strength. These qualities depend on the sudden variations in tension (fulness of blood) which the artery undergoes. For instance, a moderately strong ventricle will produce in states of easy blood-flow through the capillaries an ample pulse, but one easily compressed; whilst the same ventricle, acting with even more force, in conditions of lessened capillary permeability, will produce a pulse much less ample, lasting longer under the finger (*pulsus tardus*), and less easily compressed. The simple experiment of feeling, or recording with the sphygmograph, the pulse when the capillaries are dilated by a warm foot-bath, and, again, when contracted by a cold one, will exemplify this. The permeability of the smaller vessels also reacts on the heart, and influences both the frequency and mode of contraction. When the capillary circulation is easy, the heart's action is more frequent, and the ventricular contractions shorter or more sudden; when, on the contrary, the circulation is obstructed by contraction of the peripheral vessels, the heart's action becomes less frequent, and the ventricular contraction is longer and less sudden. Thus the vascular tension may be said to be in inverse proportion to the frequency and suddenness of the heart's action. The force of the pulse, as thus modified by the state of the peripheral circulation, gives us some of our most important clinical information.

Modern clinical research shows how valuable is a study of this force of the circulation, as manifested by the tension of the arteries. It is this quality of tension which forms the best basis for the division of the various pulse-forms into the two great classes of *hard* and *soft* pulses, or pulses of high and low tension. The hard pulse requires considerable pressure to enable the sphygmograph to record its features to the full; the soft pulse yields the best trace to slight pressure.

Miscellaneous Characters.—The *size* of the pulse depends on the development of the line of ascent and the tidal wave, which are modified by the volume of blood expelled by the ventricle, and the state of fulness of the arteries. When the arteries are contracted, the pulse is small, hard, and wiry; when the coats are relaxed, it is large and soft. The *flickering* pulse is indicative of feeble and unequal ventricular contractions; and the *undulatory* character noticed in some weak pulses is due to the influence of the respiratory movements, causing variations in the tension. The quality of *suddenness* (quick ventricular systole) is betrayed by a nearly vertical line of ascent; while the *gradual* pulse (slow ventricular systole) has an oblique up-stroke.

The following arrangement shows in a small compass the principal varieties of pulse met with in practice, apart from the quality of regularity.

A. Varieties of Hard Pulse—Pulsus durus.

1. The *hard*, *frequent*, *sudden*, and *small pulse* of peritonitis, enteritis, and pericarditis:—

Pulsus durus et frequens et celer et parvus, fig. 126.

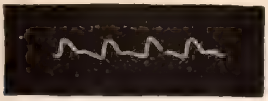

Fig. 126.

2. The *hard*, *slow*, *gradual*, and *large pulse* of contracted kidney:—

Pulsus durus et rarus et tardus et magnus, fig. 127.

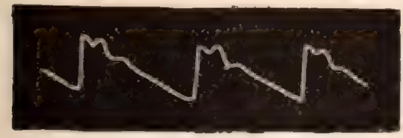

Fig. 127.

3. The *hard*, *large*, often *gradual pulse* of cardiac hypertrophy and degeneration of blood-vessels:—

Pulsus durus et magnus et tardus, fig. 128.

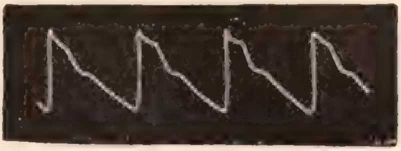

Fig. 128

4. The *hard*, *sudden* (*jerky*), *large*, and *vibratory pulse* of aortic insufficiency, with strong ventricle:—

Pulsus durus et celer et magnus et vibrans, fig. 129.

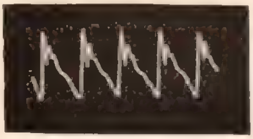

Fig. 129.

B. Varieties of Soft Pulse—Pulsus mollis.

1. The *soft*, *frequent pulse* of pyrexia; dicrotous, fully dicrotous, and hyperdicrotous pulses:—

Pulsus mollis et frequens, fig. 130.

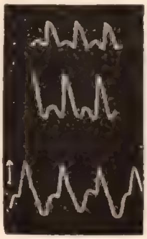

Fig. 130.

2. The *soft*, *frequent*, and *large pulse* of rheumatic fever:—

Pulsus mollis et frequens et magnus, fig. 131.

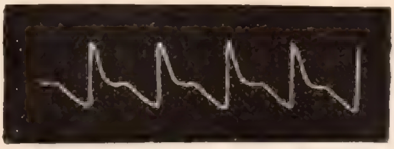

Fig. 131.

3. The *soft*, *small*, *frequent*, and *sudden pulse* of debility:—

Pulsus mollis et frequens et parvus et celer, fig. 132.

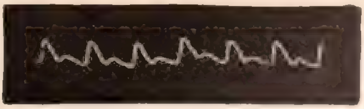

Fig. 132.

4. The *soft*, *frequent*, and *small* (*running*) *pulse* of collapse in fever:—

Pulsus mollis et frequens et parvus, fig. 133.

Fig. 133.

B. Walter Foster.

PUPIL, Disorders of the.

—Synon.: Fr. *Troubles de la Pupille*; Ger. *Stöhrungen der Pupille.*

Anatomy and Physiology.—The pupil is the approximately circular aperture situate a little to the nasal side of the centre of the iris. Responsive to the various influences which cause contraction and relaxation of the muscular and elastic tissues and blood-vessels of the iris, the pupil serves to regulate the amount of light entering the eye, and to correct some of the spherical aberration of the refracting media. In health, and when the lids are open, both pupils undergo frequent and equal variations in size: *contracting* when a bright light falls upon the eyes, and when the eyes converge or are accommodated for near objects; *dilating* when the light is feeble or the eyes are shaded, and when the accommodation is relaxed and the eyes are directed to some distant object. They also dilate when the skin is pinched, or when the cutaneous or other sensory nerves are stimulated, and in some psychical and emotional states. Fine oscillations occur synchronously with the beatings of the heart, and others with the movements of respiration. Variations in the size take place in many other physiological states. During muscular exertion, and as the result of fatigue, the pupils dilate; in deep sleep they contract. The pupils of both eyes contract and dilate together, even when only one eye is stimulated. The movements of the iris are involuntary, but, being coördinated with changes of accommodation, they are brought indirectly under the influence of the will.

The *size* of the pupils differs in different individuals, and in the same individual at different periods of life, and in different states of health and nutrition. The pupils are very small in newly born babes, larger in children and young adults, and smaller again in old persons. They are generally larger in myopic eyes, and in persons with dark irides; smaller in hypermetropes, and in persons with fair or blue irides. The size may range in health from 2·5 mm. to 6 mm.

A closer examination of the variations in the size of the pupil, and of the circumstances under which they take place, shows that some of the movements of the iris are 'reflex,' some are 'associated,' and some are 'consensual.' The contraction to the direct stimulation of light is reflex, as is also the dilatation which occurs on stimulation of the cutaneous nerves. The contraction which takes place during convergence or accommodation is associated; while the harmonious and equal action of both pupils when only one eye is stimulated is consensual.

The contracting mechanism of the iris is innervated by the third cranial nerve; the dilating mechanism by the cervical sympathetic. At the pupillary margin of the iris is a ring of plain muscular tissue (sphincter iridis); and in the expanse of the iris, and lying between the vascular and the posterior pigment layers, is a thin elastic lamina composed of long oval or rod-shaped nuclei, and radially disposed. Some authorities regard this lamina as muscular (dilator iridis), whilst others deny its muscular character. Constriction of the pupil is produced chiefly by the contraction of the sphincter muscle, though it is augmented by the turgescence of the blood-vessels of the iris. The dilatation of the pupil is perhaps less simple. It may be due to contraction of the dilator muscle. Those who deny the existence of this muscle ascribe the dilatation to the inhibitory influence exerted by the sympathetic nerves upon the sphincter muscle. According to this view, dilatation is a complex act due partly to relaxation of the sphincter, partly to the elasticity and resiliency of the iris, and partly to the depletion of its blood-vessels.

The *contraction* which takes place when light falls upon the eye is a reflex act, of which the optic nerve is the afferent path; while the efferent path is that portion of the third cranial nerve which passes through the lenticular ganglion, and enters the eye with the *short* ciliary nerves. The 'centre' is the anterior portion of the elongated nucleus of the third nerve, which lies in the front part of the floor of the aqueduct of Sylvius. From the anterior extremity of this nucleus arise also the motor fibres which govern the muscle of accommodation; and the community, or at least contiguity, of these two centres helps to explain the 'association' of contraction of the pupil with accommodation. It is, however, still uncertain how the afferent fibres reach the constrictor centre; but it would seem that these fibres are not the same as those which subserve vision, and that indeed they leave the optic path either at the chiasm, or at some other part of the tract before the visual centres are reached. The 'consensual' reaction of the pupil is accounted for partly by the incomplete decussation of the optic nerve at the chiasm, and partly by the communication (coupling) between the centres of the third nerves of the two sides, whereby the constrictor apparatus of the two eyes become functionally connected.

The *dilating mechanism* is governed by

the cervical sympathetic nerve. If this nerve be divided, the pupil contracts; and if the peripheral end be stimulated, the pupil dilates. The dilator path may be traced backwards down the neck to the upper thoracic ganglion, and along the ramus communicans to the anterior root of the second thoracic nerve, and then to the spinal cord (Foster); thence up the cord and through the bulb to a centre in the floor of the aqueduct of Sylvius, near, and a little to the outer side of, the pupil constrictor centre. Towards the eye the path is traceable, *not*, as formerly believed, to the sympathetic root of the lenticular ganglion, but to the fibres which, passing over the Gasserian ganglion, apply themselves to the ophthalmic division of the fifth nerve, and thence proceed to the nasal branch, finally reaching the eye with the *long* ciliary nerves. The existence of a dilator centre in the lower cervical and upper dorsal region of the cord (*centrum ciliospinale inferius*) is now considered doubtful (Foster). The dilator centres are in some way connected with the afferent nerves of the body generally, so that, as already stated, the pupil dilates when the skin is irritated by pricking or tickling or in any other way. This centre is also stimulated by dyspnœic blood, and by loud noises, by severe pains, &c.

The fifth nerve plays a subsidiary part in the movements of the pupil. It acts probably only as a sensory nerve, and it is doubtful whether it has any fibres which directly influence the movements of the iris. Irritation and injuries of the cornea do, however, cause contraction of the pupil. This is apparently a reflex impulse, the path of which has not been clearly ascertained. This reflex is said not to be abolished by the separation of the oculo-motor nerve from its central nucleus. It has been further alleged that direct stimulation of the margin of the cornea causes dilatation of the pupil, and stimulation of the centre of the cornea, contraction (E. H. Weber).

Physical Examination.—The *size* of the pupil may be conveniently measured by means of a gauge, consisting of a series of dots or apertures ranging in size from 0·5 mm. to 7 or 8 mm. The *reactions* of the pupil should be tested in a good diffused light, preferably daylight. Each eye should be examined separately, and in testing the reflex reactions the patient's gaze should be fixed upon a distant object, in order that the consensual and the associated actions may be in abeyance. The eye which is not under examination having been completely covered, the size and shape of the pupil under observation should be first noted, and then the eyelids closed or covered by the hand (or other opaque body) for a few seconds. In health the pupil quickly dilates. When the eye is exposed, the pupil readily contracts. After a brief interval it dilates again a little, and again contracts; until at length it becomes stationary. Note should be made of the degree, promptness, and vigour of these movements, and of their equality or inequality in the two eyes. Next, the 'associated' movements with accommodation and convergence should be investigated; and lastly the 'consensual' movements. Even in disease, so long as there is quantitative perception of light, there is, as a rule, pupillary reaction. Sometimes, however, reflex reaction is maintained in an eye which is totally blind, and less rarely it is lost while there is still more or less sight. 'Associated' movements may be also maintained after the reflex reactions have been abolished (as in locomotor ataxy), and 'consensual' reaction may persist after direct reaction has ceased. The presence or absence of reflex contraction on stimulation of a blind eye depends upon the seat of the lesion. If the lesion be above the corpora quadrigemina, pupillary reflex may persist without quantitative perception of light. In testing these various movements, care should be taken to appreciate the modifications due to local disorders within the eye. The movements of the iris may be hampered, or altogether prevented, by the presence of adhesions between the iris and the capsule of the lens (posterior synechia), or adhesions to the cornea (anterior synechia); by the remains of the embryonic capsulo-pupillary membrane; by excess or deficiency of the aqueous humour; by undue hardness or undue softness of the eyeball; by absence or dislocation of the crystalline lens; by atrophy of the iris from any cause whatever; or by the action of certain medicaments applied to the eye or internally administered, such as belladonna, Calabar bean, or opium.

Pathology.—Disorders of the pupil manifest themselves by alterations in its shape, size, mobility, and reflexes. Those alterations which arise from local changes in the iris or other parts of the eye need not be considered here. Many alterations in the pupil occur symptomatically in some general diseases, and especially in diseases of the nervous system. In such cases alterations in size are usually associated with alterations in mobility and reflexes. Rarely, there is entire absence of reaction to all kinds of stimuli with a pupil of ordinary size, as in cases where there is paralysis of both the contracting and the dilating mechanisms. It is difficult, perhaps not possible, in the present state of knowledge to give a classification of disorders of the pupil at once simple and comprehensive. It cannot always be determined whether an alteration is due to spasm of one mechanism or paralysis of its antagonist. In some diseases there is sometimes alteration in the pupil, and sometimes none; and, even when present, the alteration is not always of the same kind, and may differ at different stages of the same disease. In some general diseases there are alterations without any appreciable disease either of the eye or of the nervous system. The pupil presents characteristic differences in typhus and typhoid fevers. In typhoid the pupils are dilated; in typhus they vary from medium dilatation to extreme contraction. In intrathoracic tumour, and other diseases pressing upon the sympathetic nerves, there may be dilatation of one or both pupils in the early stages from irritation, and contraction in the later stages from destruction and paralysis of the sympathetic. The state of the pupil is not always constant in diseases which more directly implicate the nervous system. In migraine the pupil is in some cases dilated on the affected side (Du Bois-Reymond), in some contracted (Piorry); in some both pupils are equally contracted (Möllendorff), and in some the pupils are normal (Liveing). In apoplexy the state of the pupils is variable, though usually they are dilated, or one is larger than the other; in hæmorrhage into the pons the pupils are contracted, though whether from irritation of the constrictor mechanism, or from paralysis of the dilator, is not always clear. In apoplectic convulsive seizures the pupils are often widely dilated; in softening of the brain, sometimes dilated, sometimes contracted. In sunstroke they are contracted. In disease of the spinal cord the alterations of the pupil vary with the stage of the disease. There may be dilatation from irritative lesions, or contraction from a paralysing lesion; and the pupils are often unequal. In degeneration of the cord there is often double myosis, associated with loss of light-reflex, and loss of reflex dilatation from stimulation of the cutaneous nerves.

For clinical purposes disorders of the pupil may be classified as (1) contraction (myosis); (2) dilatation (mydriasis); (3) clonic spasm of the sphincter (hippus); (4) paralysis of the constrictor and of the dilator mechanisms (iridoplegia); (5) disorders of the constrictor reflex; (6) disorders of the dilator reflex; and (7) disorders of associated action.

1. **Myosis** (μύω, I close).—Synon.: Called by some, but not very appropriately, *Miosis*, from *μείωσις*, which signifies diminution in *bulk*, and is already employed as a technical term in rhetoric.—Myosis is an unnatural smallness of the pupil, and may be mechanical, toxic, or neuropathic. The mechanical forms are due to some ocular disease, or to excessive use of the accommodation at near objects.

As a neuropathic state, myosis may be due to spasm of the pupil-constrictor mechanism (*spasmodic myosis*); paralysis of the dilator mechanism (*paralytic myosis*); or a combination of the spasmodic and paralytic forms. In the two first named, there is medium contraction of the pupil, which still retains some mobility. In the last, the contraction is extreme, and the pupil is immobile.

(*a*) *Spasmodic myosis* occurs whenever there is direct or indirect irritation of any part of the reflex apparatus of the pupil-constrictor system. In a high degree the pupil does not further contract to light or to accommodation. It does not dilate on shading the eyes, and there is but slight dilatation by sensory or emotional stimuli; mydriatics act moderately and myotics excessively. It may occur reflexly from injury or disease of the cornea, iris, and ciliary body; and from some diseases of the optic nerve, retina, and choroid. More directly it may occur in the early stages of a new-growth at the base of the brain, of basal meningitis, or of any morbid change in the third nerve itself. In such cases there is often convergent strabismus. It is an almost invariable symptom of the early stages of meningitis of the convexity. In the later stages of meningitis mydriasis may occur. It occurs also in meningeal apoplexy, and hæmatoma of the dura mater. Spasmodic myosis, followed by dilatation of the pupil, has been pointed out as diagnostic between apoplexy and embolism, inasmuch as in the latter condition change of the pupil does not take place (Berthold). At the onset of an epileptic seizure there is often a momentary contraction followed by dilatation. Spasmodic myosis is said to occur in the early stages of tobacco amblyopia. Nicotine internally administered produces it, probably from the stimulation of the pupil-contracting centres. Opium probably acts similarly. Some poisons produce different effects at different stages of their action. Chloroform, ether, and alcohol at first dilate the pupils; then contraction takes place; and if the effect of the poison be prolonged or increased, dilatation may occur again. This is always an indication of great danger. Certain medicaments, such as Calabar bean and its alkaloid physostigmine, and muscarine, also cause myosis through stimulating the sphincter, and perhaps also paralysing the dilator mechanism.

(*b*) In *paralytic myosis* there is medium contraction, and the pupil contracts to light, accommodation, and convergence; it dilates moderately to mydriatics, and contracts fully to myotics; and there is no dilatation to sensory irritation or to emotional stimuli. It may be due to a paralysing lesion of the dilator centre, disease of the pons, or any part of the course of the fibres passing from the centre to the eye. It occurs, also, in injuries and other affections of the 'cilio-spinal region' of the cord, as rupture of the root of the brachial plexus, paralysis of the cervical sympathetic from wounds or from destructive compression by tumours, enlarged glands, or aneurysms of the carotid or innominate or aorta. It occurs in locomotor ataxy, and in other diseases due to degeneration of the posterior columns of the spinal cord (spinal myosis), in cortical disease of the frontal lobes, in the later stages of acute mania, in the pauses of Cheyne-Stokes respiration, in the algide stage of cholera, and in alcoholic amblyopia.

In the more advanced stages of locomotor ataxy a form of myosis is often met with, in which the light reflex is lost, but contraction to accommodation and convergence is retained (Argyll-Robertson pupil). This condition is probably due to a double lesion, implicating, on the one hand, the pupil-dilator centre or the fibres which pass from it to the eye, and, on the other, some portion of the afferent path of the pupil-constrictor apparatus between the retina and the nucleus of the third nerve in the floor of the aqueduct.

(*c*) In *combined spasmodic and paralytic myosis* there is extreme contraction; with immobility to light, accommodation, and sensory stimuli; mydriatics produce but slight dilatation, while myotics have no appreciable effect. The condition is rare, and is more common as a complication of the paralytic than of the spasmodic form of myosis. It may occur when a spasmodic myosis from efforts of accommodation and convergence is superadded to a long-standing paralytic myosis; or when meningitis of the convexity of the brain complicates a paralytic myosis. (Ross.)

2. **Mydriasis.**—Mydriasis is an unnatural dilatation of the pupil. It may, like myosis, be mechanical, toxic, or neuropathic. The mechanical form is due to local conditions, such as glaucoma, intra-ocular tumour, &c., and need not be further considered here. Neuropathic mydriasis may be due to spasm of the dilator mechanism (*spasmodic mydriasis*), to paralysis of the constrictor mechanism (*paralytic mydriasis*); or to a combination of the spasmodic and paralytic forms. In the two former there is medium, not full, dilatation, and the pupil is mobile to some stimuli. In the last there is extreme dilatation and immobility to all stimuli.

(*a*) In *spasmodic mydriasis* there is medium dilatation; the pupil contracts slightly to light and accommodation; it does not dilate to sensory or emotional stimuli; it is difficult to contract by myotics, easy to suffer maximum dilatation by mydriatics. Spasmodic mydriasis occurs whenever there is irritation of the dilator centre or of the nerve-fibres going to the eye, as in the early stages of tabes dorsalis, in myelitis and meningitis, and other irritative lesions of the cervical spinal cord; irritative lesions in the neck, such as injuries, enlarged glands, tumours, or aneurysm, exciting the cervical sympathetic. Spasmodic mydriasis occurs in the early stages of many affections which later end in paralytic myosis. It also occurs in severe neuralgia, affecting any of the nerves of the body except the ophthalmic division of the fifth nerve, in which myosis is more common; in renal and biliary colic, gastralgia, the irritation produced by intestinal worms, in 'spinal irritation,' anæmia of the brain, with or without general anæmia, in dyspnœa, Cheyne-Stokes respiration, after a paroxysm of whooping-cough, during the spasm of tetanus, epilepsy, eclampsia, acute mania, melancholia, increased intracranial pressure, chronic hydrocephalus and tumours of the brain. In general paralysis of the insane there is often unequal dilatation; and quickly alternating mydriasis and myosis has been observed as a precursor of grave mental states. (Von Graefe.)

The dilatation which occurs when belladonna, atropine, or similar drugs are applied to the eye is probably due to a paralysis of the sphincter, with also stimulation of the dilator mechanism. The dilatation which takes place with cocaine is probably only the effect of the changes which this drug produces in the size of the blood-vessels.

(*b*) *Paralytic mydriasis* is due to paralysis of the constrictor mechanism. There is moderate dilatation, with reaction to sensory and emotional stimuli. The pupil dilates well to mydriatics, and contracts but slightly to myotics. The reactions to light and to accommodation vary with the seat of the lesion. If the lesion be in any part of the afferent optic path, there is no light reflex, but the pupil contracts on convergence and accommodation, and consensual reaction is retained. If the lesion be in the centre or along the efferent path (third nerve) there is no reaction to direct or consensual stimulation, or to accommodation and convergence. If the lesion be in the fibres which connect the optic nerve with the nucleus of the third nerve, the pupil will not contract to light, though there may be sight, but it will contract on convergence. In cases of blindness due to lesion in the visual centres above the corpora quadrigemina pupillary reaction may be normal. Paralytic mydriasis may occur in diseases of the base of the brain affecting the constrictor centre; in disease of the third nerve, in the later stages of meningitis, in thrombosis of the cavernous sinus and in progressive paralysis of the insane. It also occurs in the later stages of diseases in which there was an earlier myosis. It may also be associated with atrophy of the optic nerve.

(*c*) In *combined spasmodic and paralytic mydriasis* there is complete immobility to all stimuli except strong myotics, which lessen the dilatation somewhat. This condition is rare, but it may occur when irritation of the dilator mechanism is superadded to a pre-existing paralytic mydriasis, or when a destructive lesion of some part of the constrictor mechanism is superadded to previous spasmodic mydriasis; the latter condition is occasionally seen in general paralysis of the insane. In long-standing paralytic mydriasis the dilating tissues of the iris may undergo secondary contraction. (Ross.)

3. **Hippus.**—Synon.: Chorea of the iris. Hippus consists of quickly alternating contractions and dilatations of the pupil, probably due to clonic spasm of the sphincter. It is sometimes accompanied by nystagmus, and is occasionally seen in the regressive period of paralysis of the third nerve. It occurs also in multiple sclerosis, acute meningitis, and some apoplectic attacks.

4. **Paralysis of the Constrictor and the Dilator Mechanisms.**—In this morbid condition the pupil may be of medium size, or contracted, or dilated. The paralysis may be confined to the iris (*iridoplegia*), or the ciliary muscle may also be involved (*ophthalmoplegia interna*). There is no response to light or accommodation, and only slight effect from either mydriatic or myotic drugs.

5 and 6. **Disorders of Pupillary Reflexes.**—Disorders of the pupillary reflexes may be (*a*) disorders of the *constrictor* reflex; (*b*) disorders of the *dilator* reflex.

(*a*) *Disorders of the constrictor reflex.*—(1) In *lesions in the optic afferent limb* the pupil is dilated, and the sphincter loses its tone. There is no light reflex, but the pupil does contract to convergence and accommodation. In unilateral blindness, due to atrophy of the optic nerve, neither pupil may contract if only the retina of the blind eye be stimulated, but both pupils will contract if the sound eye be stimulated (*consensual reaction*).

(2) *Lesions of the efferent limb* may exist, either at the constrictor nucleus or in any part of the course of the third nerve. It is usually associated with paralytic mydriasis, to which the reader is referred.

(*b*) *Disorders of the dilator reflex.*—The *afferent* fibres in this reflex are those which connect the dilator centre with the skin and the periphery of the body generally; while the *efferent* fibres are those which pass from the dilator centre down the cervical spinal cord to the cervical sympathetic, and thence to the eye by way of the *long* ciliary nerves.

The skin and sensory reflexes are lost in some diseases of the cervical sympathetic, and of the cervical spinal cord. They are often lost in general paralysis, in locomotor ataxy, and other degenerative diseases of the cord.

7. **Loss of Associated Action** (Gowers). The pupil does not contract on efforts of accommodation. Indeed, there may be also paralysis of accommodation (*cycloplegia*). It may be due to disease in the nucleus of the third nerve or along any part of its course, or to disease of the lenticular ganglion. This condition may be a sequel of diphtheria (diphtheritic paralysis). It occurs also in degenerative diseases of the cord.

J. Tweedy.

PURGATIVES.

PURGATIVES.—Synon.: Fr. *Medicaments Purgatifs*; Ger. *Abführungsmittel.*

Definition.—Substances which cause intestinal evacuations.

Enumeration. — Purgatives are divided into several classes, namely, *drastic*, *simple*, *saline*, *hydragogue*, *cholagogue*, and *laxative.* Under the *drastic* purgatives may be classed Colocynth, Croton oil, Gamboge, Jalap, Podophyllin, Scammony, and Elaterin. Amongst the *simple* purgatives are Aloes, Castor oil, the juice of various species of Rhamnus (*e.g.* Buckthorn, Cascara sagrada, and Frangula), Rhubarb, and Senna. Under the head *saline* we have neutral salts, especially the Sulphates of Magnesium, Potassium, and Sodium; Citrate and Tartrate of Potassium; Bitartrate of Potassium, Tartarated Soda, and Phosphate of Sodium. *Hydragogues* include Bitartrate of Potassium, Elaterin, and Gamboge. *Cholagogues* comprise Aloes; Mercurial preparations, such as Calomel, Blue pill, and Grey powder; Podophyllin, Iridin, Euonymin, and other substances of the same class. The *laxatives* are small doses of simple purgatives, such as Carbonate of Magnesium, Magnesia, Olive oil, and Sulphur, as well as such vegetable substances as contain salines and sugar in considerable proportions, namely, Cassia, Figs, Honey, Manna, Prunes, Tamarinds, and Treacle.

Action.—The increased intestinal evacuation produced by purgatives is partly due to acceleration of the peristaltic movements of the intestine, so that the intestinal contents are hurried along more quickly, and less time is allowed for their absorption. Many authorities, especially in Germany, have held this to be the only way in which purgatives act; but there is no doubt that many of them also produce increased secretion from the intestinal glands. The different classes of purgatives affect the intestinal movements and intestinal secretion in different degrees. *Laxatives* and *simple purgatives* act chiefly, if not entirely, by increasing the peristaltic action. Some of the *drastic* purgatives act in both ways; whilst the *hydragogue cathartics*, as well as the *salines*, especially increase the intestinal secretion. In the case of some of the salines, as acid tartrate of potassium, the secretion is greatly increased, while the peristaltic movement is so little affected that the secretion may lie so long in the intestine as to be again reabsorbed, and the drug therefore fails to produce purgation at all. For this reason it is usual to combine such salines with simple purgatives, which will accelerate the peristalsis, as acid tartrate of potassium with jalap, and sulphate of magnesium with senna.

Besides their direct action upon the bowels, purgatives exert an indirect effect upon the circulation, weakening it, and lowering the pressure of blood within the vessels.

Cholagogue purgatives are those which have a special power to remove bile from the body. They may do this either by stimulating the secretion of the liver, or by quickening the expulsion of bile from the gall-bladder and ducts, so that more bile is poured into the intestine at a time when this is in active movement. The bile is therefore hurried down the intestinal tube, and reabsorption is thus prevented. This appears to be the mode of action of such purgatives as euonymin and iridin. Such mercurial preparations as blue pill and calomel appear to act in a somewhat different way. Experiments, contrary to expectation, have shown that they do not increase the secretion of bile, and yet they are amongst the most efficient cholagogue purgatives which we possess. Their cholagogue action is probably due to their exerting a special stimulating action upon the duodenum, quickening its peristaltic movements, and thus hurrying down the bile, and preventing its reabsorption. Their beneficial action as cholagogues is greatly increased by the subsequent administration of a saline purgative, which will tend to sweep the bile out of the lower part of the small and the large intestine, and prevent reabsorption from these.

USES.—Purgatives are used, firstly, to remove fæcal matters from the intestinal tube. They thus not only prevent the accumulation of such matters, but remove the irritation which their presence produces, and which may evidence itself in disturbances of other organs, for example, headache and malaise. These disagreeable symptoms produced by constipation appear to be partly due to the irritation of the intestinal nerves, producing reflex disturbance of the circulation; but it is probable also that they may be caused in part by the toxic action of poisonous gases, liquids, or solids generated in the intestine by imperfect digestion or decomposition of the food. For such purposes as this we may employ, as we find them necessary, laxatives or simple purgatives. The second use of purgatives is to remove from the body an excess of certain secretions such as bile, and substances which may be contained in them, such as metallic or organic poisons which are excreted in the bile or intestinal mucus. The third use is to remove liquid from the body in cases of dropsy, due either to cardiac or to renal disease. For such purposes we use hydragogue cathartics. The fourth use is to lower the temperature in fever, and for this we chiefly use salines. The *modus operandi* here is not yet well understood. The fifth use of purgatives is to lower the blood-pressure, and thus to prevent the rupture of a blood-vessel, and consequent apoplexy; or to prevent further extravasation in a case where the vessel has already burst, as in hæmorrhage from the lungs.

T. LAUDER BRUNTON.

PURGING.—A popular synonym for diarrhœa; and also applied to the therapeutical method purgation. *See* DIARRHŒA; and PURGATIVES.

PURPURA.—SYNON.: Cutaneous Hæmorrhages; Fr. *Purpura*; Ger. *Blutfleckenkrankheit.*

DEFINITION.—A diseased condition in which circumscribed effusions of blood take place into the upper layers of the cutis, and beneath the epidermis; occurring without or with certain constitutional symptoms, or in the course of various diseases; and attended at times by hæmorrhages under and from the mucous membranes, as well as into the various serous cavities.

ÆTIOLOGY.—Cutaneous hæmorrhages have been seen as early as the third day after birth, and indifferently at all other periods of life. Women appear to be more frequently attacked than men.

Cutaneous hæmorrhages, when not due to external injury, may occur in persons apparently in the most perfect health, or they may accompany the most various diseases of the general system. They are common in the specific fevers, especially typhus, variola hæmorrhagica, epidemic cerebro-spinal meningitis, scurvy, snake-bite, and hæmophilia. They are not infrequent in the course of Bright's disease, and valvular disease of the heart; they have been seen in phthisis, acute rheumatism, cirrhosis of the liver, leucocythæmia, intermittent fever, and, in fact, in patients of the most different constitution and general condition, from perfect health to the most advanced cachexia. The exciting cause is usually quite obscure, but purpura has been seen to follow severe fright, and also sudden obstruction of the circulation, as in severe coughing and epilepsy, though this is exceptional. Purpuric eruptions have followed the use of chloral hydrate in excessive doses, iodide of potassium in specially susceptible individuals, and the inhalation of chloroform. They may be due to want of support of the vessels in old age, or under diminished atmospheric pressure.

ANATOMICAL CHARACTERS.—The rete mucosum and the papillary layer of the cutis are the chief seats of the hæmorrhage in purpura. Owing probably to rupture of the capillaries over a limited area, the blood finds its way into the meshes of the connective tissue, and fills the interspaces between the hair-follicles and the ducts which traverse these parts. Absorption of the serum is soon followed by changes in the hæmatin set free from the red corpuscles, so that it passes through various tints of blue, green, and yellow, until it is completely absorbed. Very large extravasations may result in long-continued or even permanent pigmentation of the part, owing to the formation of hæmatoidin. Similar effusions to those beneath the skin are found in the severer cases beneath the mucous membranes also; but in these parts bleeding from their free surface is not uncommon, probably from the delicacy and slight resistance of the membrane covering the capillaries. *Post-mortem* examination in fatal cases has revealed extensive extravasation into the pleural, pericardial, peritoneal, and, very rarely, into the arachnoid cavities. Extravasation may also occur into the muscles, the periosteum, and even the bones, as well as beneath the conjunctiva and into the retina. Cases complicated with other diseases, such as phthisis or Bright's disease, will present their characteristic lesions.

Pathology.—Purpura appears to depend (1) on an alteration in the nutrition of the coats of the blood-vessels, which makes them unequal to the strain of arterial pressure, so that they rupture; or (2) on alterations in the blood itself (excess of water, or salts); or (3) on both causes combined. That weakness of the vessel-walls is a main cause, is shown by the greater frequency and extent of the purpuric eruption on the feet and legs, and on the most dependent parts, such as the back, if the patient be recumbent, where gravity intensifies arterial pressure. The influence of the nervous system may account for some cases of rapid hæmorrhage, for this condition has been experimentally produced in frogs by extirpation of the sympathetic ganglia.

Embolism and thrombosis have been suggested as an explanation of some cases. The relation of the joint-affections which so often accompany purpura to the latter is not clear, and there seems ground for believing that they are not always rheumatic, but may be due to hæmorrhages into the synovial membranes of the joints.

Symptoms.—Although, as has been stated, cutaneous hæmorrhages may occur under such a variety of conditions that they can scarcely be looked on as characteristic of a definite disease, yet since they not infrequently appear in apparently healthy persons, and run a definite course, it seems advisable to retain the time-honoured name of purpura in these cases, as well as to include under the generic name two or three minor species. It must, however, be distinctly understood that *there is no abrupt line of demarcation between any of the varieties of purpura*, but that the difference between them depends on the severity of the accompanying symptoms. The eruption has the same general characters in all forms of purpura. It consists of isolated spots, whose colour varies from bright red to a livid or dark purplish-red. They do not disappear on pressure. Their shape is generally round or irregular, and their edge is almost always uneven and denticulated. Their size varies usually from that of a pin's head to that of a pea or bean, but in some cases they may be as much as several inches in circumference. The smaller spots, not larger than a finger-nail, are termed 'petechiæ,' the larger 'ecchymoses.' If they take the form of lines or broad stripes they are called 'vibices.' The spots are usually level with the skin, but they sometimes appear as small conical papules round the hair-follicles (*purpura papulosa, lichen lividus*—Willan), or as wheal-like nodules (*purpura urticans*). Very rarely the epidermis is raised into the form of bullæ containing serum and blood-corpuscles (*purpura bullosa*). The duration of each spot depends on the amount of extravasated blood giving rise to it, and on the time necessary for its absorption; but it usually disappears in a week or ten days. The spots, once formed, do not increase in size except by fresh hæmorrhage in their vicinity. They never end in desquamation, and only large ecchymoses are followed by more than transient pigmentation; but they all undergo colour-changes during absorption, by which they become brown, green, and yellow, while their edges become more and more indefinite. Their presence under the skin is unattended with pain or any kind of irritation or pruritus, so that the patient may only discover their existence accidentally while undressing.

Varieties.—We may now briefly consider the varieties of purpura:—

1. **Purpura Simplex.**—In this form the eruption is either preceded for a few days by languor and loss of appetite, or else it occurs without any previous symptom. The spots may be limited to the feet or legs, or they may be scattered over the whole body, including, in severe cases, the head and face. They come out in crops, each of which lasts from eight to ten days. There may be only one or two crops, or fresh ones may protract the disease for several weeks or months.

2. **Purpura Hæmorrhagica.**—Synon.: Land Scurvy; *Morbus Maculosus Werlhoffii.*—This form only differs from purpura rheumatica in the greater depression and constitutional disturbance which precede and accompany the outbreak of spots; in the greater extent of surface covered by the petechiæ; in the larger size of the ecchymoses; and, lastly and chiefly, in the occurrence of hæmorrhagic effusions beneath the mucous membranes of the lips, cheeks, gums, and palate, and of more or less copious free hæmorrhages from the nose, mouth, intestines, urinary tract, and more rarely from the lungs. The repetition of these hæmorrhages may rapidly exhaust the patient's strength, and cause death from anæmia

and collapse, or he may die with so-called 'typhoid' symptoms. The hæmorrhages from internal parts do not bear any necessary proportion to the skin-eruption, and they may be very severe when the latter is small, or *vice versâ*; nor need they begin or end at the same time with it. Purpura hæmorrhagica may, like the other varieties, occur suddenly in apparently healthy persons, living under the most favourable circumstances.

3. **Purpura (Peliosis) Rheumatica.** This is now classed with the polymorphic erythemata; neither the arthritic symptoms nor the character of the eruption present is sufficiently distinctive and constant to separate it from the erythemata, with which it has close alliances. *See* ERYTHEMA.

DIAGNOSIS.—The fact that the purpuric spots are unaltered by pressure, and unattended with itching, scaliness, or tendency to discharge, will separate them from almost every other affection of the skin. From scurvy, purpura is distinguished by occurring in those whose health has not been impaired by long privation from fresh meat and vegetables; by the absence of spongy gums, painful brawny swellings of the limbs, and ulceration of the skin; and by its resistance to diet and the use of lime-juice. Purpura simplex must not be confounded with flea or bug bites.

PROGNOSIS.—In purpura hæmorrhagica recovery is the rule in uncomplicated cases, though there are a few instances on record which ended fatally from the exhaustion produced by repeated hæmorrhages, although no cause could be detected, and every known remedy was tried. Purpura accompanying organic disease, such as Bright's disease or morbus cordis, is unfavourable. The duration of all the forms is very uncertain, owing to their tendency to relapse.

TREATMENT.—In the treatment of purpura absolute rest in bed is necessary, if the eruption be general; elevation of the legs is advantageous if the disease be confined to them. Any derangement of internal organs must be remedied, if possible. As a rule, tonics, especially quinine and iron, do most good in purpura simplex. Tincture of perchloride of iron, ♏xv.-xx., three times a day, is almost a specific in many cases; and the mineral acids, especially sulphuric acid, are of great value. In purpura hæmorrhagica, with copious bleedings, ergot or subcutaneous injection of ergotin has proved most effectual. Turpentine, in ten-minim doses, gallic acid, and other hæmostatics also deserve a trial. Locally, cold applications, or injections of iced water, may be resorted to in severe epistaxis or hæmorrhage from the bowel. Iodide of potassium should not be given in purpura, as it aggravates it in some cases, and has even given rise to serious ulceration.

EDWARD I. SPARKS. ALFRED SANGSTER.

PURPURIC. — Relating to purpura. *See* PURPURA.

PURRING TREMOR or THRILL. SYNON.: Fr. *Frémissement Cataire*; Ger. *Schnurren.*—A physical sign felt by the hand applied over the heart or vessels in certain conditions, resembling the sensation conveyed by the purring of a cat. *See* PHYSICAL EXAMINATION.

PURTON, in Wiltshire. — Saline waters, containing iodine. *See* MINERAL WATERS.

PURULENT INFECTION.—Infection from the absorption of pus, introduced from without, or formed within the body. *See* PYÆMIA.

PUS.—A product of inflammation. *See* INFLAMMATION.

PUSTULE.—SYNON.: Fr. *Pustule*; Ger. *Pustel.*—A vesicle of the skin containing pus, as in small-pox and ecthyma. Vesicles originally containing serum are also apt to become pustules, by a purulent transformation of their contents.

PUSTULE, MALIGNANT.—SYNON.: Anthrax; Fr. *Charbon*; Ger. *Anthrax*.

NOMENCLATURE.—Under this head will be considered the various manifestations of the effects of poisoning by the *bacillus anthracis*, which has already been described in the article on MICRO-ORGANISMS. Various names are employed to designate the different clinical forms, both in man and animals. These names came into use before the real nature of the several forms was known, and were derived from prominent features of the disease, or from its supposed origin.

In bovine animals, the great swelling of the spleen led to the names of 'Splenic fever,' 'Splenic apoplexy,' *mal de rate*, *Milzbrand*, &c. From the peculiar characters of the external lesion in man, and less frequently in animals, the terms 'malignant pustule,' 'anthrax,' 'contagious carbuncle,' &c., were derived. The especial liability of those engaged in certain occupations, especially those involving exposure to contagion, led to the names of 'woolsorter's disease,' 'hair-comber's disease,' &c. And it is very probable that several other diseases of animals, such as Siberian plague of horses, Cape horse-disease, &c., are of similar nature, deriving their special features from the mode of inoculation, or the peculiarities of the animals affected.

ÆTIOLOGY.—Anthrax is of very wide distribution throughout the world, especially affecting cattle, deer, sheep, goats, and allied animals; less frequently horses. But it can be communicated to nearly all animals by inoculation, and even to some birds and amphibia. Of mammals, herbivora are especially susceptible; whilst carnivora are with difficulty inoculated, except when young.

Rodents are highly susceptible, and hence are commonly used for test-inoculations.

Although apparently endemic in certain regions, there can be little doubt that this is due to the great persistence of the contagium by means of its spores, and that the recurrence of outbreaks in cattle is due to the careless disposal of carcasses of animals which have died of the disease.

In man, the disease is usually traceable directly to inoculation from the carcass, or from parts, such as the skin or hair, which have been kept in a dry state. Hence butchers, shepherds, and stockmen, who flay the carcass or bury it, are most commonly its victims from the more direct mode of inoculation; whilst wool packers and sorters, horsehair cleaners, workers in felt manufactories, furriers, tanners, and the like, are exposed to the less direct form. But in rarer instances no such mode of contagion can be traced, and it is probable that in these the poison has been conveyed by flies, or similar agencies. The flesh of the dead animals can rarely be suspected, unless it is eaten raw or very imperfectly cooked. Even then, as we know from experiment, large quantities of the bacillus or its spores may do no harm. Butter and milk are alleged by Heusinger to be possible carriers of the poison. Nor is it improbable that the use of water which has been contaminated by wool-waste, bone-dust, or other substances, may convey contagion to cattle. But none of these modes is proved to be common in man, and the spread of contagion from one human subject to another is extremely rare.

It will, however, be shown that in man the disease may be acquired either by inoculation or by inhalation of the dust containing the spores of the bacillus, perhaps also by swallowing them.

Description. — The form of the disease depends on the mode of entrance, and may be internal or external.

Anthrax in Cattle.—This will be briefly described, as of importance in relation to man. Whereas in some animals there are marked external manifestations, either pustular or of the nature of diffuse phlegmonous swellings, with glandular enlargement, such conditions are rare in cattle. In them there may be not only no external changes, but even few perceptible symptoms. Only for a few hours before death there may be evident languor, loss of appetite, and then stupor. But sometimes animals may be found dead in the morning which had been apparently well the night before. If, however, they are carefully observed, it is usually found that there is marked rise of temperature, followed by coldness and lividity before death.

On examining the carcass, the blood is often found fluid, and may be dark in colour. Sometimes there are glandular swellings and inflammatory œdema, especially around the pharynx, œsophagus, and stomach. But these are more frequently absent, and there are only scattered hæmorrhages here and there, especially in the lungs and heart-wall, and sometimes in the submucous tissues.

The most constant and characteristic condition is the enormous swelling of the spleen, which is engorged with blood, and readily breaks down on slight handling. This splenic enlargement, be it remembered, is constant only in cattle, and may be entirely absent in other animals, or very slight and irregular.

Microscopic examination shows enormous numbers of anthrax bacilli in the blood, especially in the spleen, lungs, and, next in frequency, in the capillaries of the glomeruli of the kidneys, and sometimes in the liver. In these organs many of the capillaries may appear to be completely filled at parts with bacilli.

It is very important to bear in mind that this abundance and this distribution of the bacilli are very inconstant in other animals. Only guinea-pigs show a similar condition with any constancy. In other animals the bacilli may be few and scattered, being found especially in the capillaries of the lungs and kidneys ; or they may be mainly limited to the lymphatics, including the glands and lymph cavities. Hence, whilst all parts of the body of cattle which have died of the disease are actively poisonous, it may be difficult to convey the disease from other animals except by inoculation of the fluid from the more affected parts.

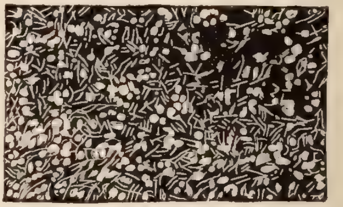

Fig. 134.—Part of the Spleen of a Guinea-pig which died of anthrax, showing the relative proportion of bacillus rods and leucocytes. × 100 diam. From a photomicrograph.

Moreover, the activity of the bacillus is rapidly destroyed by decomposition, so that no results may be produced by inoculation from the dead animal when decomposition has set in, unless spore-formation has occurred. This is also true of the human subject.

Spore-formation is sometimes alleged not to occur during life. It may, however, do so in the kidney, if the bacilli pass into the urinary tubules, and also in serous exudations in the pleura and elsewhere, either before or very speedily after death.

Destruction of the carcasses by fire or by deep burial is essential to prevent infection from them.

Anthrax in Man.—This is divisible into two primary forms, *external* and *internal*, which differ not only in the character of the disease, but in mortality and treatment. The external variety may be further described as *malignant pustule proper*; and *anthrax œdema*. The internal form may be subdivided, according to the part specially affected, into a *broncho-pulmonary* form, of which 'wool-sorter's disease' is the type; and a *gastro-intestinal* form. There may also be cases which do not come strictly under either of these heads, but more closely resemble the disease in cattle, and have been called *Anthracæmia*.

The external form, malignant pustule, is caused by direct inoculation of the skin, or of a superficial mucous membrane, for instance, that of the lip or the eye. In some cases there is only present an intense inflammatory œdema, which spreads like erysipelas, and causes enlargement of the corresponding lymphatic glands. It is like the condition to be immediately described, differing only in the absence of the characteristic pustule.

Of these cases of so-called *anthrax œdema*, it need only be said that some may not be due to the anthrax bacillus, but to the bacillus of malignant œdema, which is described under MICRO-ORGANISMS. But there is no reason to doubt that a similar condition may be produced by the anthrax bacillus.

Malignant Pustule Proper. — The typical form, malignant pustule, can usually be traced to direct inoculation. It commences as a small red swelling or pimple at the point of inoculation. It may give rise to slight irritation, or be attended by burning or itching, but may be absolutely painless. It occurs commonly on the face, neck, hand, or arm, that is, on the parts most exposed to direct inoculation in handling a carcass. The exact period after inoculation at which it appears is variable, owing doubtless to the presence or absence of a small wound: it may be from a few hours to two or three days, possibly longer. Once formed, it rapidly extends, so that in a few hours a large red swelling may be present. There then usually form upon the surface of the swelling one or more vesicles, which, if not ruptured, may reach a considerable size by confluence. By this time a more marked localised swelling has formed; and if the vesicle or bleb ruptures, or is opened, it discharges a watery fluid, either clear or slightly turbid, and often deeply blood-stained. Beneath the vesicle is a dark-red area, which usually dries, producing a dark-brown or black eschar, seated on a much raised, angry red, indurated base. Further vesicles frequently develop around this eschar; they often form a narrow ring surrounding it. The central necrosed area enlarges, and by this time a widespread livid red area and extensive brawny œdema extend from it, sometimes involving the whole arm or face. The corresponding lymphatic glands usually enlarge, often to a great degree, forming a dense mass, owing to the surrounding inflammatory œdema. The central black eschar may enlarge till it reaches one-third to three-quarters of an inch in width; and if the patient survives it may still be distinct, seated on the raised indurated inflamed base, at the end of ten days or more. These characters will be explained in considering the microscopic changes.

In some cases, this typical lesion is indistinct, the brawny red swelling, with some irregular vesicles, being alone observed. When recovery occurs, the swelling subsides more or less rapidly, the eschar separates, and healing takes place rapidly; but the swelling of the glands may last for some time.

Similar carbuncular swellings, more or less typical in character, have also been observed, though rarely, after an internal or general infection, and not as the result of local inoculation.

Microscopic Anatomy of the Malignant Pustule.—The descriptions given by various writers of the changes seen with the microscope are somewhat conflicting. The differences are partly accounted for by the different site or stage of the specimens examined. From an examination of numerous specimens at various stages, the changes appear to be fairly constant in their mode of evolution.

In the early stages there may be no indication of abrasion of the skin, and it is probable that the virus may gain access by the hair-follicles. There is at first infiltration of the corium, with inflammatory exudation, especially in its papillary portion. The epithelium becomes partially separated, and rises in the form of vesicles, as in an ordinary blister, the deeper layers alone remaining attached. Bacilli are found, though scantily, in the serous exudate.

There then ensues a deeper-seated exudation, penetrating to the deeper layers of the skin. This exudation is accompanied by hæmorrhage, and the tissue-elements swell and undergo rapid necrosis. Both the epidermis and the infiltrated superficial layers of the skin necrose and form a coagulated mass, which constitutes the dark central area of the pustule. Around this the processes of vesication and of subjacent hæmorrhagic infiltration go on spreading, both laterally and in depth.

When fully formed, the central part forms a dense, horny-looking, blood-stained mass; beneath and around it are great infiltration, hæmorrhages, and commencing necrosis. Farther out there is œdema and great vascular engorgement, often with but scanty leucocyte exudation.

In sections stained for bacilli, they are found almost solely in the vesicles and in the lymphatics around the necrosed area. They occur as scanty clusters, and are often most abundant in the more superficial lymphatics. They can be traced for a certain distance from the area of intense inflammation. Their absence in the necrosed area is doubtless explained by the necrosis in which they share. They have occasionally been seen in large numbers amongst the epithelial cells and in the superficial layers during the early stages of infection.

In more advanced conditions, leucocyte infiltration becomes abundant around the necrosed area.

Some have supposed that the peculiar characters of the pustule are due to the presence of other micro-organisms, which aid in their destruction and in the necrosis of the tissues. It cannot be said that microscopic examination of pustules in the earlier stages lends much support to this view, or to the view that leucocytes are much concerned in their destruction. They point rather to an intense irritant action of the products of the growth of the bacteria on the tissues and vessels, differing markedly from their effects as seen in the blood-vessels of the cow, in which almost no such action is apparent. When the surface has necrosed, other bacteria do no doubt enter, but they do not usually penetrate deeply into the tissues.

The normal limitation to the lymphatics, and their scanty number, the spread mainly in the superficial lymphatics, and the early and intense protective exudation and necrosis which they excite, are all favourable to recovery; and they afford strong grounds for the avoidance of any treatment which will break through these natural barriers and produce risk of contamination of the blood.

Symptoms.—The condition of the patient is very varied. Even in cases which prove fatal, there may be few or no general symptoms at first, and he may even continue at work with a large distinct pustule; or there may be only a slight degree of prostration, with a little fever. In some cases recovery ensues without the development of any general symptoms.

More commonly the development of the pustule and of the lymphatic infection are attended by prostration, fever, and some of the symptoms of general blood-poisoning. The exact character of the symptoms, which will be more fully described under the head of 'Internal Anthrax,' appears to depend on the system which is more specially involved. In some, gastro-intestinal derangement, with severe vomiting, is prominent. In others, delirium, convulsions, and coma occur. In rarer cases, the course resembles that of the bronchial form, to be described later.

The temperature is said by some not to be elevated. This may possibly be true in some cases in which there is no general infection, but it is not confirmed by cases investigated by Mr. Spear and the writer, or by the numerous medical men under whose care these patients were, and who had carefully watched other cases. The elevation may be slight at first, and in the more advanced condition the surface temperature may be subnormal; but the rectal temperature is elevated. It may rise to from 101° to 105° F., and in one fatal case it rose to nearly 107°. This point is of considerable importance in diagnosis.

Recovery may take place without special treatment, even where severe constitutional symptoms have supervened. The mortality appears to be about one in four of cases treated without incision. Convalescence may be rapid and complete, or prolonged debility may result.

In some cases, the diffuse cellulitis which spreads from the seat of inoculation may be followed by suppuration, either diffuse phlegmonous infiltration or localised abscess, especially in the glands. The occurrence of diffuse phlegmonous cellulitis appears to be commoner in a class of cases in which the carbuncular swelling is not fully developed, but forms only a small swelling, which usually vesicates. In these cases, also, blebs may form more widely over the inflamed skin, and extensive desquamation of the cuticle may accompany recovery.

Treatment.—When any local lesion forms in a person who is known to be exposed to infection, treatment should be at once commenced. If small, the pimple should be incised with a very sharp knife, and suction immediately applied by means of a cupping-glass or artificial leech; the part should then be thoroughly washed with a strong antiseptic, such as solution of biniodide of mercury 1 per cent. in excess of iodide of potassium, or corrosive sublimate of the same strength, preferably combined with peroxide of hydrogen to prevent coagulation.

If the condition is evidently anthrax, or there has been known inoculation, the more radical method of complete excision and subsequent cauterisation is probably desirable. Of the various methods which may be used, excision is perhaps the best, if it can be done speedily and with little disturbance of the part; but it must be borne in mind that the great risk to the patient's life is in the entrance of the bacilli into the blood-stream, and that the greatest precautions must be taken to avoid this. During the operation the wound should be kept irrigated with antiseptic lotion, preferably biniodide or perchloride of mercury, 1 in 2,000.

Bleeding from the wound may be encouraged by a loose bandage above, in the case of the arm or hand, the object being to prevent the entrance of bacilli into the veins. Arterial bleeding may of course be controlled in the usual way. Antiseptics should be speedily applied. Of these, strong carbolic acid or fuming nitric acid is often recommended; but the caustic action of these so limits their sphere that probably sublimate or biniodide is to be recommended, except where a caustic action is desired owing to the difficulty of complete excision, for instance, on the face. For a dressing, biniodide solution is especially to be recommended; and if applied on several layers of lint, covered with oiled silk, forms a sort of poultice which aids to draw out the lymph. Some recommend carbolic acid or other antiseptics, but these are comparatively ineffective. Oozing from the wound should be encouraged rather than checked.

The diffuse cellulitis may, if necessary, be treated by superficial linear incisions or scarifications, the parts being immediately washed with biniodide lotion, 1 in 1,000. A large poultice of iodide of starch paste, to which a solution of biniodide of mercury in a large excess of potassium iodide has been added, in such proportion as to make the poultice of the strength of 1 in 3,000 of biniodide, should then be applied.

The *rationale* of this treatment lies in the fact that the bacilli lie mainly in the lymphatics of the superficial layers of the corium. The risk of promoting their entrance into the blood must always be borne in mind. Surgical interference is therefore to be deprecated, unless the disinfectant treatment can also be carried out.

Internally, the treatment must consist in supporting the strength, especially by concentrated animal diet, and perhaps by large doses of quinine. Strophanthus should be given if the heart's action becomes feeble.

Internal Anthrax.—This term is more strictly applicable to those cases in which the starting-point is internal, usually by entrance of the virus into the respiratory or alimentary passages. But the conditions which follow general infection from an external lesion are closely analogous.

Of the forms which internal anthrax assumes, the *bronchial* and *gastro-intestinal* are the most typical. Internal inoculation may, no doubt, occur in the mouth, pharynx, &c., as well as in the stomach or intestine. Some have supposed that there may be an entrance into the blood, such as appears to occur in cattle, causing a general blood-poisoning without local lesion. But the practical evidence in favour of this view is small, and it is very doubtful if it is really true of cattle.

In those exposed to infection by the inhalation of dust charged with anthrax spores, as wool-sorters, the form of disease is usually bronchial. In all the cases investigated by the writer, in conjunction with the late Mr. Spear of the Local Government Board,[1] this was the form observed; and further investigation of wool-sorter's disease by others since that time has fully confirmed the observations then made, both as to the form of disease and the microscopic lesions.

1. Bronchial Form — Wool-sorter's Disease.—In this form inoculation takes place by the inhalation of dust from wool or hair containing the spores of the anthrax bacillus. The site of inoculation is in the lower part of the trachea and the large bronchi. Local lesions closely resembling those of malignant pustule are here produced in the mucous membrane, and thence the virus spreads by the lymphatics to the bronchial and mediastinal glands. These become greatly swollen, and often the seat of hæmorrhages. Thence infection, with intense inflammatory œdema, spreads to the connective tissue of the mediastinum, and possibly upwards to the neck, to the root of the lungs, and sometimes to the pericardium. Although the pleuræ are rarely inflamed, the pleural sacs become filled with serum, and the lungs collapse. Such are the constant lesions. But the virus may spread to other organs, if once it enters the blood, and may then produce hæmorrhages or inflammatory exudations in them, with consequent symptoms. The alimentary canal, the peritoneum, the brain and its membranes, may be especially affected. But death often occurs before they have become involved.

The symptoms and course of the disease will be better understood if the morbid anatomy is first considered.

ANATOMICAL CHARACTERS.—Marked lividity is common, often being present even during life. Some swelling may be seen in the lower part of the neck, though rarely. The blood is dark-coloured, and coagulates imperfectly.

On opening the thorax, some emphysema may be present in the anterior mediastinum. But constantly there is seen a diffuse infiltration of the mediastinal tissues, either pale and gelatinous, or deeply blood-stained, or with scattered hæmorrhages. Both pleural cavities contain a large quantity of fluid, if the two layers are not adherent; the fluid is usually pale and clear, or very slightly turbid. Rarely it is blood-stained. The quantity in each pleura may be from two to four pints. The serous membrane is usually free from all trace of inflammation, though this occurs in rare cases. The pericardium also often contains an excess of fluid. If inflammation is present, it rarely extends to the epicardium.

The lungs are collapsed; they may show minute scattered hæmorrhages, or small patches of broncho-pneumonia, but this not commonly.

The mediastinal and bronchial glands are greatly swollen, and the hæmorrhage in them may make them look like clots. Extensive infiltration of the whole of the connective tissue around them is present, reaching sometimes up into the neck.

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[1] See *Reports of the Medical Officer of the Local Government Board* for 1880 and 1881.

The fluid squeezed from this tissue may contain scanty bacilli, but both here and in the pleural fluid they may be very scanty.

On opening the trachea and bronchi, they are found to contain blood-stained frothy fluid. Towards the lower part of the trachea and in the main bronchi the mucous membrane is irregularly swollen and blood-stained in patches. In addition, hæmorrhages are seen in the mucous membrane, forming raised spots. This condition is usually limited to the main bronchi, but may extend into their primary divisions.

On microscopic examination, the most marked changes correspond to the hæmorrhagic areas. The hæmorrhage lies for the most part immediately beneath the basement-membrane, which may have ruptured, the blood forming a layer beneath the detached epithelium. It may also penetrate deeply into the mucous and submucous coats. All the tissues beneath and around are infiltrated with serum, and their tissue-elements thus separated, but not usually necrotic. The blood-vessels are dilated, but leucocyte exudation is scanty. Dense masses of bacilli are found in the exudation, and escaping to the surface. They also surround and extend in the lymphatics, perivascular and other, and may be traced in them to the deeper lymphatic plexuses. Similar masses of bacilli may also be seen in the superficial layers of the mucosa, where as yet little or no inflammation has occurred. They often lie immediately beneath the basement-membrane. Little or no catarrhal change is seen, the epithelium simply desquamating; if catarrh is present, it is usually of older date.

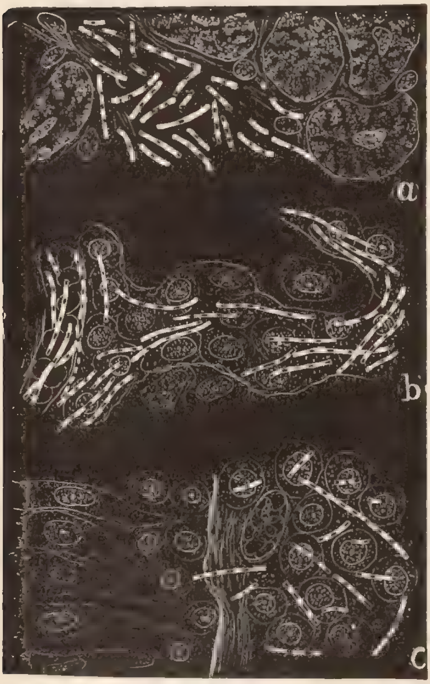

Fig. 135.—Anthrax Bacilli. *a.* In heart-wall of a cow. *b.* In the pulmonary capillaries of a cow. *c.* In the human bronchial mucous membrane, in a case of 'wool-sorter's disease.' × 800 diam.

In the bronchial glands, the condition is often masked by the extensive hæmorrhage. Bacilli are found, often scantily, especially in the lymph-sinuses of the cortex. Sometimes they are very abundant, and may then also appear in the capillaries.

In the lungs, scattered patches of hæmorrhage may be present, mainly due to the inhalation of blood from the bronchi. These may also produce areas of lobular collapse and broncho-pneumonia. But for the most part, nothing but the general collapse and congestive œdema are found in the lungs, and bacilli are often not to be discovered, except here and there in the lymphatics near the root. This common absence of bacilli in the pulmonary capillaries proper is in marked contrast with the condition usual in cattle.

In other organs, the changes are diverse, and may be absent. There is not usually much cloudy swelling or other indication of septicæmia, though they may be present. Minute hæmorrhages are often apparent; or, in the pia mater, and generally in serous membranes, diffuse extravasations. In the stomach and intestines submucous exudation and scattered hæmorrhage may occur.

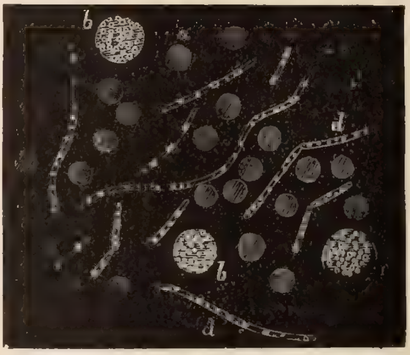

Fig. 136.—Bacilli from the fluid exuded from the lung in a case of internal anthrax. *a.* Red blood-corpuscles. *b* and *c.* Large granular corpuscles from the lung. *d.* Bacilli of various lengths, containing highly refracting granules, or fully formed spores. × about 700 diam.

For the most part, the spleen is but slightly swollen. Examination of the blood and of other organs, such as the kidney, in which bacilli are commonly abundant in many animals, is usually attended with negative results, though in some cases bacilli may be found by careful search. Inoculation with these parts or with the blood may also produce no effect.

But if susceptible animals are inoculated with the bronchial fluid, or other parts which contain bacilli, typical anthrax is produced.

The multiple nature of the lesion in the bronchi and trachea is no doubt explained by the ready spread of the bacilli in the lymphatics of the mucous membrane, and by secondary inoculation with the bacilli exuded on its surface.

The pleural exudation, which forms so constant a feature in typical cases, usually without any inflammation of the serous membrane, is probably due to the enormous and rapid obstruction of the lymph-channels in the glands and mediastinum. The swelling and obstruction of the bronchi must also aid the collapse of the lungs, by preventing the entrance of air.

A knowledge of these facts is of essential importance in relation to treatment.

SYMPTOMS AND COURSE.—Whilst presenting considerable variety in the additional symptoms and mode of termination, nearly all cases present characteristic features due to the peculiar lesions just described. To these may be added the effects of nerve irritation, especially of the phrenic nerves, the vagi, and the cardiac and pulmonary plexuses.

Only the more important of the clinical phenomena will be described.[1] The earlier symptoms are usually great lassitude, chilliness, sometimes with rigors, and mental depression, sometimes with insomnia. Headache, dizziness, and nausea are often present. Vomiting may occur early, and be a prominent symptom, possibly due to the nerve-irritation above mentioned. With these or other symptoms there is commonly complained of at an early period a peculiar sense of constriction of the chest, especially at the lower part, and a want of breath. This is sometimes accompanied by marked pain or cramp-like feeling, and is aggravated by exertion. Cramps and tingling sensations in the limbs, palpitation, flushings, and perspirations may occur.

After a variable period of from one to five days, during which there may be intervals of improvement, there ensue more severe symptoms, and the patient has to leave work and often to take to bed. These more pronounced symptoms include greatly increased prostration, accelerated and difficult respiration, usually rise of temperature, and a rapid and feeble pulse. In addition, the sense of painful constriction of the chest is often marked. Cough, which may be slight or almost absent at first, now usually becomes marked; it is dry, hacking, and painful. The sputa are usually scanty, frothy, and blood-stained, but may become abundant and hæmorrhagic. Bacilli may be found in the sputa. (Lodge.[1])

Sometimes death occurs from syncope within twenty-four hours after the patient gives up work, nothing but the dyspnœa and cyanosis being observed.

More commonly the dyspnœa and cyanosis increase, the face becomes pallid or livid, the pulse and respiration are accelerated, and the general symptoms become more marked. Headache is sometimes intense; vomiting may be frequent and urgent, and indications of the involvement of other organs show themselves. Of these, gastro-intestinal irritation is frequent; there may be severe colic; hæmorrhage from the bowels may occur, though infrequently. In fact, the disease may assume the gastro-intestinal form. Or the cerebral or spinal centres may be especially involved; hence delirium and somnolence, more rarely convulsions or tetanic spasms. Death may be preceded by coma, or the patient may be conscious to the last.

In many cases scattered hæmorrhages in the skin or subcutaneous tissue, or diffuse discolorations, are observed during life, but they may be entirely absent. In rare cases typical carbuncles have been observed. Remissions sometimes occur, to be followed by more marked prostration. In nearly all cases, even if the temperature is high, there is great coldness of the extremities, with indications of asphyxia.

The range of temperature is very variable, and it shows also marked oscillations; but observations on the surface temperature are not reliable, owing to the great chilling of the surface.

Of the physical signs, those of pleural effusion are the most marked, but the effusion sometimes occurs very rapidly, and may not do so till shortly before death. Bronchitic sounds, &c., may of course also be present

Even when severe symptoms have developed, recovery may take place. In the cases collected by Mr. Spear, four out of twenty-three recovered. And in many cases which presented marked initial symptoms, and from their relations to infection were in all probability cases of the disease, the more severe symptoms did not develop. In some, secondary changes in the lungs appear to have caused death at a much later period.

Death usually occurs within from two to six days from the onset of marked symptoms. Eleven of the twenty-three cases mentioned died within three days. Only two died at eight days, and these from septic complications.

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[1] For further details, see the admirable report by Mr. Spear, already referred to: *Report of Medical Officer of the Local Government Board*, 1880, p. 72.

[1] *Arch. de Méd. Experimentale*, ii. 1890, p. 763.

When recovery occurs, convalescence is often very prolonged.

Treatment.—Prophylactic measures are by far the most important. Of these the careful separation and disinfection by superheated steam of all wool or hair which shows suspicious characters, such as excess of blood-staining, dirt, &c., or which comes from districts where anthrax is common, are of prime importance. The characters and origin of such wool or hair are well known to those engaged in such trades. Next in importance are the thorough ventilation of the rooms in which the wool is sorted, and the greatest care in washing the hands, changing the clothes, &c. The effect of such precautions, which were first enforced in 1884, has been to reduce the mortality from the disease in the Bradford district to two per annum during the years from 1884 to 1890 inclusive; whereas in the period of ten months at the time of our inquiry in 1879–80 there were nine cases of malignant pustule with two deaths, and twenty-three cases of internal anthrax with nineteen deaths. (Lodge.[1])

Of the treatment to be adopted when the fully pronounced symptoms are present, little can be said. The evacuation of the fluid from the pleuræ is certainly indicated, and the internal administration of strong meat broths, stimulants, and cardiac tonics, especially strophanthus. But when once the virus has entered the blood, it is probable that little can be done beyond dealing with complications as they arise.

Prophylactic inoculation does not appear to be applicable. Moreover, it does not appear that one attack affords protection in man, since internal anthrax has been fatal in some who have suffered previously from malignant pustule.

2. **Gastro-Intestinal and other Forms.**—Of the other forms of internal anthrax it need only be said that they appear to be far rarer, and that their symptoms and treatment correspond with those described above, when they occur as complications of the bronchial form. A few cases are on record in which the disease has followed eating parts of animals which have died from anthrax, as flesh, liver, &c. In these cases lesions were found in the stomach, intestines, &c. corresponding to those described in the bronchi in wool-sorter's disease; the mesenteric glands showing a condition resembling that of the bronchial glands.

The symptoms in such cases are mainly abdominal, and the disease is usually rapidly fatal.

It is questionable whether many of the cases which have been described as gastro-intestinal, or *mycosis intestinalis*, and especially where there is a phlegmonous gastritis, are not due to other bacteria. In none of the cases which the writer has examined have anthrax bacilli been found; in some only micrococci were present; in others, bacilli which, though bearing a superficial resemblance to anthrax bacilli, proved to possess entirely different characters. Microscopic examination and inoculation of animals can alone decide in any particular case.

W. S. Greenfield.

PUTRID FEVER.—A synonym for typhus fever. *See* Typhus Fever.

PUTRID SORE-THROAT.—Sloughing ulceration of the throat from any cause, such as diphtheria, scarlatina, or syphilis. *See* Pharynx, Diseases of; and Tonsils, Diseases of.

PYÆMIA (πῦον, pus; and αἷμα, blood).—Synon.: Purulent Infection; Fr. *Pyohémie*; Ger. *Pyohämie*; *Pyämie*.

Definition.—A condition of blood-poisoning which gives rise to fever, accompanied either by severe visceral inflammations and congestions, or by certain local lesions, which are chiefly venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous membranes and joints, multiple abscesses in the connective tissue, and eruptions upon the skin. The disease is usually, but not always, sequential to a wound or injury.

Ætiology and Pathology.—The initiatory symptoms and the anatomical characters of pyæmia are such as point clearly to the introduction of some morbid material into the circulation, and not unnaturally gave rise to the idea, upon which the name of the disease was founded, that this material was pus. Several considerations formerly appeared to favour this belief, amongst which were especially these. Hunter believed that the lining membrane of a vein secreted pus. Now, as cases of pyæmia were found to be very commonly associated with phlebitis, and also with what were thought to be deposits of pus in the viscera, a very simple explanation of the disease seemed to be that the inflamed vein secreted pus, which became mixed with the blood, and was carried by the circulation to some distant organ, wherein, being arrested, it formed the focus of a suppuration.

Hunter observed that in cases in which an injury to a vein proved fatal, the coats of the injured vein were swollen and thickened, and its lining membrane was of an unusually red colour; and he supposed that the fragments of fibrin and the softening clots often found in such veins were the products of an inflammation of their lining membrane, which in the one case was of an adhesive, in the other of a suppurative character. He believed that the coagula generally found in inflamed veins were the means whereby these inflammatory products were prevented from being carried into the circulation, and that if such coagula were not formed, pus secreted by the inflamed vein might be mixed with the blood, and thus distributed.

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[1] *Loc. cit.* p. 761.

Hunter, though perfectly familiar with the secondary abscesses of pyæmia, does not seem to have connected them with the introduction into the blood of morbid material from a wound. That these abscesses were the result of an entrance of pus into the blood, and the arrest of pus-globules in the capillaries of the affected organ, was maintained by others, who thus looked upon the process as a mechanical transference of pus-cells from one part of the body to another. These observers supposed that in healthy wounds the entrance of pus into the veins was prevented by the formation of a coagulum, but that, if this coagulum were not formed, or became broken down, pus entered the circulation, and gave rise to the secondary abscesses by its arrest in distant organs. This view was supposed to be confirmed by Cruveilhier's experiments, in which he injected mercury into the veins, and found that abscesses were formed in the first set of capillaries to which these veins were distributed, and that such abscesses were formed around a globule of mercury. Thus, if the injection were made into the systemic veins, the abscesses were formed in the lungs; if into the portal vein, they were formed in the liver.

But this explanation of the phenomena of pyæmia was soon found to be insufficient, and also to be incompatible with many facts since ascertained. Cases of pyæmia occur in which there is no primary suppuration from whence the pus could be derived; there is no evidence that the lining membrane of a vein ever secretes pus; the secondary abscesses of pyæmia are not deposits of pus, but true inflammations, and, if examined at their commencement, are found not to be purulent. Again, the first set of capillaries occasionally escape, and the secondary lesions occur in parts beyond them in the order of the circulation; and the position of the abscesses—as, for instance, in the lung, where they chiefly occupy the lower parts of the organ—is not explained by the purely mechanical theory. Besides which, there are the general symptoms of systemic poisoning to be accounted for, and these are sometimes so severe as to kill the patient before any secondary lesions are developed. Experiments upon animals show that the injection into the veins of pus, or any material containing solid particles, is usually followed by the arrest of the solid particles in the first set of capillaries with which they meet, and a consequent obstruction of the capillary circulation; but the result of this capillary obstruction varies according to the nature of the obstructing substance. The injection of septic liquids filtered from solid particles causes fever and other constitutional symptoms, varying according to the virulence of the poison contained.

An examination of the symptoms of pyæmia will show that it consists of two series of morbid processes, the first series manifesting the general constitutional disturbance due to the systemic poisoning, the second having relation to the secondary lesions thereupon developed. Both analogy and morbid anatomy point to the primary cause of these being the introduction into the blood of an animal poison, which at once gives rise to the first series or the general disease; and we shall see that the secondary lesions are to be accounted for, either by a venous thrombosis, leading to a capillary embolism, or by a stagnation of the diseased blood and the changes which ensue thereupon.

Of the exact nature of the poison which gives to the blood in pyæmia its infective character, we are in ignorance; and it is better to admit this. Our powers of organic analysis are not yet sufficient for the isolation of the subtle but potent poisons upon which so many of the specific diseases depend. Micro-organisms are usually found in the blood; and though the part they play in connexion with pyæmia is not yet exactly and with certainty defined, there is good reason to believe that upon their presence and action depend the most important phenomena of the disease. Even though in some cases of pyæmia it may not be possible during life to discover in the blood the characteristic organisms, yet nevertheless the poison may have been elaborated by such organisms and introduced from without, or the organisms which have produced it in the body may since have undergone destruction. But wherever and however the poison be generated, and whether or not it be *necessarily* connected with the *presence* of micro-organisms, it seems certain that there are predisposing causes which render a person peculiarly prone to its generation or reception.

Of predisposing causes, impure air, and especially that kind of impurity which results from the presence of decomposing animal matter, is doubtless one of the most important. Thus the crowding together of a number of persons with suppurating wounds, neglect in removing the discharges and excretions from sick persons, and imperfect drainage, are causes favouring the development of pyæmia The puerperal condition is also a powerful predisposing cause. Disease of important excreting organs, whereby effete materials are retained in the blood, also renders a person more liable to pyæmia, as is often observed in cases of Bright's disease; and any great nervous depression (perhaps because of its influence in diminishing excretion) has a like effect. Intemperance, and acute fevers, probably render their subjects somewhat more prone to pyæmia; but it is a [illegible] to assert that chronic invalids, or persons in weak health, have any special liability to the disease. Children, though by no means exempt from, are somewhat less liable to, pyæmia than adults.

Pyæmia, then, is caused by the entrance into the blood of an animal poison, which in the majority of instances originates in a wound, an injury, or a local inflammation; but in some few cases it has been impossible to determine where the disease began. This poison under favourable conditions multiplies in the blood; that is to say, its introduction gives rise to an infective process which is connected with the presence and development of micro-organisms.

Pyæmia is especially liable to follow certain diseases and injuries, and, before the introduction of antiseptic surgery, used to be the gravest danger of many operations. Thus, it has been observed in frequent association with compound fractures, and operations involving the section of a bone; after injuries of the bones of the head, and in connexion with acute necrosis of the long bones from suppurative periostitis; also after wounds or injuries of veins; after parturition; in connexion with diffuse cellular inflammation, suppuration of the internal ear, and operations upon the urinary organs. Facial carbuncle is a disease peculiarly prone to lead to pyæmia.

Anatomical Characters. — The morbid anatomy of pyæmia reveals two series of changes—the one depending upon the primary infection of the blood, the other upon the secondary effects of this. When the blood is very profoundly infected, the results of general blood-poisoning are often all that can be found; the patient dies before the secondary affections can be produced. When the poison is less virulent, or not much in excess of the eliminative powers, or meets with conditions unfavourable for its development, the secondary lesions predominate, and in some instances are alone discoverable; but in most cases changes of both kinds are found.

The wound, or the tissues at the site of the primary disease or injury, from whence the poison has entered the blood, may be found in various conditions. There is often, but not always, suppuration present, and the wound is bathed in foul and unhealthy pus; or the wound may be dry, and discharging only a little thin ichor; or the cellular tissue may be infiltrated with sero-purulent fluid. The veins in the neighbourhood of the diseased tissues are often found blocked with coagula, extending a variable distance along their channels, and in different stages of disintegration. These clots may be soft and dark, or firm and adherent to the lining membrane of the vein, and partially decolorised; or they may be broken down in the centre to a reddish-yellow pulpy material, consisting of disintegrated fibrin. Sometimes the whole clot is thus softened, and the fragments of fibrin have been partly carried away into the circulation. Occasionally, but rarely, the clots contain real pus; but the puriform material found in the vessels is usually only broken-down fibrin, and the *débris* of cells.

An abscess may, however, open into a vein, and thus pus may gain a direct entrance into its channel; in such a case a coagulum, consisting of a mixture of pus and blood, is found in the vessel, and we have a true purulent clot. Softening thrombi are found with especial frequency in connexion with injuries and diseases of bone, as, for instance, in the sinuses of the dura mater after bruising of the cranial bones, or in consequence of caries of the bones of the ear; or in the veins of an unhealthy stump, in which there is inflammation or necrosis of the bone.

But it may be certainly affirmed that many cases of pyæmia occur in which no thrombi are found, and in which the most careful examination fails to detect any morbid condition whatever of the veins. It is necessary to point this out, because it has been erroneously asserted by some that phlebitis is an essential process in the disease. It is to be observed also that the presence of pus is not a necessary element in the causation of pyæmia, as was once supposed; well-marked cases have been seen in which there has been neither wound nor suppuration for its origin. When a wound does exist, however, it is usually found in an unhealthy condition, and in this may probably be found the explanation of the spread of pyæmia by contagion. Healthy granulations do not allow the entrance of septic matter into the blood; a wound may be bathed with fœtid fluids of a most poisonous character, and yet none may be absorbed, as has been proved experimentally by Chauveau; but if the surface of the wound becomes unhealthy, the granulations no longer present a barrier to the absorption of poisonous fluids. This may be due, as Sir William Savory has suggested, to the dialysing property of animal membranes. If, then, the secretions or exhalations of an unhealthy wound come in contact with another secreting surface, an unhealthy action may thereby be set up on that surface, producing a condition favourable to the production and absorption of poisonous material. This explains the prevalence of pyæmia where a number of persons with open wounds are crowded together. A similar condition of wound may also be induced by neglect of other sanitary precautions, especially by the presence of decomposing animal matter, and the escape of sewer-gas into the air surrounding the patient.

In cases of acute pyæmia the morbid changes found *post-mortem* are chiefly congestion and softening of the viscera, local stagnation and extravasation of blood, and a general blood-staining of the tissues—conditions indicating profound changes in the state of the blood. In what these changes consist we are at present ignorant; but usually the blood contains an excess of leucocytes, and its fibrin is diminished in quantity and lacks contractility.

When the disease is not of this acutest form, but is of longer duration, there are developed those secondary lesions which are especially characteristic of pyæmia.

Most notable and commonest among these are the so-called 'secondary deposits' or 'secondary abscesses' of pyæmia. These are found most frequently near the surface of the viscera, and are the result of the obstruction of the terminal branches of the vessel supplying the part with blood. This obstruction is followed by engorgement and extravasation, by inflammation, and by rapid necrosis or suppuration. It is necessary more fully to describe this process before giving an account of the morbid anatomy of individual organs thus affected. The obstruction may be caused in several ways.

(1) It may be embolic. A portion of a disintegrating clot may be carried into the circulation, until it meets with an artery too small to allow its transmission, or with the first set of capillaries in its route, wherein it becomes arrested. In this way a portion of the organ is deprived of its arterial blood-supply, and in consequence of the absence of the *vis à tergo* of the heart, regurgitation takes place from the veins into the capillaries, and even into the terminal arteries, giving rise to a venous engorgement of the affected region. The nutrition of the capillaries being interfered with by the lack of arterial blood, their walls become altered or necrosed, and extravasation of blood takes place, the area of extravasation corresponding with the part supplied by the obstructed vessel. At the same time the vessels of the tissues immediately surrounding the obstructed region become dilated, and so form a zone of intense hyperæmia. So far, this process is only what occurs in any case of embolism (as, for instance, when minute fragments of fibrin are detached from an inflamed mitral valve), but the importance of the process in pyæmia depends upon the changes which subsequently occur. Now the changes which occur in the tissues of a part the seat of embolism depend upon the character of the embolus. If the embolus come from a part wherein putrefaction is active, the same process will be set up in the tissues in which the embolus is arrested; if the part in which it originates be in a state of inflammation, a corresponding inflammation will ensue; if the embolus be purulent, or come from a suppurating region, suppuration will occur; if it have origin in a gangrenous area, gangrene will usually follow in the spot to which it is carried. It will be seen, therefore, that the area affected by the embolism at first undergoes those changes in nutrition which are common to embolism generally; but to these are added certain special and destructive processes, which vary in their activity and character with the activity and character of the process in progress at the spot from whence the embolus comes. Each of these two changes is modified by the other. The mechanical effects of the embolism pass into the destructive processes set up by the infected embolus; and the destructive processes originated by the infected embolus are expended upon tissues already altered by the mechanical effects of embolism, with results proportionately modified. Thus the suppurative process usually leads to the formation of a comparatively small quantity of true pus, which is mixed with a relatively large amount of the *débris* of necrosis.

If, then, the embolus originate in a wound infected with the pyæmic poison, it sets up an unhealthy inflammation and rapid disintegration of the tissues wherein it is arrested. The important difference, therefore, between pyæmic and other embolism consists in the fact that the pyæmic embolus is composed of *infected* clot. It has been by some maintained that this is the sole mode of production of the secondary pyæmic formations. This is incorrect, for, although such formations doubtless often have such an origin, they may also arise in a different manner. The embolic theory will not account for cases in which the first set of capillaries in the order of the circulation from the seat of injury escape, and secondary deposits are found in other organs beyond; as, for instance, where they occur in the liver after an injury of the head, and the lungs are not affected. Neither does this theory explain the cases in which the joints only are affected, as in connexion with gonorrhœa or scarlatina; nor are the chronic cases in which only superficial abscesses occur thus explicable. It must be remembered, too, that the lesions in the lungs are found chiefly in the inferior parts of the organ, which is not what would be expected were their origin always embolic.

(2) The capillary obstruction may be caused by a local stagnation depending upon the poisoned state of the blood. The infection of the blood interferes with the normal interchange between this fluid and the tissues, and produces a tendency to coagulation in the minuter vessels. This coagulation is especially prone to occur in organs or parts of organs already congested, for where the circulation is slow the impurity will be the greater. In this way the greater frequency of the secondary lesions in the lower than in the upper part of the lungs is accounted for. When this form of thrombosis has taken place, the part so affected is in a condition similar to that above described as due to embolism, and the same series of changes

ensues. It must be remembered, also, that the impurity of the blood interferes with the nutrition of the vessels, which thus easily allow of the extravasations that are so frequently found, not only in the viscera, but on the surface of the skin and mucous membranes.

(3) Cases are, however, occasionally met with in which the clinical symptoms of blood-poisoning are associated with the formation of visceral abscesses, but in which after death no evidence of either embolism or thrombosis can be discovered.

(4) In another and more numerous class of cases, usually of the less acute kind, the disease expends itself chiefly upon the surface of the body, and abscesses are found in the subcutaneous or inter-muscular cellular tissue, the viscera altogether escaping. Here we often have evidence of a thrombosis preceding the suppuration; and the pus contained in such abscesses is frequently found mixed with considerable quantities of blood-clot in various stages of disintegration.

(5) There is also a group of cases in which the local manifestations of the disease are chiefly or entirely confined to the joints, and certain structures connected therewith, namely, the sheaths of tendons and the fibrous fasciæ.

It has been shown by Dr. Burdon Sanderson that great numbers of microzymes may be found in the blood and inflammatory exudations of animals suffering from acute infective fever, produced by inoculation of septic matter. Others (Wilks, Moxon, Goodhart) have failed to find bacteria in the blood of living cases of pyæmia, though they may be found in great numbers after death. The committee appointed by the Pathological Society 'to investigate the nature and causes of those infective diseases known as pyæmia, septicæmia, and purulent infection,' state that, 'although bacteria of various forms were found in the blood in a number of cases, they could not be found in all the cases, nor were they discovered constantly in those cases where at one or other time they were present' (*Trans. of Path. Soc.*, vol. xxx. p. 44).

But the arrest of micrococci in the tissues in connexion with the thrombi and emboli so frequently observed in pyæmia would seem with great probability to be the important factor in the production of the secondary abscesses. The conditions are just such as would favour the development of these organisms, and the success of their attack upon the tissues; that is to say, the micro-organisms are arrested in a part which is rendered vulnerable by the interference with its blood-supply and the consequent impairment of its nutrition, while, at the same time, the access of the leucocytes to the micro-organisms is impeded, and their power of incorporating and destroying them diminished. But for the attainment by the micrococci of a harmful ascendency in the tissues there is also necessary a certain degree of susceptibility on the part of the infected individual, and we do not yet know precisely in what this susceptibility consists, or how it is produced. There is this notable fact, moreover, which gives great countenance to the importance of micro-organisms in pyæmia—that since the general adoption of the antiseptic method of treating wounds, the basis of which is the exclusion or destruction of these micro-organisms, the number of cases of pyæmia has been enormously diminished, and that as a sequence of operations performed with antiseptic precautions it is almost unknown.

It is difficult to explain the occurrence of the joint-affections, and the especial vulnerability of certain organs to the secondary inflammations of pyæmia. All that can be said on this part of the subject is that the poison of pyæmia selects certain organs and tissues wherein to expend itself, just as that of rheumatism, syphilis, or typhoid fever does.

Having thus far considered the general pathology of the disease, it will be convenient to pass to the morbid anatomy of individual organs. The *lungs* are usually congested throughout, and are very prone to the secondary lesions. These are found chiefly near the surface and in the lower and posterior portions, and consist, in the early stage of the process, of small extravasations and patches of congestion; the minuter branches of the pulmonary artery are herein found plugged with coagulum; and hæmorrhage, or inflammatory exudation, has taken place into the surrounding tissues. Thus we have a patch of pulmonary hæmorrhage, or of lobular pneumonia. Later on, the centre of this area of consolidation is found in a state of necrosis, and its circumference surrounded by a ring of intense congestion. The process of disintegration occurs with great rapidity, and the central portion of the nodule may be found, within forty-eight hours of the first symptom of pulmonary mischief, broken down into a soft yellow puriform material, or even containing true pus. The nodules are perfectly circumscribed, and average in size about that of a hazel-nut, though they may be smaller or larger. On section, they are seen to consist, in the centre, of a cavity filled with pus or puriform *débris*; surrounding this is an area of pneumonic consolidation, the circumference of which is formed by a narrow ring of intense congestion. The surrounding lung is usually simply congested, or it may even be natural in appearance. An examination of the early stages of these changes shows the first step in the process to be a blocking of the minute branches of the pulmonary artery; and this may depend either upon thrombosis or upon embolism; but, in whichever manner it originates, it is followed by a rapid exudation into, and disintegration of, the portion of lung to which the blocked vessels belong. It has been pointed out that these changes take place chiefly in parts of the lung near the surface. The result of this is that the *pleura* becomes involved in the inflammation, and those nodules which have reached the surface of the lung are coated with a patch of lymph, which may subsequently become part of a more general pleurisy. Or one or more of the abscesses may burst into the pleura, when a rapid effusion of sero-purulent fluid takes place into its cavity.

Pleurisy may, however, occur independently of the lung-disease; and in this case, also, the effusion becomes rapidly purulent. In the early stage of the disease numerous subpleural ecchymoses are frequently found. Pleurisy is especially prone to occur in those cases of pyæmia originating in caries of the bones of the ear, and in children thus affected is often the first symptom of the pyæmic infection.

The *heart* is liable to be affected by the same kind of embolic abscesses as are found in other organs. They occur most often in pyæmia from acute necrosis, in young persons. In the early stage small spots of congestion, due to the plugging of small arteries, are found both on the surface and in the substance of the heart, and also beneath the endocardium. Later on, small cavities containing pus or puriform fluid, and surrounded by a zone of congestion, are found in the walls of the organ. These abscesses are sometimes very numerous, and may occur in any part of the organ; they may open on the surface or into the cavity of the heart; the muscular tissue around them is softened and broken down. The *pericardium* may thus become inflamed from the contiguity of an abscess in the wall of the heart; but, as with the pleura, pyæmic pericarditis may occur independently of such an origin, and in either case the effusion rapidly becomes purulent. The same process may lead to inflammation of the endocardium.

The *brain*, although less frequently the seat of pyæmic abscess than many of the organs, may be the sole organ affected by the secondary lesions; and it not uncommonly happens, when this is so, that the general symptoms are unusually slight. Small extravasations are often found in the subarachnoid tissue. Circumscribed softening, ending in abscess, is most frequent in the white matter of the brain. It commences as a patch of red softening, due to obstructed vessels, which subsequently changes to a reddish-yellow pulp, or to greenish pus, enclosed by a more or less defined wall. Such an abscess may run a very chronic course, and is then found enclosed in a cyst of connective tissue.

The *peritoneum* is occasionally found acutely inflamed, its surface vascular and coated with lymph or pus; in other cases the membrane is spotted with numerous ecchymoses. Peritonitis may also be set up by secondary abscess of the liver making its way to the surface, or even bursting into the abdominal cavity. In some cases of strangulated hernia, death takes place with great rapidity after operation, from absorption of septic fluid which has escaped from the sac into the abdominal cavity. In addition to the usual visceral conditions, the peritoneum is then found vascular, and slightly coated with commencing exudation.

In acute cases of pyæmia the *alimentary canal* may present patches of intense congestion, or numerous small spots of subserous hæmorrhage.

The *liver* is, next to the lungs, the organ in which secondary deposits are most frequently found in pyæmia. In acute cases the organ is found congested, softened, and swollen; it has lost elasticity; and its texture on section is confused and clouded. Secondary abscess is, of course, especially prone to occur in connexion with dysenteric and other lesions of the bowel. but is also found in cases of general pyæmia, originating in any part of the body. It commences by plugging of the portal capillaries, leading, as has been explained with regard to the lung, to congestion and stagnation of blood in the affected portion; the nutrition of this portion being thus interfered with, necrotic changes soon commence, and the infective character of the clot gives the start to destructive inflammation. The capillaries surrounding the diseased area dilate, and inflammatory exudation occurs into its circumference; at the same time central disintegration is rapidly going on; and in a short time we find a purulent collection, surrounded by a zone of exudation and congestion. Occasionally these abscesses run a more chronic course, and become encysted; and it seems probable that the tropical hepatic abscesses, which often attain a large size, have an embolic origin, connected with the ulceration of dysentery, and may thus be classed with pyæmic suppurations. It must be remembered that pyæmic abscess in other parts is not always acute. Sometimes, but more rarely, hepatic abscess originates in embolism of the hepatic artery, in which case the suppurations are usually smaller and more scattered.

The *spleen* may be simply swollen and soft, or may contain abscesses precisely resembling those described in the liver; the same may be said of the *kidneys*.

Inflammation of the *bones* and *joints* may be either the cause or the effect of pyæmia. The frequency with which pyæmia originates in diffuse periostitis and osteo-myelitis is well known. In such cases the heart and kidneys are especially liable to be the seat of secondary deposits, and the disease is generally of a severe form. The bone is found stripped of its investing periosteum, and separated from it by a quantity of pus. The surface of the bone is bare, and of a yellowish-white colour; the medulla is usually also inflamed, and is tumid and vascular, or it may be infiltrated to a varying extent with purulent fluid. Sometimes, as after amputation, the medulla is the part chiefly affected, and the inflammation extends to a greater distance along the interior than the exterior of the bone. These changes may also be secondary effects of pyæmic infection from disease of other parts. The disease is usually arrested at the epiphyses, but it may spread to the adjacent joints. The joint-affection most commonly found in pyæmia is an extremely rapid suppuration. In no other kind of joint-inflammation does the destruction of the tissues involved so quickly take place. The cartilages may be found extensively ulcerated, and the joint filled with purulent fluid, within forty-eight hours of the first symptom of inflammation. At first the synovial membrane is swollen and vascular, and the joint distended with a slightly turbid fluid. This fluid usually quickly becomes purulent, and superficial erosions and softening of the cartilages occur, soon leading to extensive ulceration and irreparable destruction of the joint.

A less acute form of pyæmic arthritis is, however, not uncommon, in which several joints in succession become painful and distended, the effusion not becoming purulent, but subsiding after a variable period. 'Gonorrhœal rheumatism' is an example of this, and the joint-swellings occurring in women suffering from vaginal and uterine discharges are of the same kind. This affection of the joints frequently leads to adhesions, but occasionally runs on to suppuration. Scarlatinal pyæmia (in which the infection takes place from the ulcers in the throat), though often of a severe kind, is not infrequently attended with merely serous effusions into the joints, from which complete recovery takes place.

In some cases the inflammation, instead of attacking the synovial membrane, affects the fibrous structures around and outside the joints, or the sheaths of tendons, causing thickening and matting together of these tissues, and thus interfering with the mobility of the joint.

The *muscles* and *cellular tissue* are often invaded by pyæmic abscesses, and by inflammatory exudations and extravasations of blood. In the muscles the process commences in the cellular tissue between the fibres. Abscess in the inter-muscular septa and the subcutaneous cellular tissue is often the result of the more chronic forms of pyæmia.

The *skin* in many cases of pyæmia is found more or less jaundiced; petechiæ and sudamina are not uncommon; and sometimes a pustular eruption is seen. Patches of livid congestion also occur, some of which may have passed into gangrene in the centre or where subjected to pressure.

The morbid anatomy of *other organs* shows that secondary abscesses may occur in almost any situation; among the less rare may be mentioned the eye, the prostate gland, and the testicle.

SYMPTOMS.—A patient who has become the subject of pyæmia, often appears to be progressing quite favourably up to the moment when the disease attacks him; in other cases there may have been loss of appetite, depression, or restlessness, for a day or two, with perhaps some little elevation of temperature. The wound, if there be one, has probably assumed an unhealthy appearance; its surface may be dry, or the discharge may be thin and offensive, the healing process is arrested, and recent adhesions may give way. The attack, however, is usually sudden, and is almost invariably ushered in by a severe rigor, followed by sweating. The rigors are of variable duration and frequency, but are usually severe while they last; occasionally they recur with such regularity as to simulate ague. The patient at first may not feel particularly ill, but he rapidly becomes so. Pains in the limbs and general uneasiness occur; the pulse becomes weak and rapid; fever, of an intermittent type, commences, with its usual accompaniments of loss of appetite, restlessness, and thirst. The tongue becomes dry and brown; the bowels may be either constipated, or loose and irritable; and the skin and conjunctivæ may become jaundiced. If the infection be profound, the prostration is extreme; there are usually cough and dyspnœa; muttering delirium sets in early, and soon leads to unconsciousness and death. In such cases the blood-poisoning kills before there is time for the development of any secondary lesions.

In less acute cases local symptoms soon begin to appear. A day or two after the initial rigor, pain and swelling of one or more joints occur, or a subcutaneous abscess forms, or discolorations or pustules are seen on the skin. Cough, attended with rusty expectoration, is common; the respirations are rapid and shallow; there is pain in the chest; and perhaps dyspnœa or orthopnœa from pleuritic effusion. Meanwhile the depression increases; jaundice frequently comes on; and the face assumes a pinched and anxious expression. There is, moreover, often a peculiar sweet smell about the patient, somewhat resembling that of diabetic urine. The rigors mostly cease after the first few days, but the temperature usually maintains a remittent character. The skin shows a tendency to slough on very slight pressure, so that troublesome bedsores easily form; and patches of superficial gangrene sometimes occur without any such provocation. Vomiting is not a symptom of frequent occurrence; and though there is usually no appetite, yet nourishment is often freely taken and digested. The cerebral symptoms are not usually severe, unless there be secondary lesions in the brain, but there is often a low form of delirium; and towards the end the patient usually becomes unconscious, and passes the evacuations unknowingly. Death may occur from general exhaustion; or from the severity of some local lesion, as, for example, from pericarditis, pleurisy, or cerebral abscess.

The duration of the disease is, in the majority of cases, from a week to ten days. It may, however, prove fatal in forty-eight hours; or, on the other hand, it may be prolonged for weeks or even years.

Pyæmia may commence at any stage of disease or injury; the most common period of invasion is during the second week.

Certain peculiarities must be noted concerning some forms of pyæmia, for which no satisfactory explanation can be given. For instance, in acute necrosis, pyæmic symptoms are frequently seen almost from the commencement of the disease, and yet these cases of pyæmia are sometimes of very long duration. Such cases, though severe, are among the least fatal; and when death does take place, abscesses are usually found in the heart and kidneys. The pyæmia arising from disease of the internal ear is especially prone to lead to pleurisy, which is often the prominent condition throughout. That variety of pyæmia associated with gonorrhœa and with scarlatina tends especially to affect the joints, and these are often the only parts invaded; but this joint-inflammation is very different from that which occurs in the course of other cases of pyæmia, for the effusion is generally slight, and does not usually become purulent. Such joint-affections are not uncommon after parturition.

Chronic Pyæmia.—There is, moreover, a chronic form of pyæmia which is not rare, and which is sometimes the prolonged termination of an acute attack, but more often is from its commencement characterised by the absence or slight degree of the constitutional disturbance. In this form of the disease ill-defined purulent collections occur, mostly in the connective tissue (subcutaneous, subperiosteal, or inter-muscular), which quickly reach a large size in a singularly quiet and painless manner, and with little or no febrile disturbance. Similarly quiet swellings or suppurations of joints may ensue; often there is an obvious phlebitis, and often also there are œdematous patches and puffy swellings, indicative of the blocking of less accessible veins. In some of these cases rigors occur, and profuse sweatings, with progressive emaciation, pallor, and weakness; in others the health and nutrition are but little affected, and the chief discomfort is due to the recurrent suppurations and their local effects. The disease may extend over months or years. Paget quotes a case lasting three years, and he points out that 'the election of a single tissue, and the observance of an uniform method of disease, in the secondary affections, are characteristic of chronic rather than of acute pyæmia. They are very marked in some of the cases that follow parturition, in which women suffer for many weeks with a succession of abscesses in the subcutaneous connective tissue of the limbs, and usually (after long suffering) recover completely. Such cases are also sometimes seen in men' (Paget, *Clinical Lectures and Essays*).

Occasionally, also, cases are seen of unusual duration in which there are severe constitutional symptoms throughout.

Diagnosis.—The chief difficulties in the diagnosis of pyæmia arise from the occasional prominence of some local symptom, which masks the general disease. Probably the most common mistake is to regard a case of acute necrosis, with early joint-symptoms and rigors, as one of rheumatism. Herein, however, there is an absence of the acid perspirations and the coated tongue of rheumatism; the rigors are more frequently repeated; and a careful examination will reveal mischief about the shaft of the bone as well as in the joint. When the chest-affection is severe, as in the pleurisy of children with disease of the internal ear, it may be looked upon as the primary disease; but a sudden attack of pleurisy occurring in anyone with otorrhœa, should at once give rise to a suspicion of pyæmia. The later stages and more chronic forms of the disease may present some resemblance to fever, but the history would usually give marked distinctions; and in the majority of cases the diagnosis is sufficiently easy at any period of the disease.

Prognosis.—The prognosis in all acute cases of pyæmia is very unfavourable. The great majority die, sooner or later; either early in the disease, from the general blood-poisoning, or subsequently, from the gravity or exhausting character of the secondary lesions. Yet some few do undoubtedly recover, and these are they in whom the viscera escape, and the disease expends itself upon the surface of the body, or runs a chronic course without involving vital organs. Puerperal pyæmia is less fatal than surgical.

Treatment.—The unsatisfactory results of the treatment, and the great mortality of pyæmia, are the strongest reasons for taking every possible precaution for its prevention. A consideration of the causes which predispose to, and favour the development of, the disease will suggest certain prophylactic measures. For instance, a patient who is suffering from an injury or operation should be supplied with an abundance of fresh air, and carefully guarded from the exhalations of decaying organic matter. The most scrupulous cleanliness, both of the patient and his surroundings, should be observed. Overcrowding, and especially the accumulation of cases in which suppuration is going on, should be avoided. The careful drainage of wounds is of the greatest importance; for, whether germs be admitted or not, one obvious way of preventing decomposition in a wound is to take care that nothing is left therein to decompose. But by far the most important defence against pyæmia is the adoption of the antiseptic treatment of wounds. It is indisputable that since the general use of this method pyæmia has become a comparatively rare disease, and it is equally indisputable that this result depends upon the adoption of the principles of antiseptic surgery which have been so perseveringly taught and so carefully wrought by Sir Joseph Lister. Some statistics recently published furnish most striking evidence on this point. (See a paper by Messrs. Dent and Bull, analysing four hundred cases of amputation performed at St. George's Hospital, in which it is shown that the diminished mortality, as compared with previously published series from the same hospital, is due to the absence of pyæmia, resulting from the general use of the antiseptic system.—*Med.-Chir. Trans.*, vol. lxxiii.) Antiseptic dressings, besides their antagonism to the development of micro-organisms in the wound, have the great advantage of preventing putrefaction of the discharges, and the contamination of the surrounding atmosphere. Moreover, their use shields the patient from some of the accidental sources of infection which many of the former dressings made so easy; while at the same time the disturbance of the wound is greatly diminished (*see* ANTISEPTIC TREATMENT).

The integrity and functional activity of the chief excreting organs should be inquired into in all cases of operation or injury, so that the accumulation of effete material in the blood may be guarded against; and it should be remembered that the sudden change of condition that an operation or accident frequently involves, may in itself seriously interfere with the action of the bowels and kidneys.

When, however, pyæmia is developed, it must be admitted that treatment has over it but little control. The chief indication is to combat the extreme depression which is always present, and to endeavour so to support the patient that he may be able, if vital organs escape, to pass through the series of severe local affections that may be anticipated. Of drugs, the most useful is quinine, which sometimes produces marked benefit; it should be given in full and frequently repeated doses.

The local affections must be treated on general principles. If there be a wound, the dressings should be critically examined, and any defect in the antiseptic precautions sought for and remedied. If the discharges be foul, or there be any evidence of septic changes, the wound should be thoroughly exposed and cleansed with some powerful antiseptic. Drainage of the wound should be carefully attended to, and the possibility of the retention of discharges investigated. If there be no wound, the source of the pyæmic infection should be perseveringly looked for, and, if possible, removed, the frequency of its origin in disease of the middle ear, in discharges from the genital organs, and in osteo-myelitis, being especially borne in mind. The secondary abscesses should be opened early; and this is especially important with regard to the joints, from whence the pus should be evacuated directly we are sure of its existence. If symptoms of pyæmia occur in connexion with inflammation of a long bone, the question of amputation must be considered; and there are strong reasons for believing that by this measure the disease may sometimes be arrested. During the progress of the disease bedsores must be carefully guarded against, and the diet studiously adjusted to the daily needs; in fact, much will depend in this, as in the majority of serious disorders, upon careful nursing, judicious feeding, and the observance of every hygienic precaution.

J. WARRINGTON HAWARD.

PYELITIS (πύελος, a vessel).—SYNON.: Fr. *Pyélite*; Ger. *Nierenbeckenentzündung*. Inflammation of the pelvis of the kidney. *See* KIDNEYS, Diseases of: 22. Kidney, Inflammation of Pelvis of.

PYLEPHLEBITIS.—Inflammation of the branches of the portal vein, often associated with thrombosis. *See* PORTAL THROMBOSIS.

PYLORUS, Diseases of.—The muscular fibres of the stomach are disposed in three layers. Immediately below the peritoneum they are placed in a longitudinal direction; these are continuous with those of the œsophagus, and pass downwards over the organ, being continued to the duodenum; they are collected into bands of considerable thickness along the curvatures, especially the upper, and become stronger as they approach the pylorus. The middle layer surrounds the whole of the stomach, but to the left of the cardiac orifice the fibres are thin, and are replaced by those that are oblique. At the pylorus they form a thick band or ring, acting as a sphincter to the opening into the duodenum. The oblique fibres are continuous with the deep layer of the muscular coat of the œsophagus. They arch over the fundus, but are quite lost towards the opposite end of the organ. The muscular coats of the stomach are formed of involuntary or unstriped fibres, being composed of elongated fibre-cells, which are united together by a sparing amount of connective tissue. The connective tissue is much thicker and stronger at the pylorus than at other parts of the organ, giving a great amount of firmness and strength to that region. The mucous membrane is also thicker, and the gastric tubes are wider than elsewhere. Most of these contain gastric cells, but are lined with conical epithelium to a greater depth than in the more actively secreting regions. Some anatomists have stated that in the human stomach, as in many of the lower animals, there are no pepsin-forming cells in this part; but in numerous cases the writer has been able to obtain an active artificial gastric juice from the mucous membrane covering it.

The pylorus participates in the diseases of the stomach, which are fully described under that heading (*see* Stomach, Diseases of). As the outlet of that organ, however, the patency of the pylorus is of so great importance that its obstruction will be specially considered here.

Pylorus, Obstruction of.—An obstruction to the passage of the contents of the stomach into the duodenum is not infrequent, and may arise from very different pathological conditions. 1. The most common of these is the presence of a *cancerous* tumour at the pyloric end of the stomach. It usually surrounds the opening, and rarely spreads to the intestines. On microscopical examination the muscular fibres in the vicinity of such tumours are sometimes found to be hypertrophied, the contractile fibres being enlarged and increased in number. More generally the cells are atrophied, although to the naked eye the muscular bundles may seem to be enlarged; sometimes the contractile cells are faint and small; in other cases they are reduced to fibrous tissue, and no trace of the original structure can be discovered. This condition of the muscular tissue furnishes us with an explanation of the fact, that there is often great obstruction to the passage of the gastric contents into the duodenum where the pyloric opening seems only partially constricted, and it is to this loss of muscular contractility, and not to the mere narrowing of the opening, that we must look in order to understand how in many cases the stomach becomes dilated from its incapacity to discharge its contents. 2. The pylorus is sometimes narrowed by *fibroid thickening* of the submucous tissue. This morbid change may be confined to the opening only, or it may extend some distance from the part chiefly affected, producing a hard, leathery condition of the coats. The same effect, although to a less degree, is produced by an obstruction of this kind, as by cancer. The muscular bundles become hypertrophied, their contraction being embarrassed by the tough, fibrous tissue that surrounds and separates them. 3. The pyloric opening may be obstructed by an *ulcer*. This may arise either by its cicatrix producing a contraction, which leaves only a small opening through which the food has to find its way; or, on the other hand, the muscular coat may have been destroyed by the ulceration, and the stomach may, in this way, be unable to force onwards its contents. 4. The pylorus or the duodenum may be constricted by the pressure of a *tumour*. Cases have occurred where a cancerous gall-bladder has compressed these parts, but more generally the pressure is caused by glands enlarged by malignant disease. In a case which came under the notice of the writer, the opening was constricted by enlarged scrofulous glands occurring in a man affected with phthisis. 5. *Adhesions* may form between the duodenum or pylorus and the neighbouring parts, and in this way they may produce a difficulty in the passage of the food from the stomach. A curious case fell under the writer's notice in which a man received a severe blow in the abdomen, which was followed by symptoms of obstructed pylorus. On *post-mortem* examination a portion of the upper part of the small intestine was found to be bent upon itself by the exudation of lymph into the mesentery close to its edge.

Effects.—The effect of any considerable obstruction at the pyloric opening is to produce a greater or less degree of dilatation of the stomach. The most prominent symptom is vomiting, occurring at irregular intervals, and usually several hours after taking food. Along with this we find heartburn, and other signs of indigestion; and a gradual loss of flesh and strength. The treatment must be directed to these effects and symptoms. *See* Stomach, Diseases of: 7. Dilatation.

Samuel Fenwick.

PYONEPHRITIS.—Inflammation of the kidney, leading to the formation of abscess. *See* Kidneys, Diseases of: 28. Kidney, Suppurative Inflammation of.

PYOPNEUMOTHORAX.—A morbid condition of the pleural cavity, in which it contains both pus and gas. *See* Pleura, Diseases of.

PYRENEES. — *See* Bagnères-de-Bigorre; Eaux-Bonnes; Eaux-Chaudes; and Pau; and Climate, Treatment of Disease by.

PYREXIA (*πῦρ*, fire; and *ἔχω*, I have). This word is sometimes employed as a synonym for fever; but it is more properly applied to the elevation of the body-heat which is one of the phenomena of fever. *See* Fever; and Temperature.

PYRMONT, in Germany. — Iron waters and salt waters. *See* Mineral Waters.

PYROMANIA.—A name which has been given to insanity when the patient manifests a propensity to incendiarism. Its claim to be regarded as a special form of insanity has not been established. *See* Insanity, Varieties of.

PYROSIS (*πυρόω*, I burn).—Synon.: Water-brash; Fr. *Pyrosis*; Ger. *Sodbrennen*.

Description.—Patients affected with water-brash experience a severe spasmodic pain at the epigastrium, which is often attended with a feeling of constriction; and after the lapse of a few minutes relief is afforded by the rejection of a quantity of watery fluid. The fluid is usually tasteless, without any odour, and seldom amounts to more than two or three ounces. Microscopically, it presents numerous epithelial scales from the mouth, and the writer has also found in it some gastric cells. It is neutral to test-paper, is not albuminous, and in one case in which he carefully examined it, it gave a dense precipitate with baryta, and a bulky precipitate with nitrate of silver, soluble in nitric acid. Frerichs remarked that the fluid contains sulphocyanuret of potassium, and therefore believed it was only saliva. But it is evident that it can scarcely be possible to obtain it entirely free from the salivary secretion, and therefore no great weight can be allowed to the observation. However, in some cases the fluid rejected is evidently only saliva. Water-brash is not necessarily connected with structural disease of the stomach, for the majority of those who suffer from it recover perfectly. In some persons affected with disease of the pylorus, the rejection of a tasteless fluid takes place, but this is not necessarily accompanied nor preceded by pain.

Ætiology and Pathology.—Water-brash seldom occurs before puberty; it affects females more frequently than males; and chiefly presents itself in persons of middle age. It is more prevalent in some countries than in others; and is most general amongst those who subsist on food of a coarse and indigestible kind. Much difference of opinion has been expressed as to the source of the fluid which constitutes water-brash. It has been referred to the œsophagus, stomach, duodenum, and pancreas. The pancreas seems unlikely to be the organ from which it comes, for the fluid is unmixed with bile, and we should imagine a more violent effort would be required to reject it from a part so distant from the mouth. Again, the œsophagus is very intolerant of any collection of liquid in it, and it would only be by a spasmodic closure of the cardiac orifice that such an accumulation could occur in this tube. As regards the stomach, it seems improbable that the larger and more active end of this organ should be the source of the liquid, for any irritation would produce an acid, not a tasteless, fluid. At the pyloric end, however, there is a mass of tubes, lined chiefly with conical epithelium, the office of which is to secrete mucus; and as the only structural change that has been found along with water-brash is thickening at the pylorus, we may reasonably conclude that this is the part whence the fluid is ordinarily derived.

Treatment.—All sources of gastric irritation should be removed, such as every form of insoluble or irritating food. Astringents, with or without opium, are the most efficacious remedies. They should be given in the intervals between digestion, so that they may act directly on the mucous membrane. Lime-water, bismuth, zinc, or other mineral astringents, or vegetable astringents, such as kino, krameria, logwood, or tannic acid, may be preferred; but, on the whole, the writer has found the oxide and nitrate of silver the most efficacious. Unless there be some objection to it, opium may be combined with the astringents, as it both lessens the pain and seems to restrain undue secretion; or mercurial alteratives may be given, as their use is often attended with the best results.

Samuel Fenwick.

PYSTJAU, in Hungary.—Thermal sulphur waters. *See* Mineral Waters.

PYTHOGENIC FEVER (*πύθω*, I rot; and *γεννάω*, I beget).—A synonym for typhoid fever. *See* Typhoid Fever.

PYURIA (*πύον*, pus; and *οὖρον*, the urine).—A name for a condition of the urine in which it contains pus. *See* Urine, Morbid Conditions of.

Q

QUARANTINE (Ital. *quaranta*, forty). Synon.: Fr. *Quarantaine*; Ger. *Quarantäne*.

Definition.—The enforced isolation of individuals and certain objects coming, whether by sea or by land, from a place where dangerous communicable disease is presumably or actually present, with a view of limiting the spread of the malady. The objects liable to quarantine include—on the assumption of their being apt to carry the contagion or infection of the disease—the luggage and personal effects of the individuals isolated, certain articles of merchandise, and ships; and, in land quarantine, carriages and other vehicles. Sometimes entire communities and districts are subjected to quarantine.

History.—According to systematic writers, quarantine had its origin in the fourteenth century, when the principle of isolation, applied from a much earlier period to leprosy (*mal de St. Lazare*), began to be extended to pestilential diseases; and leper hospitals (*lazarets*), then falling into disuse from the decline of the disease, were converted to (as we should now say) quarantine uses. To this day quarantine establishments retain the name significant of their original purpose—namely, *lazarets*. Fodéré suggests that the period of forty days during which it was customary formerly to enforce isolation, and from which the designation *quarantine* is derived, had its source in the teaching of Hippocrates, who, according to Pythagoras, attributed a special virtue for the completion of many things to that period of time. The methodical establishment of quarantine dates from the sixteenth century, when the earliest doctrines of contagion, in the original acceptation of the term, were also formulated. These doctrines, fantastic though in many respects they now appear, still largely adhere to the practice of quarantine. Plague, as we now understand the word (*see* Plague), was the disease against which quarantine was chiefly, indeed almost wholly, levelled, until the beginning of the present century; and the system is so imbued with the notions formerly held as to this malady that it has been found impossible to disembarrass it from them, in endeavouring to apply quarantine to other forms of disease. It is noteworthy that, as plague declined in Western Europe, and the area of its prevalence in the Levant became more and more restricted, the system of quarantine appears to have become more elaborate. Speculative notions, uncontrolled by experience, and applied to the system, caused it to be overlaid with grotesque and puerile details. Notwithstanding, however, these drawbacks, the arbitrariness of the system, and the losses it inflicted upon commerce, without obvious proportionate gains, the advantages offered by quarantine in the protection of a country from pestilential disease appeared theoretically to be so great, that neither administrative follies, nor the lessons as to its fallacies derived from experience, nor its general futilities, availed to bring about the substitution of a more rational system of protection.

Quarantine remained substantially unmodified from the termination of the last century to the fifth decade of the present, since which time it has undergone great changes, with a view of rendering the practice more consistent with existing knowledge of the diseases to which it is applied, and of freeing it from the more preposterous detentions and practices which had become attached to it.

Quarantine Acts.—In the present article we shall deal only with quarantine as it exists in this country. In Great Britain and Ireland, quarantine, which is carried out under an Act of Parliament passed in the reign of George IV. (6 Geo. IV. c. 78), has no longer a medical signification. It is practised, and that only to a limited extent, solely with a view of relieving our maritime commerce from disabilities which would else be imposed upon it by other countries, in which quarantine is regarded as an essential part of the public-health administration. The regulation of quarantine is not a function of the department of the Government which is concerned with the sanitary administration of the kingdom (the Local Government Board), but of the Privy Council, aided by the Board of Trade, the subject being dealt with as an international commercial question. In what follows an authoritative official memorandum of the late Dr. E. C. Seaton (formerly medical officer of the Local Government Board) on the subject is closely adhered to.

The Quarantine Act provides for land quarantine and the quarantine of inland waters, as well as for maritime quarantine—internal and external quarantine, so to speak. It does not appear that internal quarantine has ever been enforced in this country since the Act was passed. Maritime quarantine alone has been practised, and this has been applied to three diseases only, all of them infectious diseases of foreign origin, namely, plague, cholera, and yellow fever. Of plague there has been no question in English ports for the last thirty years or thereabouts, except a slight alarm in 1879, consequent upon an outbreak in south-eastern Russia, in the province of Astrakhan. Against cholera, quarantine has not been enforced since 1858, its futility as a precautionary measure in this country having then been abundantly manifested. Yellow fever is the sole disease at present subjected to it in our ports, and this, as already stated, not from the medical necessity, but from the commercial exigency of the case. The only quarantine establishment now remaining in England—that at the Motherbank—is maintained in respect of this disease. Infectious diseases habitually current in this country, such as small-pox and scarlet fever, notwithstanding that the phraseology of the Quarantine Act covers *any* 'infectious disease or distemper,' have always been in practice exempt from quarantine, and dealt with under the general sanitary law of the kingdom. It appears to have been recognised that measures, primarily designed to prevent the introduction into the country of diseases only coming to us from abroad, and which involved international considerations, would be misapplied if used for the purpose of preventing the importation of diseases ordinarily existing here, the limitation of which, and not the exclusion, could alone be in question.

In reference to cholera, foreign countries have, during recent years, shown a readiness to modify the requirements of quarantine, and substitute shorter periods of detention for those formerly insisted on. Conferences between representatives of the Powers have been held at Paris in 1854, Constantinople in 1866, Vienna in 1874, Rome in 1885, Venice in 1892 (the conclusions of which were subsequently modified at Paris), and Dresden in 1893, when Great Britain was represented by Mr. Strachey, the resident Minister at Dresden, Dr. Thorne Thorne, C.B., Medical Officer of the Local Government Board, and Mr. H. Farnall, C.M.G., of the Foreign Office. Inasmuch as the conclusions of this last conference have been accepted by the English Government, it will be convenient to give a brief account of their nature.

I. *Notification to Foreign Governments.*—A cholera centre [1] is to be notified to all the Governments signing this agreement. Isolated cases are not necessarily to be notified. Communications concerning progress of disease are to be made at least once a week.

II. *Circumstances under which Districts are to be deemed Infected.*—A district is to be considered infected when the existence of a cholera-centre has been officially stated; no longer infected when no deaths or fresh cases have occurred within five days, and the measures for necessary disinfection have been taken.

[The word 'district' is applied to any part of a country placed under a well-defined administration.]

III. *Limitation to Infected Districts of Preventive Measures.*—Measures for limiting the spread of the epidemic are only to apply to products of the infected districts, and not then if the products have left the country five days before the outbreak began.

IV. *Merchandise or Dangerous Articles considered from the point of view of* (1) *Prohibition of Importation and Transit, and* (2) *of Disinfection.*

1. The only things to be forbidden are: (*a*) body-linen, clothes in use, bedding (except when considered as luggage or when moving from one house to another, when they are to be specially dealt with); (*b*) rags and drills, but the following are not to be prohibited: rags compressed by hydraulic power, which are forwarded as wholesale merchandise and labelled with name of the place of destination, &c.; and clean clippings coming direct from spinning, weaving, making up, or bleaching establishments; artificial wool, and fresh paper shavings. Goods are not to be detained in quarantine on the frontiers of countries.

2. Disinfection of baggage is to be obligatory in respect of such things as clothes, dirty linen, &c., coming from an infected district, if the local sanitary authority consider them contaminated. Merchandise is to be disinfected so as to damage as little as possible; each State is to arrange the method of disinfection. Letters or printed matter are not to be disinfected.

V. *Measures at Land Frontiers—Railways, Travellers.*—Infected carriages are not to be retained at frontier towns—if soiled, they are to be detached for disinfection wherever possible. Land quarantine is no longer to be established. Only persons suffering from cholera and those attacked with a choleriform disease are to be detained. The officials of the railway are to see if all travellers are well—if ill, a medical man is to be called in. Inspection is to be made, if possible, at the Custom-house stations so as to hinder travellers as little as possible. On arrival at destination, travellers coming from infected districts are to be subject to five days' observation dating from the time of their departure from such districts. This, of course, does not apply in the case of Great Britain which has no land frontier.

Special measures may have to be taken with regard to bohemians, vagabonds, emigrants, and persons travelling in parties.

VI. *Regulation of Frontier Traffic.*—Frontier traffic arrangements are to be left to special measures to be taken by the neighbouring (adjoining) countries.

VII. *Waterways.*—The arrangements for regulating traffic are to be left to the States on river banks. Those regulations in force in Germany in 1892 are recommended.

VIII. *Measures to be taken at Ports.*—A ship is to be considered *infected* which has cholera on board, or if it has had fresh cases of cholera during the preceding seven days; to be considered as *suspected* where there have been cases on board though not during the last seven days; to be considered as *healthy*, though coming from an infected port, if having had neither case of cholera nor death from cholera on board before the departure, during the voyage, or since arriving.

Infected ships are to submit to the following:—

(1) The sick are to be disembarked and isolated. (2) The others are to disembark and remain under observation during a period not exceeding five days. [The signature of

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[1] The term actually used is *foyer*, and is thus referred to by the *Lancet* of July 15, 1893, p. 152: 'Practically the use of the term *foyer* means that if there are isolated cases of cholera the French Government will not notify; but if cases are grouped together and form a sort of kernel—a centre, a focus, radiating, scattering around the germs of disease—then the French Government will notify.'

Great Britain to the Dresden Convention was conditional that for the purposes of England the 'observation' should, both for infected and suspected ships, be in the homes of the persons under observation instead of in any specially provided place.] (3) Dirty linen and clothes, &c., belonging to passengers are to be disinfected, if deemed contaminated by the sanitary authority, as well as the ship or part of ship infected.

Suspected ships are to submit to—

(1) Medical inspection, (2) disinfection, (3) removal of bilge-water after being disinfected, and substitution of good drinking-water in place of that stored on board.

It is recommended that passengers should be under observation not more than five days from the date of arrival, and that the disembarkation of the crew should be delayed.

Healthy vessels are to be allowed free pratique. It is, however, permissible that the authority of the port may in the case of healthy vessels adopt the same measures as in the case of suspected vessels, except that the period of observation (five days) should date from the time of departure of the vessel instead of the date of arrival.

The authority of the port is to take into consideration, before ordering these measures to be adopted, the presence of a doctor and of a disinfecting-stove on board the vessel. Special precautions are to be taken on vessels crowded with emigrants, and insanitary vessels. Goods arriving by sea can only be treated similarly to those arriving by land. All ships refusing to submit to the port arrangements are free to put out to sea. They may only unload after the necessary precautions have been taken—(1) isolation; (2) removal of bilge-water; (3) substitution of good water. No passengers are to disembark unless willing to submit to the port regulations. Every country should provide at least one port on each of its coasts with the organisation and apparatus for receiving ships whatever their sanitary state. Coasting vessels are to be subject to special regulations, to be arranged between the countries interested.

Special measures are to be taken with regard to vessels coming from an infected port and going up the Danube. Until the town of Soulina is provided with a good water-supply, all boats going up the river are to be subjected to rigorous hygienic measures. Overcrowding of passengers is to be strictly forbidden.

It is interesting to observe that, while foreign countries are thus agreeing to regulations which approximate in some degree to those which are in force in Great Britain, British colonies, having independent control in respect of this subject, maintain a more rigid system of quarantine, and do not limit its application to diseases which in this country are subject to the quarantine law. Thus Malta, Gibraltar, and Cyprus, as well as the more distant colonies, adhere to the old quarantine system; and, indeed, the West Indian colonies have during the present year (1893) enacted a quarantine law, to which reference may be made as illustrative of the action of colonies in this respect.

The measures which have, in England, been substituted for quarantine against cholera—the only foreign epidemic which at present much concerns the health of this country—consist in a 'system of medical inspection,' the details of which are set forth in the Orders of the Local Government Board, dated the 28th of August, 1890, the 29th and 31st of August, 1892, and the 6th of September, 1892. This plan differs from 'quarantine' in the following essential respects:—

(*a*) It affects only (1) such ships as have been ascertained to be, or as there is reasonable ground to suspect of being, *infected* with cholera or choleraic diarrhœa; no vessel being deemed infected unless there has been actual occurrence of cholera or of choleraic diarrhœa on board in the course of the voyage. (2) Ships not infected with cholera, but having passengers on board who are in a filthy or otherwise unwholesome condition. (3) Ships coming from a place infected with cholera.

(*b*) It provides for the detention of the vessel so long as is necessary for the requirements of a medical inspection; for dealing with the sick (if any) in the manner it prescribes; and for carrying out the processes of disinfection.

Any person suffering from cholera must be removed, if his condition admit of it, to some hospital, or other suitable place for that purpose appointed by the sanitary authority; and no person so removed may leave such hospital or place until the medical officer of health has certified that he is free from the disease. If any person suffering from cholera cannot be removed, the ship must remain subject to the control of the medical officer of health. If any person is certified by the medical officer of health to be suffering from any illness which he suspects to be cholera, such person may be removed to some hospital, or other suitable place provided by the sanitary authority, or be detained on board the ship for any period not exceeding two days.

(*c*) It subjects the healthy on board to detention only for such length of time as admits of their state of health being determined by medical examination, or until they have satisfied the medical officer of health as to their names, places of destination, and addresses at such places. The name and address of any such person is to be forthwith given by the medical officer of health to the clerk to the sanitary authority, who is required to transmit the same to the local authority of the district in which the place of destination of such person is situate.

In the case of ships infected with cholera, or which have come from a place infected with cholera, the medical officer of health may direct the bilge-water to be pumped out before such ship enters any dock or basin; and, on the sanitary authority providing a proper supply of water for drinking and cooking purposes for persons on board the ship, he may direct all casks or tanks on board the ship containing water for the use of such persons to be emptied; and the master is required to cause these directions to be carried into effect.

In addition to the above Orders, others have been issued from time to time regulating the admission of rags from foreign countries infected with cholera.

The measures for dealing with the sick under the Orders of the Local Government Board, are but an adaptation to a particular exigency of the principles of sanitary administration with regard to infectious diseases, which are in force under the general sanitary law of the kingdom.

But though quarantine has no present practical existence in this country, except as regards yellow fever, and all other infectious diseases are dealt with either under the general sanitary law of the country, or such modification of it as has been just described with regard to cholera, the machinery which is maintained under the Quarantine Acts, for obtaining information as to the existence of infectious diseases on board foreign-coming ships, is made available for dealing with all diseases of that kind, whether they are quarantinable or not. The quarantine questions, as they are termed, which it is the duty of the Customs to put to the masters of all such vessels, embrace all infectious diseases; and, in the event of any such disease not of a quarantinable kind being found to exist on board, or to have existed in the course of the voyage, the quarantine officer is required to detain the vessel, and to forward the information with the least practicable delay to the sanitary authority of the port. In regard to cholera, moreover, both the Customs and the sanitary authority have certain powers of detaining the vessel specified in the Orders of the Local Government Board above referred to.

The provisions under Articles 12, 13, and 14 of the Order of the Local Government Board of 1890, as to the mode of dealing with persons who may arrive from abroad infected with cholera, will be better understood if a succinct statement be made of the ordinary provisions of the aw with regard to infectious diseases in England. The authorities which have to administer that law, as now existing under the Public Health Act, 1875, are the urban, rural, and port sanitary authorities of the districts into which the whole kingdom is divided. These authorities are empowered—

(*a*) To provide hospitals or temporary places for the reception of the sick (section 131);

(*b*) Where a hospital or place for such purpose is provided, to remove thither by order of any justice, on a certificate signed by a legally qualified medical practitioner, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, *or on board any ship or vessel* (section 124);

(*c*) To make regulations (to be approved by the Local Government Board) for removing to any hospital, to which the local authority is entitled to remove patients, and for keeping in such hospital so long as may be necessary, any persons brought within their district by any ship or boat who are infected with a dangerous infectious disorder (section 125);

(*d*) To provide and maintain a carriage or carriages suitable for the conveyance of persons suffering under any infectious disorder (section 123);

(*e*) To cleanse and disinfect infected premises, and articles therein; to destroy any bedding, clothing, or other articles which have been exposed to infection from dangerous infectious disorder, giving compensation for the same; and to provide all necessary means for the disinfection of infected things (sections 120, 121, 122);

(*f*) To take proceedings against (1) any person who, while suffering from any dangerous infectious disorder, wilfully exposes himself, without proper precautions against spreading the said disorder, in any street, public place, shop, inn, or public conveyance, or enters into any public conveyance without previously notifying to the owner, conductor, or driver thereof that he is so suffering; or (2) any person who, being in charge of any person so suffering, so exposes such sufferer; or (3) any person who gives, lends, sells, transmits, or exposes without previous disinfection, any bedding, clothing, rags, or other things which have been exposed to infection from any such disorder; or (4) any owner or driver of a public conveyance who shall not have immediately provided for the disinfection of such conveyance, after it has to his knowledge conveyed any person suffering from a dangerous infectious disorder; or (5) the owner of any house, in which any person has been suffering from any dangerous infectious disorder, who shall knowingly let it or part of it for hire, without having previously disinfected it, and all articles therein liable to retain infection, to the satisfaction of a legally qualified medical man; or (6) any person who, showing for the purpose of letting for hire any house or part of a house, shall make false statements as to the existence of infectious disease therein, or within six weeks previously (the several acts here enumerated constituting offences liable to penalty under the Public Health Act, ss. 126, 128, 129);

(*g*) To provide mortuaries, and to obtain the removal thither, by order of a justice, of the body of anyone who has died of any infectious disease, which is retained in a room where persons live or sleep, or of any dead body in such a state as to endanger the health of the inmates of the house or room in which it is retained (sections 141, 142);

(*h*) To make inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of the Act, and to enforce the provisions of this Act in order to abate the same (section 92): a provision which extends to shipping—any ship or vessel lying in any river, harbour, or other water, within the district of a sanitary authority, being subject to the jurisdiction of that authority, in the same manner as if it were a *house* within such district;

(*i*) Finally, to appoint a medical officer of health, inspector of nuisances, or several of those officers, according to the needs of the district, and other requisite officers to aid them in the proper and efficient execution of the Act (sections 189, 190). The duties of the medical officer of health and of the inspector of nuisances, when (as is the case in the greater number of instances) the assent of the Local Government Board has to be given to their appointment, are set forth in Orders of the Board dated March 1880.

Beyond the powers conferred upon Sanitary Authorities by the Public Health Act, 1875, other powers of considerable importance in relation to the subject under discussion can be obtained by Sanitary Authorities adopting the provisions of the Notification of Infectious Diseases Act, 1889, and the Infectious Disease (Prevention) Act of 1890.

Under the former Act, the authority can require every medical practitioner attending or called in to visit a patient to give notice to the Medical Officer of Health of the district if the patient be suffering from 'small-pox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names—typhus, typhoid, enteric, relapsing, continued, or puerperal,' as well as any other infectious disease which the authority by special resolution may require. The duty of giving notice to the Sanitary Authority also devolves upon the head of the family to which the patient belongs, and in his default the nearest relative of the patient present in the building or being in attendance on the patient, and in default of any such person, the occupier of the building.

Under the latter Act, powers can be obtained for—

(*a*) Prohibiting the supply within a district of milk from a dairy believed to be productive of infectious disease.

(*b*) Prohibiting any person ceasing to occupy a house, room, or part of a house, which has been occupied by a person suffering from infectious disease, without having such house, room, or part of a house, and all articles therein likely to retain infection, disinfected to the satisfaction of a registered medical practitioner, or without giving notice of the previous existence of such infectious disease to the owner, and prohibiting any such person giving any false answer to the owner or to any person negotiating for the hire of such house, room, or part of a house, as to the fact of there having within six weeks previously been therein any person suffering from any infectious disease.

(*c*) Prohibiting any person from retaining without the sanction in writing of the Medical Officer of Health or a registered medical practitioner, elsewhere than in a mortuary or in a room not used at the time as a dwelling-place, sleeping, or work room, for more than forty-eight hours, the body of any person who has died of any infectious disease.

(*d*) Prohibiting any person from removing from any hospital or place of temporary accommodation for the sick, except for the purpose of burial, the body of any person who has died from infectious disease, if the Medical Officer of Health or any other registered medical practitioner has certified he is of opinion that it is desirable, in order to prevent the risk of communicating any infectious disease, or of spreading infection, that such body should not be removed from such hospital or place except for the purpose of being forthwith buried. Under such circumstances the body when removed must be taken directly to a place of burial or to a mortuary.

(*e*) Empowering a justice of the peace on the application of the Medical Officer of Health to order the removal to a mortuary, and to be buried, the body of any person who has died of infectious disease, and which has remained for more than forty-eight hours without the sanction of the Medical Officer of Health or a registered medical practitioner in a room used at the time as a dwelling-place, sleeping-place, or work-room.

(*f*) Requiring any person who desires to remove in a public conveyance, other than a hearse, the body of any person who has died from infectious disease, to give notice to the owner or driver, and requiring such owner or driver to disinfect the conveyance.

(*g*) Authorising a justice of the peace to make an order directing the detention in a hospital, at the cost of the authorities, of any person suffering from infectious disease, and who would not on leaving such hospital be provided with lodging or accommodation in which proper precautions could be taken to prevent the spreading of the disorder of such person.

(*h*) Prohibiting the casting into any ash-pit, ash-tub, or other receptacle for the deposit of refuse matter, any infectious rubbish without previous disinfection.

(*i*) Empowering the local authority to provide, free of charge, temporary shelter or house accommodation, with any necessary attendants, for the members of any family in which any infectious disease has appeared, who have been compelled to leave their dwelling for the purpose of enabling such dwelling to be disinfected by such authority.

The general powers above enumerated, if exercised duly and with reasonable diligence, are held sufficient to provide for the exigencies which may arise in our ports from the introduction of infectious diseases by ships, whether the disease be current in this country or be of foreign origin not naturalised here; but in the case of a non-naturalised disease, such as cholera, certain additional securities are taken by the Orders of the Local Government Board previously referred to. The general powers, moreover, which are available against the importation of infectious diseases by shipping, are available also, and have on occasions been used, against their exportation in like way to other places.

HARRY LEACH. SHIRLEY MURPHY.

QUARTAN (*quartus*, the fourth).—A form of ague, in which the paroxysm returns after an intermission of two days. *See* INTERMITTENT FEVER.

QUEENSTOWN, in South of Ireland.—Mild, not relaxing, winter climate. Southern exposure, with shelter. Mean winter temperature 44·1° F. *See* CLIMATE, Treatment of Disease by.

QUINISM.—SYNON.: Cinchonism; Fr. *Quinisme*; Ger. *Cinchonismus*.

DEFINITION.—A group of symptoms, chiefly connected with the nervous system, produced by the presence of quinine in the system.

ANATOMICAL CHARACTERS.—In the rare cases in man in which death has been due to quinism, *post-mortem* examination has revealed only the appearances which are common to every case of gradual suspension of respiration, namely, accumulation of dark blood in the internal veins. The same has been found in experiments on animals.

SYMPTOMS.—Large doses of quinine prove fatal by paralysing, first, the brain and respiratory centre; secondly, the heart. Smaller doses may produce various symptoms on the different organs.

On the whole, quinine does not disturb *digestion*; on the contrary, of all alkaloids tested on this point, of course in the shape of a readily soluble salt, quinine, when given in small doses, alone promotes digestion. Undoubtedly it may often cause vomiting, but for this there may be three reasons—the sickening bitter taste, the selection of a salt not easily soluble when there is a deficiency of normal hydrochloric acid in the stomach, and the unusual influence of quinine on the brain. The first two reasons can easily be avoided, if the physician knows them; and also the third, if too large doses are not given at once to susceptible patients. The intolerance of the brain soon ceases. It is advisable to tell the patient that vomiting may perhaps follow on the first dose, but that that must not prevent the second being taken—then only a little nausea will ensue, and after the third dose neither. In whooping-cough the first effect of quinine is even to stop vomiting, and improvement of other symptoms follows.

The local irritation of the stomach often depends on the use of the sulphate, whilst the hydrochlorate is easily borne. The sulphate is soluble in about 800 parts of distilled water, the hydrochlorate in about 30 parts. Free hydrochloric acid renders them both equally soluble; but when this acid is deficient in the gastric secretion, as is the case in most fevers, the water alone may sufficiently dissolve the hydrochlorate, but not so the sulphate. It remains longer than it should as a foreign body in the stomach, and causes irritation. It is an old mistake to prescribe the sulphate, merely because it happened to be the quinine salt first introduced. The hydrochlorate not only irritates the stomach less, but contains also a greater percentage of the base than the sulphate does. These advantages compensate for a somewhat higher price.

The *toxic* effects of quinine, so often mentioned, are the result of large doses. They manifest themselves as deafness, noises in the ears—humming, or resembling the roar of a distant waterfall, the ringing of bells, or the striking of a clock; sickness, heaviness in the limbs, retching, vomiting, and inclination to sleep. Quinine intoxication can, of course, become dangerous, should the dose have been too large. It shows itself as paralysis of the nerve-centres, and later as paralysis of the heart. Irritation no longer causes the slightest contraction; one could imagine that the heart was poisoned by digitalis. The writer has at least thus observed it in animals. The skin is pale and cold, and the temperature of the blood, measured in the rectum, may show an enormous depression.

A man of forty-five, who suffered from constipation, took by mistake three drachms of sulphate of quinine, instead of the same quantity of cream of tartar, at a single dose. In an hour, pains came on in the head and stomach, giddiness, and general weakness, followed by unconsciousness. The face was pale; the lips blue and cold, as also the limbs; the pulse was still regular, but slow and almost imperceptible; the respiration languid and superficial; the pupils much dilated; vision and hearing almost gone, even after return of consciousness. The medical attendant, who was called after eight hours, wrapped up the whole body in hot towels, and used frictions of the skin and internal stimulants. Improvement ensued after a few hours, and increased steadily during the following days; but even on the fifth day the patient was unable to leave his bed for more than half an hour. The general weakness and that of sight and hearing improved, but did not disappear completely for a long time.

In a French military hospital (1885) a soldier got by mistake a 5 per cent. solution of sulphate of quinine, instead of a similar solution of sulphate of magnesium, equal to twelve grammes, viz. two-fifths of an ounce, of the former. When he complained of the disagreeable bitter taste and of the humming in the ears, the attendant thought proper to swallow the same quantity. Both were taken very ill after less than half an hour; both suffered from great general apathy and weakness of the heart. The soldier recovered, because a large portion of the solution of quinine was rejected by spontaneous vomiting; the attendant died before the lapse of four hours, with the symptoms of paralysis of the nervous centres.

Experiments on rabbits and dogs have proved to the writer that, under the influence of large doses of quinine, the respiration is first paralysed, and that life can be preserved at this stage by artificial respiration. Then the heart becomes paralysed by direct influence of the quinine on it, and death ensues.

Altogether, the physician should ask himself, in every case where he considers large doses of quinine desirable, whether an existing or threatening weakness of the respiration or the circulation might prove an objection to the prescription. Speedy death has been observed in typhoid fever in patients or convalescents after about twenty grains of quinine; and even less may prove dangerous. In such cases one should not go higher than ten grains, and at the same time give good wine in moderate doses and frequently.

In connexion with the influence of quinine on the heart, it must be mentioned here that its action in *small* doses consists of a slight irritation of the organ, probably of its substance The vagus has no connexion with the effect; it requires strong doses to depress this nerve a little, and infinitely less than atropine does.

The disorders of *hearing* caused by quinine generally last only for some hours or a few days; but severe cases are also reported. A man of thirty-seven took 20 grains of hydrochlorate of quinine in one dose for ague. The ague left him, but he almost immediately got loud noises in the ears, pain in the left ear, heaviness of the head, fits of giddiness, and intense deafness. The ticking of a watch, and the humming of a diapason, were no longer heard when they were pressed to the skull. Eighty grains of salicylate of sodium, taken within five hours (one must ask for what purpose), aggravated all the symptoms. Aural treatment during several months produced but partial improvement. Hearing was slightly better, but still bad.

Investigations on the hearing of healthy men have yielded some interesting results. The temperature of the outer ear, after a dose of 17 grains of hydrochlorate of quinine, sank 0·56° C. on an average in twelve experiments within two or two and a half hours. The external meatus and the tympanum were not hyperæmic—on the contrary, they were pale—when the effect of the quinine was at its height. It does not follow that this must always be the case. Some people may get inflammation of the tympanic cavity; others, again, inflammation of the skin, as will be described presently. Inflammatory extravasations were produced artificially in the *canalis cochleæ spiralis* and other parts of the inner ear in a cat, by dosing it with quinine. The writer knows from his own observation that this animal is certainly very sensitive to quinine. It is only in exceptional instances that quinine produces lasting bad effect on the hearing of human beings.

Disturbances of *vision* after large doses of quinine have often been observed. They are caused by direct paralysis of the optic nerve, not by dimming of the refractive media. A. von Graefe, the founder of modern ophthalmology, has described two cases, both malarial patients. In one case 360 grains had been taken during several weeks; in the other case 500 grains. In the first case weakness of sight ensued; in the second case blindness. Both cases lasted several months. Improvement began of itself. and was apparently aided by artificial bleeding from the temples. Many similar cases have since been reported.

The following case is more recent: A woman of thirty-five had aborted, with symptoms of septic endometritis. Cold baths and quinine—80 grains in the course of thirty hours—were employed to control the fever. An eclamptic fit ensued, and immediately afterwards complete loss of hearing and sight. The urine was free from albumen; the pupils were much dilated and fixed, the refractive media clear, the retina almost bloodless and perfectly insensible to strong light. Consciousness returned a day after the attack; hearing within the first few days. The blindness of the peripheral parts of the retina remained permanently; that of the central parts disappeared slowly within six months. Colour-blindness, which had been total when the sensibility to light returned, persisted partly.

It is evident, however, from the reports of cases, that disturbances of vision in patients treated with quinine may often be caused to a great extent by the illness itself, and are then incorrectly attributed to the remedy.

Transient *affections of the skin* after the ingestion of quinine are especially frequent. They present themselves chiefly as eczema, roseola, erythema, urticaria, and purpura. Here only a few instances need be mentioned. Four cases of purpura hæmorrhagica have been described. The most remarkable point about them was their appearance after only small doses; for instance, after 2 or 3 grains every six hours. According to another medical report, a lady of forty got œdema of the face and limbs, with violent erythematous eruptions, followed by peeling, after taking quinine. A repetition of the medicine caused the same symptoms.

The *kidneys and bladder* do not remain insensible to the alkaloid. Given in large doses it may cause albuminuria and catarrh of the bladder. The latter has appeared with violent fever after 60 grains in one day. Cases have been communicated where a few grains of quinine caused bloody urine, jaundice, and fever, apparently quite independently of the malaria for which it was ordered. This is less singular than the skin-eruptions, as the greater part of the quinine which leaves the body passes through the kidneys. The points of particular interest to us regarding this secretion may be noticed here. G. Kerner recovered 80, 90, and 96 per cent. of the ingested quinine from the urine. The excretion of the hydrochlorate of quinine began as early as fifteen minutes after its ingestion, was most active in the twelfth hour (30 per cent.), and lasted till the forty-eighth hour, when 1 per cent. still appeared. The sulphate of quinine was first traceable in the urine after forty-five minutes, and showed itself—1 per cent. only—till the sixtieth hour. The greater portion of both quinine salts passes out in the amorphous modification; a smaller part becomes oxidised.

Abortion and *premature birth* are often attributed to quinine. It seems to the writer, after carefully reading the literature of the subject, that these results are mostly due to the illnesses for which the quinine has been given. As it is a distinct protoplasmic poison, one must admit the possibility that when given in daily long-continued small doses in pregnancy it acts with specific energy on the tender protoplasm of the fœtus, whose gradual decay would lead to evacuation of the uterus. At all events, chronic quinism, even of a mild character, is to be avoided under such circumstances, and regarded with suspicion.

Several cases of so-called contrary quinine-effect, that is a real *febrile attack*, without apparent inflammation of any organ, have been published from time to time. How they originate is altogether unknown. Even relatively small doses may cause them.

Increase of the *general reflex excitability* has also been described as an unusual effect of small doses of quinine. Epileptic patients are said to react to quinine by increase of their fits in number and severity. This would correspond more with the facts derived from experiments on animals, than the assertion that quinine diminishes greatly the reflex function of the spinal cord. Such a diminution takes place only when one gives large doses, dangerous to life. Then the reflex function of the spinal cord ceases at the same time as all other functions.

It seems to be an accepted fact that quinine is less injurious to children than to adults.

Quinine has often been employed externally on account of its powerful antiseptic action, without showing injurious effects, when applied in the form of preparations with neutral or weakly alkaline reaction. Repeated frictions of ointment of quinine into the healthy skin cause abrasion and soreness.

Treatment.—The treatment of quinine-poisoning will vary with the various possibilities which have just been described. Should a large dose of quinine be still in the stomach, sickness must be induced by mechanical irritation of the pharynx, or the stomach should be cleared by the pump. Nothing is more unwise than to try to empty the stomach by chemical emetics, such as tartar emetic or ipecacuanha. Firstly, much time is wasted by their application; and secondly—what is still more serious—if they really do act at last, they depress the nervous system and the heart, and diminish the power of resistance to the poison. If any emetic seems to be indicated, only a cautious hypodermic injection of hydrochlorate of apomorphine can be permitted. Tannic acid or carbonate of sodium should be introduced into the stomach before or during evacuation, as quinine salts are precipitated by these bodies in a much less soluble form.

In cases of *acute* quinine-poisoning recourse must be had to artificial respiration, with rhythmical pressure on the heart about thirty times a minute, as it produces strong mechanical irritation of this organ. Further, hot baths (38° C. or 108° F.), with cold affusions over the neck, should be tried. The room and bed in which the patient is lying must be kept as warm as possible. Strong hot coffee or tea is to be administered.

What is to be done in cases where the quinine has already passed into the blood has been already indicated. Stimulation of the kidneys is also required, to promote excretion of the alkaloid. Abundance of water containing free carbonic acid, like Seltzer or Apollinaris, mixed with small quantities of wine or other good alcoholic beverage, will answer this indication best.

As the head in such cases is of sufficiently low temperature, in consequence of the general depression of the body-heat, cold compresses to the head are not advisable. This part of the body must be kept rather low, in order to allow the weak action of the heart to fill the brain with renewed blood as easily as possible.

The other symptoms caused by quinine will call for the treatment appropriate to each. Most of them disappear of themselves as soon as the drug is no longer given.

CARL BINZ.

QUINSY (*cynanche*, sore-throat). — A popular synonym for acute inflammation of the tonsils. *See* TONSILS, Diseases of.

QUINTAN (*quintus*, the fifth).—A form of ague, in which the paroxysm returns after an intermission of ninety-six hours. *See* INTERMITTENT FEVER.

QUOTIDIAN (*quotidie*, daily).—A form of ague, in which the paroxysm occurs at the same hour every day. *See* INTERMITTENT FEVER.

R

RABBI, in the Austrian Tyrol.—Chalybeate waters. *See* MINERAL WATERS.

RABIES (*rabies*, rage or madness).—SYNON.: Fr. *la Rage*; Ger. *Hundswuth*.

DEFINITION.—A non-febrile disease, due to a specific poison; and most frequently met with in the canine, feline, vulpine, lupine, and other species of carnivora; but communicable by inoculation to all warm-blooded animals. It is accompanied by an inclination to attack other animals; and is characterised by nervous disturbances, together with listlessness, uneasiness, wildness, cramps, paralysis, rapid emaciation, altered voice, quick course, and fatal termination.

ÆTIOLOGY.—Various antecedent phenomena are supposed to be either the actual or predisposing causes of rabies; but we may say that neither climate, season, food, water, sex, genital excitement, pain, anger, age, nor breed, as far as we are able to judge, has the slightest effect in producing the disease.

Many persons still adhere to the belief that rabies arises spontaneously in the canine, and probably also in the feline, lupine, and vulpine species of carnivora; although most, if not all, of the old school, admit such cases to be extremely rare (Boerhaave, Hamilton, Gilman, Coleman, Renault, Haubner, Williams, Hill, &c.). Others (Maynell, Blaine, Youatt, Virchow, Gerlach, Röll, Böllinger, the writer, and most modern investigators) believe that it never arises spontaneously, but that it is always the result of the introduction of the specific animal poison into the system, either by a bite from a rabid animal, or by the absorption of the virus through the medium of an abraded surface. To prove beyond doubt, in any given case, that affected animals had never been bitten, nor placed in contact with those already diseased, is extremely difficult.

The contagium is universally believed to be a micro-organism, although it has not yet been isolated. According to Pasteur, it is more virulent in the spinal cord than in any other part of the body. We have reason to believe that it is present in the secretions and excretions (Röll, Hering), in the blood, and consequently in all organs and parts of the still warm body (Haubner, Eckel, Lafosse, Röll, Fleming, and others); although others (Breschet, Majendie, Dupuytren), from some cause or other, failed to transmit the disease by inoculation with the blood of rabid animals. Whether the poison is present in the saliva, blood, and other parts during the incubative stage is unknown; but the spinal cord has been found to be inert before the infected animal shows symptoms of the malady, and therefore we may presume that other parts are not poisonous (Dowdeswell). There is no evidence to show that the dried virus is virulent; and the contagium is found to be destroyed by ordinary influences, such as heat, calcium chloride, caustic alkalis, and concentrated acids. It is a disputed point whether the meat and milk of rabid animals are fit for animal food; but few doubt the innocuousness of butter and cheese made from such milk. M. Galtier has found that the saliva of a rabid dog which has succumbed to the disease, or has been killed, does not lose its virulent properties through mere cooling of the body. It is important, therefore, in examining the cavities of the throat and mouth after death, to guard against inoculation. The same observer has also found that the saliva of a rabid dog, obtained from the living animal and kept in water, continues virulent for five, fourteen, or even twenty-four hours in the case of the rabbit. Water from which a mad dog may have drunk must, therefore, be considered dangerous for at least twenty-four hours. Although previous observations and experiments seem to prove that the virus loses its potency as soon as the body is cold, or *rigor mortis* has set in, and it has therefore been assumed, *à fortiori*, that the flesh of rabid animals might be eaten cooked (Dr. Lecamus) or uncooked (Decroix, Bourrel, &c.) with impunity, even if the mucous surfaces were injured, these statements must now be received with great reserve.

Animals that are inoculated with fresh (warm) saliva, blood, &c., do not in all cases contract the disease. Renault inoculated ninety-nine animals (horses, dogs, and sheep), and only sixty-seven became affected. Röll says that successful inoculations vary from 24 to 70 per cent., whilst from the bites of rabid dogs the proportion varies between 20 and 70 per cent., showing that the disease is comparatively less likely to follow from the natural (bite) than from the artificial (injection, &c.) introduction of the virus. This is probably due to the bleeding produced by the bite washing the poison out again, or to the clothes, hair, &c., of the bitten subject wiping the teeth before they pierce the skin. The researches of M. Galtier seem to show that the diluted poison of hydrophobia, injected into the blood of animals, acts as a preventive of the development of the disease. M. Pasteur has so far completed his experiments as to establish with accuracy the virulence of the poison in the spinal cord of rabbits by subjecting them to various degrees of dryness, its potency being in the inverse ratio of its dryness. It must also be remembered that the percentage—however the poison is introduced—is larger in carnivorous than in herbivorous animals or man. Fleming tabulates them thus: 'Dogs and cats hold the first place in the scale of susceptibility; then man and the pig; next ruminants, the sheep and goat being more susceptible than the ox; and lastly the horse.'

It has been denied by some authorities (Betti, Girard, Vakl, Huzard, Dupuy, Lafosse, &c.) that the virus of other than canine and feline animals, or those which use their teeth as natural weapons of defence, is capable of transmitting the disease to others. But of late years, this has been proved by many (Bourrell, Eckel, Berndt, Youatt, Breschet, Majendie, Earle, and others) to be incorrect.

INCUBATION.—The period of incubation in rabies ranges between extremely wide limits; but the average period in any animal may be said to be from three to six weeks. It is comparatively shorter in young than in old animals. Spinola said that gestation prolongs it, and according to Fleming it appears sometimes to be hastened by excitement, anger, sexual irritability, terror, injury to the cicatrix, sudden changes of temperature, and other causes. By inoculation the disease develops in from five to fourteen days.

ANATOMICAL CHARACTERS.—The anatomical changes in rabies are by no means constant, nor do they at all amount to what one would expect to find, judging from the symptoms presented during life. The following are the principal lesions found:—

The skin may be covered with mud, and wounded, especially about the lips. The visible mucous membranes may be injected; the teeth fractured; the tongue swollen, dark red, and wounded. The mucous membrane of the fauces, larynx, trachea, pharynx, œsophagus, stomach, and intestines may be swollen, congested, or hyperæmic, or may present hæmorrhagic erosions, and signs of catarrh. The tonsils and salivary glands may be enlarged and vascular. The stomach usually contains some indigestible and foreign substances, such as pieces of wood, leather, straw, hay, or iron. These, however, are rarely found in herbivorous animals. The small intestines are usually empty, or they only contain a mixture of bile and mucus. The solitary, agminate, and mesenteric glands may be found enlarged. The spleen is frequently enlarged and congested, hence the disease has often been mistaken for anthrax. The blood is dark-coloured, and coagulates with a soft loose clot. The kidneys and bladder may be hyperæmic, and the latter is usually empty and contracted. The lungs are generally gorged with blood. The vessels of the cerebro-spinal coverings may be congested, and serous effusions in the cavities will sometimes be observed. Williams says: 'On the lower surface of the medulla oblongata, at the origin of the seventh, eighth, and ninth pairs of nerves, the membranes are generally highly congested, thickened, softened, and matted together.' The brain-substance may be soft and friable; there is rarely congestion; and, as a rule, the brain is pale and bloodless (Fleming).

For the microscopical changes, *see* HYDROPHOBIA.

SYMPTOMS.—In the lower animals, the trains of symptoms are so marked that they have given rise to the distinction of two different forms of the disease: one in which the nervous system is excited, hence the terms *furious*, *wild*, or 'excited' rabies; the other, where it seems to be depressed, and to which the names of '*dumb* tranquil,' 'torpid,' or 'paralytic' rabies have been given. Although this distinction is convenient for description, it must not be forgotten that paralysis, in some form or other, usually sets in, sooner or later, in the excited form; whereas in the latter it is rarely, and then only for a short time, preceded by any signs of excitement or inclination for mischief. In other words, the symptoms of rabies may be divided into three stages, namely, the *premonitory*, *irritative*, and *paralytic*. In the 'furious' form, all three stages are well-marked; but in the 'dumb' form, only the first and last. The transition from one stage to the other is gradual and imperceptible.

The *premonitory stage* is characterised by an alteration in the manner and habits of the animal. Dogs, for instance, that are naturally friendly and docile, suddenly turn surly and bad-tempered, and as quickly return again to their former docile manner, showing more affection than usual. Nearly all animals are restless, and frequently change their posture and position. Most are dull, lazy, languid, and seek seclusion from society by hiding themselves in dark and quiet places. Irritation at the seat of inoculation, demonstrated by rubbing, nibbling, or scratching the cicatrix, is frequently an early symptom. The appetite is lost, and in ruminants rumination is suspended. Sometimes a depraved appetite is present, evidenced in dogs and pigs by their eating all sorts of strange things, such as wood, iron, &c.; and these, as well as sheep, often swallow their own fæces and urine; whilst the latter have been seen to lick blood and even eat their wool. Carnivorous animals and pigs frequently 'gulp,' as if trying to swallow something, or retch, as though to free their throat from some foreign body; and vomiting sometimes occurs. The visible mucous membranes are red, and saliva almost always (except in horses) drivels from the mouth, due in all probability to dysphagia. The sexual organs of all species, except the pig (Haubner), are frequently excited in the early stage of this disease, and ungovernable salacity is present. The bowels are constipated; the urine is suppressed.

These symptoms may last from twelve to forty-eight hours, and then gradually pass either into the irritative, marking the 'maniacal' form, or into the paralytic stage, characteristic of the 'melancholic' form.

The *irritative stage* is distinguished by a propensity to injure other animals; by great uneasiness; and by paroxysms of fury and excitement, with intervals of quietude and exhaustion.

The increased restlessness, which marks the commencement of this stage, is manifested differently by different animals. They are constantly changing their position and posture. Dogs lie down in one place and quickly shift to another; horses move their ears backwards and forwards, as though they were listening to some distant sound.

During the paroxysms dogs become excited; disturb their beds; tear carpets, mats, or whatever comes in their way; and bite their kennels, chains, other animals, and even their own bodies. They may lie quietly for a time, and then suddenly jump up with a peculiar howl; remain in the same posture for a time; look vacantly around them; then suddenly walk forward as though following something; and all at once snap at some imaginary object. The dog may obey its master's call, although reluctantly, and look up pitifully, as though it did not wish to be disturbed. The tongue is swollen, and frequently dipped into water to cool it, although the poor creature cannot swallow any, and saliva hangs in strings from the angles of its mouth. The countenance is anxious and haggard. If the animal should succeed in escaping from its kennel at the early part of this stage, it wanders forth 'on the march,' apparently not knowing or caring where it goes. If anything comes in its way the dog immediately attacks it, and then resumes its journey. The gait and carriage of the dog are at first natural, but as the nervous energy fails, it becomes unsteady and tottering; the tail drops between its legs; the head is carried near the ground; the abdomen is 'tucked up;' and the poor beast, which a few days previously was plump and fresh-looking, is now comparatively a skeleton. Dogs generally endeavour to retrace their way back to their homes to die. Cats are very savage, arch their backs, lash their tails, and freely use their teeth and claws. Horses become very violent, frequently neigh, bite the bars and mangers, kick, paw, and endeavour to get loose. Cattle rarely, if ever, use their teeth, but bellow, paw the ground, butt and toss, frequently breaking their horns. Sheep seldom, but goats often, use their teeth. Their natural timidity is replaced by a pugnacious disposition, and they will even attack dogs. Pigs slaver at the mouth, bite their fellows and other animals, and become very wild. Poultry make stupid high jumps and other frenzied movements, peck one another, and chuckle frequently. Deer point their noses towards the sky; sniff and throw their heads back, run at other deer, and butt at and fight the trees and other objects, until they even rub the skin off their foreheads; suddenly start galloping, and as suddenly stop, seize sticks and other objects with their teeth, attack persons, eventually become paralysed, and die in from two to eight days. The voice of all animals affected with rabies is altered in character, and is continually being exercised. In dogs, the character of the voice is one of the best diagnostic signs of the disease. It has a peculiar high-toned, croupy, ringing sound, as if the bark and howl were blended together. In the early part of this stage of the malady, the eyes are bright and glaring—especially in cats; but as the disease advances, the bulbus oculi retracts in its orbit, and the membrana nictitans is forced half over the cornea, giving the animal a horrible and forlorn appearance.

At first the paroxysms are strong and prolonged, but as the disease progresses they become weak and short, and the periods of depression which intervene between the paroxysms are lengthened, until finally the animal has not power or strength to move his limbs, when the *paralytic* stage may be said to have commenced. We now notice continual twitching and convulsions of the muscles—even tetanus; and death soon takes place.

The *paralytic stage* of the 'dumb' or 'torpid' form of the disease is marked by 'dropping' or paralysis of the inferior maxilla, rendering the animal unable to bite or bark. Although at the commencement of this stage there may be an inclination in the dog to leave its abode and 'march;' still it is less so than in furious rabies, and if he do go, the creature either quickly returns again, or seeks some secluded spot in which to die. The animal endeavours to remain quietly in a dark place, and takes little notice of what is going on around him. The tongue is swollen, livid, and hangs out of the mouth; the saliva is tenacious and abundant. Paralysis of the posterior extremities soon sets in, and death quickly follows. When the tranquil form of rabies attacks other animals than dogs, it usually paralyses the posterior extremities.

Duration and Termination. — Rabies generally takes a rapid course, sometimes killing within forty-eight hours, and rarely lasting more than ten days, although cases of canine madness have been reported as having lasted from fifteen to twenty days. The duration depends to a certain extent upon the constitutional vigour of the animal. The termination is fatal in all animals.

Diagnosis.—Marochetti and others have asserted that rabies can be diagnosed a few days after inoculation, by the presence of a sublingual vesicular eruption, but there is no evidence to warrant us in believing this statement; and Mr. Fleming remarks 'that it is much to be regretted that those who have seen these *lyssi* did not resort to inoculation with the contents of the vesicles to prove whether they really contained the morbific elements or not.'

The most characteristic symptom of the 'furious' form is undoubtedly the peculiar 'falsetto termination of the bark' (Horsley); and of the 'dumb' form the dropping of the inferior maxilla. But since these symptoms only appear when the disease is comparatively advanced, we must take other symptoms into consideration, such as the behaviour of the animal, its physiognomy, inclination to bite, and to eat strange and indigestible substances. An acquaintance with the history of the case is necessary if we would avoid confounding it with other diseases.

Epilepsy is distinguished from rabies by the sudden and complete loss of sense, champing of the jaws, foaming at the mouth, convulsions, cries, and rapid recovery.

Distemper has sometimes been mistaken for rabies, from the fact that catarrh of the eyes and nose, giddiness, weakness, and emaciation are sometimes present in both diseases; and it is this circumstance, with the fact that epilepsy is sometimes a sequela to distemper, that undoubtedly led the late Mr. Grantley Berkeley, a professed authority on rabies, to state 'that dogs become utterly insane from distemper, and that if this disease be prevented by vaccination, hydrophobia (rabies) will be decreased.' It is scarcely necessary to say that such assertions are liable to cause serious mistakes.

Foreign substances in the fauces or pharynx, especially in the dog, may be distinguished from rabies by the history of the case, and by careful examination.

Inflammation of the throat only presents one symptom of rabies, namely, inability to swallow.

Gastritis and *enteritis* may be distinguished by the absence of the nervous symptoms, and by the pain produced on pressing the abdomen.

Phrenitis, especially in horses, may be confounded with rabies; but although the animals may be delirious, there is no inclination to do mischief, nor are they irritated by the presence of a dog or a person, and the course of the disease will soon decide the question.

Tetanus in the dog has been confounded with rabies, but this is such a rare disease in dogs, cats, cattle, sheep, goats, and pigs, as to call for no special mention. In horses such a mistake could scarcely happen.

Anthrax.—The pathological changes of rabies and anthrax, says Mr. Fleming, have at times lent some support to the idea that they were identical, or at least resembled each other. Although vertigo, and a disposition to fury, do in some cases accompany anthrax in the lower animals (especially in the horse), the other symptoms of anthrax, the rapidity with which it runs its course, and the pathological anatomy of the several diseases, will serve to distinguish one from the other. The presence of the bacillus anthracis in the blood is absolutely characteristic. *See* Micro-organisms.

Cattle-plague.—The fits of delirium that now and again appear in this disease, as well as the great depression, apathy, and the unsteady gait, have a resemblance to those present in a certain stage of rabies. But this resemblance is very superficial. The existence of the plague in the district, the appearance of the visible mucous membranes, and the other symptoms during life.

as well as the pathological alterations after death, are sufficient to establish a distinction.

A ferocious dog has frequently been mistaken for a rabid one.

There are no *post-mortem* signs sufficiently trustworthy or characteristic to enable us to form a direct diagnosis of rabies. The history of the case, however, together with the facts that foreign bodies are present in the stomach and the mucous membrane of the fauces, larynx, and stomach congested, will materially assist us in forming a correct opinion.

Treatment.—The *curative* treatment of rabies, so far as our experience at present goes, has yet to be discovered; and since the malady is so dangerous to other animals and man, we think its cure ought not to be undertaken, except by experienced persons and under adequate restrictions.

All affected animals should be killed at once and burned, or buried deep with quicklime.

The *prophylactic* treatment, however, deserves our best consideration. If an animal has been inoculated by a bite from a rabid animal or otherwise, the circulation in the part should be immediately stopped by a compress above it; the wound thoroughly washed, sucked, or cupped; and all parts that are supposed to have been in contact with the virus excised, and either the actual or potential cautery freely applied. In the lower animals some of the wounds may escape our notice on account of the hair, and therefore, even after the above precautions are taken, the subject must be treated as suspicious.

The researches of MM. Pasteur and Galtier demonstrate the advantage that may result from inoculation with the attenuated poison, for the purpose of preventing the development of the disease. For a detailed account of these experiments, *see* Hydrophobia.

Cows, sheep, and pigs, if the wounds have been promptly cauterised, may be used for food, provided they are killed within twenty-four hours of the inoculation, and, if Dr. Dowdeswell's experiments are correct, even before any signs of the malady are manifested.

If an animal is suspected of being inoculated from, or has been in company with, one affected with rabies, it should be kept in a secure place, and watched for at least four months, and then only allowed to go out muzzled; but it is preferable to destroy it. If such an animal has bitten any person, it should not be destroyed until it has been positively ascertained whether it is rabid or not.

When a case of rabies has occurred, notice ought to be given at once to the local authorities, to prepare them for making and enforcing stringent measures to prevent its spread. No dogs ought to be allowed to enter public buildings or conveyances, or to frequent the public streets or highways, without a muzzle, under the penalty of being seized by the police. If a rabid animal is at large, notice should be given of the fact to the neighbourhood as soon as possible. All kennels, chains, collars, and places with which a rabid animal has been in contact should be scalded and disinfected.

Dogs should always be under strict police surveillance, by owners not only being compelled to pay taxes, but also by placing evidence of this fact on the dogs' collars in the form of a small metal disc. In addition, every owner should have his name and address on the collar. Should any dog be at large without a collar and the metal disc, it should be at once seized by the police, and if not claimed within a prescribed period it should be destroyed.

George A. Banham.

RACE, Ætiological Relations of.—*See* Disease, Causes of.

RACHITIS (ῥάχις, the spine).—A synonym for rickets. *See* Rickets.

RAGATZ, in Switzerland.—Simple thermal waters. *See* Mineral Waters.

RAILWAY INJURIES. — Description.—The points of difference between railway injuries and those sustained in other ways, such, for instance, as by a fall from a horse or a carriage, are virtually those of degree. The more serious results are referable, firstly, to the great weight and impulse of the railway train, crushing, perhaps completely, some portion of the body; secondly, in the case of collision, to the sudden arrest of momentum of such ponderous bodies in more or less rapid motion, causing thereby violent vibratory shocks to the travellers; and, thirdly, the occurrence being sudden and unexpected, the muscles are, as it were, taken by surprise, and before contraction can take place the ligaments of the spine are frequently strained or even torn. There is no time for preparation; the whole is the work of an instant. In cases of injury to those who jump or fall from a train in motion, the gravity of the resulting injury depends on the rate of speed of the train at the moment; on the part of the body which first strikes the ground, and the angle at which it is struck; on the weight of the individual; and also on the nature of the ground.

Accidents which happen to persons either getting into or out of trains not in motion, possess no special characters. Serious spinal injuries have occurred to those sitting in a train not in motion, when, by a sudden unexpected jerk, as from a train running into it from behind, a violent shock is sustained.

It is, then, the sudden and violent character of the occurrence, the alarm and fright necessarily associated therewith, the general jar or commotion of the system, and the possible localised physical damage, which constitute the main features of this class of injuries, conditions which do not obtain in cases of less sudden violence.

Results. — 1. The *direct* or *immediate* results of railway accidents are of various kinds. Locally, they consist of simple or compound fractures, contusions, and lacerations, caused either by the force of the collision, by the legs being caught between the seats of the carriage, or by the wheels of the carriages where the individual has been run over, or by fragments of splintered wood, iron, or glass. Burns and scalds may add to the sufferings of the injured. These injuries, if not resulting immediately in death, may ultimately prove fatal in various ways, or permanent injury to a greater or less extent may ensue. Such conditions, however, are not peculiar to railway injuries, and need no special description here.

The immediate effects on the cerebro-spinal system are, on the other hand, of special interest and importance. Local injuries to the spinal column and cord, or to the head, are frequently met with, such as fractures of the skull or of the spine, implicating the brain or spinal cord or their membranes, stretching or rupture of spinal ligaments, &c., and these *ligamentous* lesions are, perhaps, the most characteristic features of railway injuries. Death has resulted from sheer fright; the influence of intense fear on the minds especially of persons suffering from heart-disease, aneurysm, and the like, being sufficient to cause death. The primary depression produced on the nervous and circulatory systems continues and deepens, there is no power to rally, and a fatal result from syncope ensues. A general condition of shock or concussion is also commonly met with, where the symptoms presented are mainly subjective; and in emotional individuals an attack of acute hysteria may be induced, laying the foundation of a chronic condition.

For a description of concussion of the cord, and of the localisation of lesions of the cord, *see* Spinal Cord, Diseases of.

2. The *indirect* or *remote* results of railway injuries are numerous and varied in character. *Locally*, it must not be forgotten that an accident may readily light up chronic inflammatory mischief in individuals who are predisposed by some inherited or acquired weakness, or by some particular diathesis. Thus syphilitic, tubercular, gouty, and even cancerous disease may follow and complicate the symptoms arising from the injury. Again, chronic inflammatory conditions of the spinal cord and its membranes may be induced thereby, and the usual train of symptoms accompanying such lesions will be manifested. But, apart from the existence of such organic mischief, certain indefinite phenomena, subjective and functional in character, are constantly met with, which render the diagnosis and prognosis of railway injuries difficult, and considerably increase the responsibilities of the medical attendants. It is especially, however, when there is no local lesion of importance, such as a fractured limb, that these general 'neurasthenic' conditions are likely to occur; for it can be readily understood that if the force of the accident expend itself upon some injury, say, to one of the extremities, there is less likelihood of a general concussion of the nervous system. The familiar and often-quoted illustration is that of a watch, in which the works are less likely to be damaged by a fall if part of the violence be expended in breaking the glass. This neurasthenic condition is evidently the expression of an exhausted nervous system, and may come on in various ways and at various times after the accident. The mental shock is to be held responsible for its occurrence nearly as much as is the physical. It may arise out of the general collapse or shock into which the patient has been suddenly thrown by the accident, but perhaps more commonly the extent of the mischief is not evident at the time. As a typical illustration of such a case, the following may be taken: A person in a collision receives a sudden, unexpected, and violent shock, the result of being thrown or jolted backwards and forwards. He feels faint and collapsed for a few moments, but recovers sufficiently to be able to assist his fellow sufferers; returns home, and resumes his usual avocations. After an interval of a day or two he begins to complain of pain and stiffness in the back and neck, but particularly in the lumbo-dorsal region. He goes to his business, but cannot attend to it, being unable to concentrate his attention or make calculations, any special effort resulting in marked occipital headache. He is unable to read comfortably, as the letters run into one another and become blurred. He goes home and consults his medical man, who probably advises rest in bed, and prescribes bromide of potassium, &c. The temperature in these cases is often subnormal, and the pulse slow, except when agitated as by a medical examination. These symptoms in the majority of cases pass away after a short rest, and terminate in complete recovery. In other cases, fortunately the exceptions, further symptoms develop, such as irritability of the bladder, inability to empty the viscus, occasional dribbling of urine, lightning pains in the spine, spasm of the legs, and others too numerous to mention here. These may depend either upon the condition of neurasthenia, just alluded; to or more rarely upon definite congestive or other pathological changes occurring in the

spinal cord. The prognosis of the latter is grave in the extreme.

In the condition of neurasthenia, asthenopia, with difficulty in or real loss of the power of accommodation, may be one of the causes of the impaired vision just mentioned. Physical changes in the retina and optic disc, such as those detailed by Dr. Clifford Allbutt, are extremely uncommon, and the latest writers on this subject, namely, Mr. Page and Mr. Thorburn, seem to doubt their occurrence. In all probability, they only exist as sequelæ of organic lesions of the spinal cord and membranes.

Added to this neurasthenic condition, there is often seen a certain amount of functional disturbance, probably of cerebral (cortical) origin, which may be described as chronic hysteria, under which one includes changes of various kinds in the cutaneous sensibility, spasmodic contractions of limbs, and paralyses; and it is often a most difficult question to decide whether these phenomena are functional or real. Cases such as these are frequently the subject of litigation as regards claims for damages against railway companies.

MEDICO-LEGAL QUESTIONS IN CONNEXION WITH RAILWAY ACCIDENTS.—In cases of claim for compensation for these injuries, it is of the highest importance that the medical men engaged should make themselves thoroughly acquainted with all the circumstances connected with the accident and its results. This applies to the *medical attendant* of the injured person, as well as to the *medical officer* examining on behalf of the company.

Duties of the Medical Attendant.—1. It is desirable to obtain in writing the *patient's statement* as regards: (*a*) the accident; ascertaining, if possible, the approximate speed of the train when the accident occurred, the position of the injured person in the carriage, and of the carriage in the train; also whether other persons were present or not; (*b*) his condition from the time of the accident to the time of his examination; and (*c*) the symptoms complained of at the time of his examination.

2. Investigate the general condition of the patient, especially as to his appetite, and his capacity for sleep or work; ascertain also his previous habits. The possible existence of organic disease, previous to the accident, should not be overlooked, as it has happened that symptoms referable to disease—tabes dorsalis, for example—have been erroneously ascribed to injury. The urine should be carefully examined in every case.

3. Note bruises or any sign of local injury on any part of the body.

4. Where injury to the spine is alleged, the investigation should be conducted as far as possible according to the following systematic plan:—

(i.) Notice the amount of mobility or rigidity of the spine whilst the patient is undressing.

(ii.) Examine the spine by digital pressure or percussion, and by the application of hot or cold sponges.

(iii.) Investigate any alleged paralytic symptoms by (*a*) measuring the circumference of the limbs, where needful; the right side, it should be remembered, is usually somewhat fuller than the left, and the existence of any other pre-existing inequality of the limbs should not be lost sight of; (*b*) testing the electrical excitability of the muscles; (*c*) noting the existence of spasm or tremor of the muscles of the spine and limbs; and (*d*) examining the condition of the reflexes, superficial and deep.

5. Investigate the presence of any abnormal cutaneous sensibility. This is entirely a subjective phenomenon, on which reliance cannot always be placed.

6. Ophthalmoscopic examination must be made, in order to determine the existence or not of local lesion in the fundus oculi, confirmatory or otherwise of cerebral or spinal symptoms; but, as already stated, such pathological changes are exceedingly rare.

During this examination, it should be borne in mind that the simulation of symptoms, such as spinal tenderness or muscular tremor, can frequently be detected by distracting the attention, when pressure on the part previously complained of may be made with impunity, or the muscular tremors will cease. This, however, is not conclusive of imposture, for in hysteria, when the attention is diverted, the same occurs.

As an instance where the truth of a patient's statements may be tested by the astuteness of the medical man, a case may be mentioned in which the plaintiff, who had travelled up some fifty miles to London to be examined, stated, among other symptoms, that his urine continually dribbled from him. The surgeon immediately asked to see his shirt, which had been worn at least six hours, when it was found perfectly dry and devoid of any stain of urine! In another case a man presented extreme spinal tenderness, even to the extent of complaining of pain when the part was blown upon with the breath. A sheet of paper being interposed, without the patient's knowledge, the effect was the same.

It now becomes the duty of the medical attendant to form an opinion on the following points:—

(α) Has the patient been really injured?

(β) What is the nature of the injury?

(γ) Is the injury a possible or probable result of the accident as described?

(δ) Are the symptoms consistent with the history and the objective signs?

Duties of the Medical Officer examining on behalf of the Railway Company.—The medical officer of the company should on no account constitute himself the agent of the company for settling the terms of compensation. The examination should be made, if possible, in the presence of the medical attendant of the patient, and not in the presence of the legal advisers of either side; it should be conducted with thoroughness and tact, and without inflicting any unnecessary mental or bodily pain.

A report of the case should be drawn up at the time, giving:—

(1) The patient's account of the accident, and of his subsequent and present symptoms.

(2) The present condition of the patient, noting particularly any objective signs of injury.

(3) An opinion as to whether the symptoms complained of are likely to be the result of the accident; and as to the probability of recovery, and at what period.

As the plaintiff's solicitors in an action can apply for a copy of this report, it should, of course, be worded with extreme care.

The actual question of pecuniary compensation does not concern either the medical attendant of the patient, or the medical adviser of the company. They merely have respectively to bring forward facts in support of their opinions as to the value of symptoms, and how far they are dependent upon the injury.

Such investigation should take place as soon after the accident as possible, by which means the chances of imposture would be lessened; whilst by a careful and impartial estimate of the facts of the case as obtained by such a thorough examination as that sketched above, much conflict of medical opinion would be avoided, the medical men being witnesses, not advocates.

Fraudulent Claims.—It will be well to allude to some of the ways in which fraudulent claims are brought against railway companies. These may be conveniently divided into:—

(1) Claims made by persons who, as may be subsequently proved, were not even present at the time of the accident;

(2) Claims by those who, though present and unhurt, yet simulate the symptoms of injury; and

(3) Claims by those who, having sustained some trifling injury, wilfully and intentionally exaggerate their symptoms in order to obtain a larger amount in compensation.

The medical man should, therefore, be alive to the possibility of wilful deception being practised on him, lest he should be led away by a well-planned history, and thus unwittingly be made a party to such fraudulent transactions.

Unintentional Exaggeration.—The difficulty of assessing the value of subjective symptoms in general is much increased by the fact that there are certain persons who, undoubtedly injured, may, without any fraudulent design, unintentionally exaggerate their symptoms. This is to some extent explained by their thoughts being constantly directed to their sufferings, and the worry necessarily attending a protracted lawsuit, or whilst an action for damages is pending. The suspense and anxiety, the examinations by the medical men, and the repeated interviews with their solicitors, keep them in a constant state of nervous tension. When, therefore, their claims are settled, it is natural that the relief they experience should frequently be attended by beneficial results, or even complete recovery. *See* FEIGNED DISEASES.

TREATMENT.—The chief injuries received at the time of a railway accident being surgical, the treatment adapted for each particular case will be found in surgical works. Nevertheless there are some general points in the immediate treatment to which any medical man present on such occasions would do well to attend.

1. *Hæmorrhage.*—Death from hæmorrhage should be prevented, where possible, by promptly adopting pressure of some kind. If no tourniquet or indiarubber band be available, a handkerchief tied round the limb and twisted tight with a piece of stick, or direct pressure by the finger, will suffice for the time.

2. *Fractures.*—Temporary splints may be improvised out of umbrellas, walking-sticks, cushions, newspapers, and broken pieces of wood, &c., fixed by straps or handkerchiefs, so that the injured may be removed with as little pain as possible, and simple fractures may be prevented from becoming compound. Simple dislocations should be reduced at once, if possible.

3. *Shock, collapse, and fright.*—In the treatment of these conditions great caution is required to maintain the vital powers until reaction sets in. The temperature of the body, the strength and rate of the heart's action, together with the respiration, should be kept up by stimulants and warmth. Sir William Savory, in his article on 'Shock' in Holmes's *System of Surgery*, is careful to point out the dangers of *over*-stimulation, whereby the flickering powers of nature may be extinguished altogether.

4. *Exposure to wet and cold.*—Every endeavour should of course be made to prevent prolonged exposure, by sheltering the injured as much as possible, and securing their early removal to any neighbouring houses.

The subsequent treatment of railway injuries is one which requires the exercise of considerable skill and judgment on the part of the medical attendant. Absolute rest is of course a *sine quâ non* where any spinal concussion or local lesion is suspected; but where the symptoms are due to neurasthenia, long confinement in the horizontal position is often productive of harm, whereas change of scene and moderate exercise might prove beneficial.

William Rose.

RÂLES (Fr., Rattles).—Certain adventitious sounds heard on auscultation, in connexion with the respiratory organs, during the act of breathing, in various morbid conditions. *See* Physical Examination; and Rhonchus.

RAMOLLISSEMENT (Fr., Softening).—This word is associated with all forms of softening of tissues and organs; but by English pathologists it is generally used in connexion with softening of the central nervous system. *See* Softening.

RANULA (*ranula*, dim. of *rana*, a frog). A cystic growth in the floor of the mouth. *See* Mouth, Diseases of.

RAPE.—Synon.: Fr. *Viol*; Ger. *Nothzucht.*

Definition.—By the English law rape is defined as 'the carnal knowledge of a woman forcibly and against her will.'

General Remarks.—The crime of rape is punishable by penal servitude for life. By the Criminal Law Amendment Act of 1885 the defilement of a girl under thirteen is a felony punishable by penal servitude for life, and the attempt to have carnal knowledge of a girl under thirteen is a misdemeanour punishable by two years' hard labour, or by a whipping if the offender be under sixteen. The carnal knowledge of a girl between thirteen and sixteen, or the carnal knowledge of an idiot or imbecile girl, is a misdemeanour punishable by two years' hard labour.

Of cases of rape recorded by Casper, 73 per cent. were upon the persons of little children under twelve. Of 136 cases put upon record by this author, the ages were as follows:—

From	2½	to	12	years of	age,	99	cases
,,	12	,,	14	,,	,,	20	,,
,,	15	,,	18	,,	,,	8	,,
,,	19	,,	25	,,	,,	7	,,
			47	,,	,,	1	,,
			68	,,	,,	1	,,

For proof of the crime of rape it is not necessary that the force employed should have been of a violent physical kind. A mere *threat* of violence, or even of moral injury, is 'force' in the eyes of the law. The surreptitious administration of chloroform, or a narcotic, for the purpose of having intercourse with a woman against her will, is also force in the eyes of the law. The Criminal Law Amendment Act quoted above has the following clause: 'Whereas doubts have been entertained whether a man who induces a married woman to permit him to have connexion with her by personating her husband is or is not guilty of rape, it is hereby enacted and declared that every such offender shall be deemed to be guilty of rape.'

The moral character of the woman is theoretically, but seldom practically, beside the question; and, provided force be used, and the woman's consent be wanting, sexual intercourse even with a prostitute is legally 'rape.'

The punishment of the crime of rape was provided for in the criminal code of Moses, who ordained that the ravisher of a betrothed damsel should die.

The Roman law punished the crime with death and confiscation of goods, but provided the following saving clause:—

Rapta raptoris, aut mortem, aut indotatas nuptias optet.

Upon this, says Percival, there arose what was thought a doubtful case: '*Una nocte quidam duas rapuit; altera mortem optat, altera nuptias.*'

Many accusations of rape are false and trumped up, and are only brought by the woman when she finds that some sexual indiscretion is likely to bring her into trouble, or cannot be concealed by reason of her pregnancy.

This being the case, *stale accusations* should be received with very great caution. The laws of Henry III. provided that the accusation should be made immediately '*dum recens fuerit maleficium.*' By the old Scotch law no delay was allowed in bringing the accusation *ultra unam noctem*, and by the modern Scotch law a delay of three days is alone permitted. By the law of England no limit is placed on the time at which an accusation of rape may be made. An English jury is, however, naturally chary of giving credence to a stale charge of rape. Some few years back a charge of rape was brought against a gentleman of position in one of the home counties by a girl with whom he had had connexion some five months previously. There was no evidence that the girl had offered any resistance, and as the accusation was brought only after pregnancy had become evident, and after ineffectual attempts had been made to extort money from the defendant's relatives, and as the charge was evidently made at the instigation of an uncle who was a superintendent of police, and a cousin who was a lawyer, the case was dismissed. It shows, we think, an imperfection in the English law that it should be possible, under such circumstances, to prefer a charge of so serious a crime.

The law for the substantiation of a charge of rape is satisfied with proof of a minimum amount of 'carnal knowledge.' The mere touching of the vulva by the penis is carnal knowledge in the eyes of the law. The complete introduction of the penis into the vagina need not be proved, and still more is proof of emission unnecessary.

THE SIGNS OF RAPE.—From what has gone before, it is evident that there need be no signs whatever. If a girl be overawed by a threat and her vulva be touched by the penis, that is rape; and, if proved, is punishable as such.

On the other hand, the evidence of rape may be very convincing; for example:—

(*a*) The woman may have been heard to cry for help.

(*b*) There may be the signs of a struggle at the spot where the rape was alleged to have occurred.

(*c*) There may be damage to the woman's clothing, and bruises of various parts of her body—signs that she has been subjected to physical force.

(*d*) The genital organs may be found injured; the vulva bruised and perhaps bleeding; the hymen recently ruptured; and, in cases where the disparity in size between the man and woman is very great, rupture of the perinæum and mortal injuries to the vagina.

(*e*) Seminal spots may be found upon the woman's clothing, which is a certain proof of a previous 'intimate relation' with a male. Blood-spots also afford valuable evidence, but necessarily not so conclusive. Care must be taken not to confound menstrual fluid with blood.

The concurrence of all these signs would amount to certain evidence of forcible connexion. It must be borne in mind, however, that violence may be done to the female organs in other ways than by forcible connexion, and the medical examiner should be upon his guard against inferring too much from the evidence afforded. He also should be on the look-out for facts which may rebut assertions made by the woman. Thus, signs of a previous pregnancy or the evidence of previous venereal disease (scars in the groin, sores upon the pudenda, or symptoms of constitutional syphilis) may serve to disprove any assertions which might be made as to the woman's virginity or previous chastity. To *prove* whether or no a woman be '*virgo intacta*' is next to impossible, and we can only state the probabilities for and against. Such a question, however, is quite beside the mark in many cases of rape; but the presence of an unruptured hymen is an unlikely occurrence after forcible connexion. An examination of the person of the supposed ravisher may afford some corroborative evidence. Blood or recent seminal spots upon the linen or clothing, and injury to the person or clothing, all afford their quota of evidence of a sexual act combined with violence.

It is a matter of doubt whether the rape of a woman of fair size and strength be possible by an unaided man. If a woman be in the enjoyment of her faculties she is capable of offering an amount of resistance which would be well-nigh insuperable; and if she have offered a decent resistance, the person of the ravisher should bear evidence of it.

Rape, as we have seen, is most often committed on children of tender years. It is well to be on one's guard against error with regard to the rape of little children. It must have come within the experience of most members of the profession, and especially of those engaged in hospital practice, to have brought to them children suffering from a purulent discharge from the vagina, the mother at the same time alleging that some one must have violated the child. It must be borne in mind that purulent discharges from the vagina are not uncommon in ill-fed, dirty, scrofulous children; and that after some of the infantile acute specifics, sloughing of the pudenda is a rare, though recognised occurrence. The case of Jane Hampson, æt. 4, who died of sloughing of the genitals at Manchester in 1791, should stand as an incentive to caution in these matters. The signs were considered as those of defloration, and the coroner's jury returned a verdict of *murder* against the boy who slept with her; but luckily for the male child there occurred many other cases of sloughing of the pudenda in Manchester before he was brought to trial, and as the doctor who was called to Hampson recognised and acknowledged his error, the boy was discharged. It was at one time a popular belief that connexion with a virgin was a sure cure for venereal disease, and this has led, no doubt, to many cases of rape on young children. The presence of venereal disease in one or both of the parties may be of value as evidence. Its presence in the woman and not in the man affords a strong presumption against rape.

The finding of spermatozoa within the vagina is proof positive of connexion. But here, again, care must be taken not to mistake for spermatozoa the *trichomonas vaginalis*—a microscopic organism, not unlike a tadpole in shape, which has been described by M. Donné, as occasionally found in vaginal mucus. It must be remembered, also, that seminal fluid may contain no spermatozoa. Rape is occasionally effected with so much violence that death results. Ogston records the case of one Margaret Paterson, who was raped between Edinburgh and Dalkeith by two carters, who took her into their cart on the pretence of helping her on her journey. They forcibly held her down and repeatedly violated her person, and afterwards took stones from the road, coals, straw, prickly plants, &c., and forced them into the vagina. They then left her in a ditch, and she died in three days of her injuries. *Post mortem* the vagina and rectum were found lacerated and broken down into one passage, and the abdominal viscera in a high state of inflammation. The two carters were convicted and executed. This case does not stand alone, for it is an interesting fact that rape has not infrequently been accompanied by acts of violence which are not only brutal and senseless, but which appear to have no relation to sexual acts or feelings.

It has been doubted whether pregnancy can follow rape, but there seems to be no sufficient grounds for this doubt.

Duties of the Medical Examiner.—When called to a case of supposed rape, the medical examiner must remember to take note of every circumstance—the time that has elapsed since the alleged outrage, the mental state of the woman, her size and physical power as compared with that of the man, and evidences of a struggle in the surroundings of the woman, or on her clothing and person. He should keep his mind open to receive any facts which may throw light on the moral character of the woman. He should accurately take note of the exact condition of the genital organs and linen; should take possession of all stained linen for the purpose of chemical and microscopic examination; and should remove a portion of any discharge which may be found in the vagina for the same purpose. In drawing up a report, he should describe, as accurately and drily as possible, all facts which he may notice; and should be carefully upon his guard against drawing any undue conclusions from those facts. G. V. Poore.

RASH.—An outbreak of redness of the skin, or efflorescence; called by the Greeks an *exanthema*, or blossoming out. The word rash, or as it were 'rush,' conveys the idea of suddenness, whilst in reference to development it is generally extensive. The best illustrations of the rashes and of the meaning of the term are erythema, the red rash; roseola, the rose-rash; rubeola, the crimson rash, generally known as measles; scarlatina, the scarlet rash; purpura, the purple rash; and urticaria, the nettle rash.

RATIONAL (*ratio*, reason). **In conformity to reason.**—A term applied to the mental state; also to treatment when founded on scientific principles, in contradistinction to *empirical* treatment, founded solely on experience. *See* Consciousness, Disorders of; and Disease, Treatment of.

RAYNAUD'S DISEASE.—Synon.: Symmetrical Gangrene; Fr. *Gangrène Symétrique*; Ger. *Symmetrische Gangrän.*

History and Definition.—This disease was originally described by Maurice Raynaud in the year 1862, under the name of Symmetrical Gangrene. The diseased state, in its mildest form, he termed 'local syncope.' To more severe cases he gave the name of 'local asphyxia;' while a still more aggravated form of the malady was designated by him 'local' or 'symmetrical gangrene.' The stage of local syncope is accompanied by coldness and pallor of some portion of the extremities. This is popularly known as the 'dead finger' stage. In the second stage, that of local asphyxia, the same parts become not alone cold, but more or less cyanotic. They assume a bluish-black tint, as though stained with ink. In the third stage, that of local or symmetrical gangrene, actual mortification not infrequently ensues. Raynaud further showed that the various symptoms are to be ascribed to a spasmodic contraction of the arteries and arterioles.

Ætiology.—This disease may occur at almost any period of life. It is especially common amongst young children. In a series of papers published in the *Lancet* in July and August 1889, the writer referred to 93 cases which he had collected and analysed. The youngest subject of the disease was two and a half and the oldest fifty-nine. Of the 93 cases, 54 were females and 39 males. The disorder, therefore, is more prevalent among women than among men. These tables further show that a large proportion of the sufferers were young children, 24 of the 93 being under ten years of age. In early life also the cases often assume a singularly acute and malignant form. Indeed, in some instances, the child has died in from thirty to forty hours, the progress of the disease being continuous from bad to worse; no paroxysmal attacks occurring at any time. According to Raynaud, females between the ages of eighteen and thirty are particularly liable to be affected. This opinion is not supported by the statistics above referred to. From them it appears that the disorder is pretty equally distributed between the different decades of life; though, as already stated, it is especially prevalent among the young. Indeed, in no fewer than 13 cases, the age of the patient ranged from two and a half to five years; in 11, from five to ten; in 15, from ten to twenty; in 16, from twenty to thirty; in 15, from thirty to forty; in 13, from forty to fifty; and in 10, from fifty to sixty. Raynaud considered suppression or irregularity of the menstrual functions a frequent exciting cause of symmetrical gangrene; but this opinion is only partially confirmed by subsequent writers. Cold certainly is a very powerful factor in exciting the attacks; indeed, the great majority of cases are directly referable to the effects of cold, and occur far more frequently in winter than in summer. Still, well-authenticated cases have been recorded where paroxysms of the disease proved especially severe even during the hottest weather. Sudden emotion and mental shock have in some instances excited an attack. It further appears that a considerable number of those who have suffered from Raynaud's disease may be looked upon as hysterical, emotional, and excitable persons, in whom the neurotic element is highly developed. Indeed, there is every reason to believe that the unstable equilibrium of the nervous system is a potent predisposing factor in the pathogenesis of the disease.

Symptoms. - In a typical case, observed by the writer, the symptoms commenced by a tingling sensation in the fingers and in the ears, which burned and itched as though they had been stung by nettles. The tingling was succeeded by icy coldness in the parts affected. The patient noticed at the same time that tactile sensation in his fingers was altogether lost. If he attempted to pick up any small object he was not conscious of holding it, unless his eyes were actually fixed upon it. This extreme coldness in the fingers lasted for five or six weeks; the parts felt icy to the touch, and looked white and bloodless. They were constantly blanched, and did not resume their natural tint. All the digits of both hands were affected. The thumbs also suffered, the nails being markedly exsanguine. Here was illustrated the stage of local syncope. After remaining white for about six weeks, the fingers assumed a bluish shade; they became cyanotic, and in the course of a few days turned black, as though dipped in ink. The nails also remained bluish-black. With this change in their colour, the parts grew painful. So long as they remained white, they merely felt numb; but in proportion as the dark shade became more pronounced, so was the pain more severe. The cyanotic tinge occupied nearly the whole of the phalanges of the several fingers, the digits of the right hand also being symmetrically affected. Soon after the fingers became blue, the ears also assumed a similar shade. The tip of the nose likewise was of a bluish-black tint, while the alæ nasi on each side looked purple and congested. Here local syncope was succeeded by local asphyxia. In the course of a few days a further change was noticed. The skin, over the black portion of the fingers, more especially over the bulbs, separated from the parts beneath, and was cast off in small sloughs. It was then seen that the derma was extensively destroyed; its surface looked honeycombed, numerous little ulcers eroding the deeper tissues. A few days later a portion of the helix of the right ear sloughed away, the cartilage being at the same time destroyed. Here the well-marked features of symmetrical gangrene were characteristically developed. In still more severe cases the progress of the mortification is far more rapid. The affected parts are frequently covered with beads of sweat; a large slough forms, and a finger, or even whole segments of limbs, may mortify and separate. The lesions of the nervous system are very numerous; indeed, the brain, spinal cord, sympathetic system, and peripheral ganglia, may be severally, or together, involved. Hence it is reasonable to expect that the symptoms should prove proportionately varied and uncertain, and that in one case a terminal phalanx of a single digit may be alone affected, while in another a whole limb may be rapidly destroyed and cast off as a lifeless mass. In many characteristic cases, not alone are the fingers, toes, ears, and nose simultaneously attacked, but also other portions both of the trunk and of the limbs; parts, in fact, in which each side of the body has its corresponding counter-part on the opposite side, are at the same time involved. These patches have been observed over the heels, over the calves, and over the tibiæ. In several cases the nates have been affected; in others the cheeks and the mammæ. Raynaud speaks of the coccyx being occasionally implicated; and in one curious case the tip of the tongue felt numb, and turned a bluish-black colour.

Associated Diseases. — Numerous observers have referred to the fact, now well-established, that in a considerable number of cases intermittent hæmoglobinuria is associated with symmetrical gangrene. Indeed, occasionally a well-marked attack of hæmoglobinuria may occur instead of a paroxysm of local asphyxia, or, as not unusually happens, a patient suffering from symmetrical gangrene may at times pass urine more or less bloodstained and dark. But, closely allied as these two affections admittedly are, important points of distinction may still be noted between them. In the first place, hæmoglobinuria is, in the majority of cases, accompanied by far more grave constitutional symptoms than are usually observed in cases of symmetrical gangrene. In the latter disease, even though the extremities are gangrenous, the sufferers often look remarkably healthy and vigorous. The subjects of hæmoglobinuria, on the other hand, are usually spoken of as sallow and cachectic. Among them disturbances associated with the abdominal organs, such as pain and tenderness at the epigastrium, irritability of the stomach, feelings of nausea or actual vomiting, are often observed. Then, again, not a few of the sufferers from hæmoglobinuria have experienced attacks of malarial fever; in symmetrical gangrene this complication is comparatively rare. And lastly, while Raynaud's disease is seen most frequently among females, hæmoglobinuria prevails to a far greater extent among males.

Various skin-affections not infrequently are associated with attacks of local asphyxia and gangrene. In some cases patches of subcutaneous mottling; in others a peculiar marbling of the surface; in others, again, urticaria; in others an eruption of wheals or chilblains; in others, well-marked scleroderma of various parts of the body, have been described as occurring with more or less frequency. In several instances (10 out of 93) syphilis, either acquired or congenital, has been noticed. In one case seen by the writer many of the symptoms characteristic of tertiary syphilis were at times replaced by those changes in the extremities which constitute a distinguishing feature of Raynaud's disease; while both the syphilis and symmetrical gangrene eventually disappeared under the use of antisyphilitic remedies. Although peripheral neuritis has, in a considerable number of instances, been noted by competent observers as occurring in these cases, still there are reasons for believing that it cannot be looked upon as an essential factor in the pathogenesis of this disease. In the great majority of instances, the lesions undoubtedly are symmetrical; still, a symmetrical distribution of the patches is by no means universal; indeed, in 8 out of 93 cases no traces of it could be discovered.

Pathology and Morbid Anatomy.—The conclusion at which Raynaud arrived, that the disease is due to a spasmodic contraction of the arteries and capillaries in certain parts of the body, has been fully confirmed by subsequent authorities. We must assume that a sensation, as, for example, of cold, is transmitted by the sensory nerves to an excitomotor centre in the cord, and from that centre a stimulating influence is reflected along the vascular nerves, which causes the vessels to contract. Raynaud proved that there could be no actual obstruction within the arteries, due either to arteritis or to mechanical closure, because injections made in corpses penetrated readily into the parts affected by gangrene. He further showed that the change was not to be ascribed to any congenital or acquired narrowing of the arteries; that it was not dependent on embolism; and was in all respects distinct from the gangrene of diabetes mellitus and ergot of rye; and he strengthened his views regarding the nature of the affection by his observations on the narrowing and constriction of the arteries in the retina, which he observed in a remarkable case of symmetrical gangrene which came under his care in the month of April 1872. But the question naturally arises, What are the portions of the vascular system which are more especially affected in symmetrical gangrene? Some authorities consider that the arterioles are alone involved; others maintain that the capillaries also are spasmodically contracted; while others assert that the process may be solely confined to the veins. A study of the phenomena which accompany the disease seems to show that in local syncope, when the ischæmia is extreme, arteries, capillaries, and venules are alike affected by the spasmodic constriction, and are all contracted. After a time, however, when local syncope is succeeded by local asphyxia, the veins, to which the muscular elements are more sparingly distributed than to the arteries, are the first to dilate, the latter remaining impervious. In a still later stage of the disease we observe changes similar to those with which Cohnheim has made us familiar, when the terminal arteries are closed by an embolus, venous blood unsuited to the nutrition of the parts regurgitating from the veins into the capillaries and arterioles, and setting up in the tissues supplied by them more or less destructive changes. In these cases true mortification may occasionally ensue.

Diagnosis.—Symmetrical gangrene is thus distinguished from senile gangrene. It is usually symmetrical, and occupies two similar extremities, or all four at the same time. The nose and ears also are often similarly affected. Senile gangrene, on the other hand, almost invariably attacks a single limb, generally one of the lower extremities. Further, senile gangrene mostly invades the deeper parts; symmetrical gangrene is more frequently confined to the skin and the contiguous parts. In senile gangrene the arteries are hard and atheromatous; in symmetrical gangrene the pulsation and coats of the vessels are generally normal. Senile gangrene also is, as its name implies, essentially a disease of the old. In Raynaud's disease, the average age of 93 sufferers was about twenty-six. In gangrenous ergotism the constitutional symptoms are, as a rule, far more severe than in symmetrical gangrene. At the same time, the latter disease is more frequently observed among women, while the gangrene of ergot is rare among females; and, further, in this disease the upper extremities are but seldom involved.

Prognosis.—Considering the severity of the symptoms, in many cases of symmetrical gangrene the mortality is considerably less than might have been anticipated; still, it appears from the tables to which reference has been made that in 15 out of 93 cases the patients died while under medical observation. Several of these deaths, however, were attributed to phthisis, or some intercurrent attack of disease. Many of the deaths also occurred amongst young children, in whom the intensity of the symptoms is very marked.

Treatment.—Raynaud entertained a very high opinion of the value of galvanism in these cases. Electricity was, in his practice, usually employed for ten minutes or a quarter of an hour daily, descending currents being always recommended. The positive pole was applied over the spinous process of one of the lower cervical vertebræ, while the negative pole was placed over the lumbar region. In his hands the success of this mode of treatment seems to have proved very remarkable. Other writers recommend that the affected hand or foot be immersed in a basin of hot water, in which the negative electrode is placed, while the positive is applied over the spine or the upper part of the limbs. At the same time, it is advisable that persons suffering from paroxysmal attacks of any stage of Raynaud's disease should be, as far as possible, protected from cold, by having their extremities swathed in cotton-wool and enveloped in flannel. In very severe cases the patients should even be confined to their beds. Where a syphilitic taint is suspected, recourse must be had to mercury and iodide of potassium; in cases complicated by ague, quinine has in several instances proved useful; in the more chronic forms of the affection, where the joints are implicated, massage may be expected to prove beneficial. In other cases, where pain is the most characteristic symptom, the subcutaneous injection of morphine, especially when combined with atropine, has, in the writer's experience, given more relief than any other remedy. Belladonna, nitrite of amyl, and nitroglycerine, drugs which induce dilatation of arteries, though occasionally prescribed, have, on the whole, proved disappointing in their effects.

John Edward Morgan.

REACTION.—When any substance or influence affects the organism sufficiently to cause appreciable physiological disturbance within it, it is said to have a *physiological action* upon the body; or, more briefly, to *act* or to have an *action* upon it. If the effect of such an influence have been well-marked, the organism does not always return to the original or ordinary condition, or to what is called the 'physiological balance,' with the cessation of the influence; but may pass beyond it into a state characterised by phenomena which are, speaking broadly, the opposite of the former. The condition which is thus the effect or outcome of the *action* is called the *reaction*; and the same name is also given to the *process* by which the primary effect passes into the secondary. The cold bath furnishes a familiar illustration of physiological action and reaction. The contraction of the superficial vessels, the pallor, the sensation of intense cold, and the fall of temperature, which are the immediate effects of the cold bath, are speedily replaced by such exactly opposite phenomena as dilatation of the cutaneous vessels, flushing of the skin, a warm glow, and a rise of temperature; and in the same way the primary nervous stimulation gives way to a feeling of general calmness and comfort. It is usually found that the phenomena of action and reaction are in direct proportion to each other, unless the action be excessive, in which case reaction may not set in. In other instances the irritability or excitability of the organism, whether as a whole or in part, may be either unnaturally increased or unnaturally diminished, and the reaction be either *excessive* or *imperfect* accordingly.

Excessive emotional excitement, whether pleasurable or painful in nature, such as joy or fear, may similarly be followed by corresponding depression, by prostration, or even by death. In the reaction which follows severe injuries, especially when they are met with under circumstances of intense fear—for example, in railway accidents—both the bodily and the mental functions, so called, are simultaneously involved.

The effects of reaction are also illustrated *locally* in the condition of wounds. Local reaction takes the form chiefly of inflammation, and is carefully studied by the surgeon, who finds in it a ready means of estimating the severity of an injury; the vigour of the system generally, and of the affected part; or, it may be, the value of some particular kind of treatment.

Treatment.—Reaction may itself call for treatment when it is either imperfect or excessive. Stimulation is demanded in the former case—for instance, by warmth, alcohol, or ammonia. When reaction is excessive, nervous and circulatory sedatives are equally indicated.

J. Mitchell Bruce.

RECEPTACULUM CHYLI, Diseases of.—The receptaculum chyli is the dilated portion of the absorbent system forming the commencement of the thoracic duct, which receives the contents of the lacteal vessels, and of the lymphatics of the lower limbs and abdomen. It lies deep in the abdominal cavity, about the level of the first lumbar vertebra. The only morbid conditions which need be specially noticed in connexion with this structure are *dilatation* and *rupture*. The receptaculum chyli has been found in rare instances enormously dilated, and its walls thickened. It has also been known to burst as a result of this dilatation, with the escape of its contents into the peritoneal cavity, fatal peritonitis being thus set up. It would be quite impossible to diagnose or treat these conditions during life, and they have only been discovered on *post-mortem* examination.

Frederick T. Roberts.

RECOARO, in the Province of Vicenza, in Italy.—Chalybeate waters. *See* Mineral Waters.

RECRUDESCENCE (*re-*, again; and *crudesco*, I become fresh).—The increase or exacerbation of a disease or morbid process, after a temporary diminution; for example, of fever or inflammation.

RECTUM, Diseases of.—Synon.: Fr. *Maladies du Rectum*; Ger. *Krankheiten des Mastdarms.*

The diseases of the rectum may be conveniently discussed in the following order: (1) Congenital Imperfections; (2) Fistula in

Ano; (3) Cancer; (4) Polypus; (5) Prolapse; (6) Non-Malignant Stricture; and (7) Ulceration. Other diseases connected with the rectum will be found discussed under special headings. *See* ANUS, Diseases of; DEFÆCATION, Disorders of; HÆMORRHOIDS; and STOOLS, Characters of.

1. **Congenital Imperfections.**—Malformations of the rectum may be classed as follows: (1) Imperforate anus, without deficiency of the rectum. (2) Imperforate anus, the rectum being partially or wholly deficient. (3) Anus opening into a *cul-de-sac*, the rectum being partially or wholly deficient. (4) Imperforate anus in the male, the rectum being partially or wholly deficient, the bowel communicating with the urethra or neck of the bladder. (5) Imperforate anus in the female, the rectum being partially deficient, and communicating with the vagina. (6) Imperforate anus, the rectum being partially deficient, and opening externally in an abnormal situation by a narrow outlet. (7) Narrowing of the anus. These imperfections can be remedied either partially or completely by surgical operations.

2. **Fistula in Ano.**—DESCRIPTION.—The loose areolar tissue around the lower part of the rectum is occasionally the seat of abscess, which bursts externally near the anus (*see* PERIPROCTITIS). But instead of the part healing afterwards, like abscesses in other situations, the walls contract and become fistulous, and the patient is annoyed by a discharge from the opening. On introducing a probe it may pass through a small opening in the coats of the rectum into the bowel. The case is then called a *complete fistula.* When there is only one aperture, either mucous or cutaneous, the term *incomplete fistula* is used. The external orifice is usually near the anus, the internal between the two sphincters. The abscess before bursting may have burrowed to some distance, and the external orifice may be situated in the direction of the buttock or perinæum. Fistula in ano arises in several ways. It commonly originates in an abscess in the ischio-rectal fossa, the anatomical condition of the parts not favouring closure after the pus has escaped. An ulcer just within the external sphincter sometimes perforates the bowel, allowing the escape of fæculent matter into the areolar tissue, and thus leads to abscess. Ulceration induced by a pointed foreign body, as a fish-bone, may also induce a rectal abscess. Fistula is common in the late stages of rectal cancer. Fistula occurs also in phthisical subjects, owing to tuberculous mischief in or around the rectum. This tuberculosis may be primary or secondary, and in the discharge from such fistulæ the bacillus of tubercle has been found. The inner opening is sometimes found higher up the bowel, and there may be more than one, the sinuses being complicated.

An anal fistula is an annoying complaint. The patient is troubled with a discharge which stains the linen, and with the escape of flatus. Attacks of inflammation and suppuration are common, and the trouble produces often great mental depression, and much constitutional disturbance. Fistula is a disease of middle life, more common in men than in women.

TREATMENT.—The cure of fistula in ano is by a surgical operation.

3. **Cancer.**—Cancer of the rectum is common; appears with about equal frequency in males and females; and is an affection of middle life or old age. The form of cancer is that known as cylindrical epithelioma or adeno-carcinoma.

It corresponds with the squamous epithelioma of other parts, and the most conspicuous feature is the infiltration of the submucous and muscular coats with adenoid growth. Scirrhus cancer is not met with in the rectum. The growth may appear as a tuberous mass springing from one side of the rectum, and more or less occupying its lumen; or it may assume the aspect of a laminar deposit in the rectal walls; or may take the form of an annular growth. The deposit tends to narrow the bowel, and is disposed to early ulceration. The growth may invade and open the vagina, urethra, or bladder, and is in time attended with glandular enlargements. Malignant disease may attack any part of the bowel, but generally appears in the lower part, within three inches of the anus. It is liable also to affect, though less frequently, the point where the sigmoid flexure terminates.

SYMPTOMS.—The disease generally commences insidiously. Its early symptoms are often similar to those of simple stricture, and the real disease is usually not detected until a considerable change has taken place in the condition of the bowel. The patient is troubled with flatulency; has difficulty in passing his motions; and as the disease progresses, experiences pains about the sacrum, which gradually increase in severity, and dart down the limbs. The stools become relaxed and frequent; contain blood; and in passing cause a scalding pain. Often also there is a thin offensive serous discharge. The first symptom complained of may be an obstinate diarrhœa. Loss of retentive power may ensue, from destruction of the sphincter, or of the nerve supplying the muscle. As the disease advances the patient loses flesh, and exhibits the blanched, sallow look, anxious countenance, and emaciated appearance commonly observed in persons suffering from malignant disease. In consequence of communications established with the neighbouring passages, liquid fæces may escape from the urethra in the male and vagina in the female; and at length the patient becomes exhausted by this painful and distressing malady. Complete obstruction may occur, and accelerate the fatal termination. There is great variety in the degree of suffering, and of constitutional derangement. The pains are in some instances excruciating, in others very slight. If the growth can be reached by the finger, it will be found to present a hard, nodular, uneven, and ulcerated surface, and to become soon fixed.

Treatment.—Little can be effected by remedies in this terrible disease, beyond palliation of the symptoms, and ease from pain. The general health may be supported by tonics. The motions must be kept soft by medicines or by injections, and pain must be alleviated by narcotics, such as morphine given in suppositories or by subcutaneous injections. Local applications of cocaine answer well in some cases. The diet must be carefully regulated so that as little *débris* as possible is left in the intestine, and the bowel should be frequently irrigated with some antiseptic injection. In cases of obstruction, as well as in cases of severe suffering, life may be greatly prolonged by colotomy. Excision of the diseased bowel has also been resorted to, but not with much success.

4. **Polypus.**—Polypus of the rectum may be conveniently considered under three headings: (1) *The soft polyp or adenoma.* (2) *The firm polyp or fibroma.* (3) *The villous polyp or papilloma.* They are all innocent growths.

Description.—(1) The *soft* polypus is a true adenoma, with a network of small vessels ramifying in it, and a peduncle which varies in length. The polypus is usually single, but several may exist. In children it usually makes its appearance at the anus after a stool, resembling a small strawberry, being soft in texture, granular on the surface, and of a red colour. It has a narrow pedicle, about the size of a crowquill, attached to the wall of the rectum, as a rule about two inches from the anus. It produces no suffering, but causes a slight bloody discharge, some tenesmus, and a sense of a foreign body in the bowel. It is the commonest form of polyp.

(2) The *hard* or fibrous polypus occurs in adults, is of a pear-shape, and has a peduncle more or less long and thick. It seldom bleeds, but occasions a slight mucous discharge; and when the peduncle is long, the growth protrudes at the anus after stool. It is uncommon; and is due to a fibrous growth in the submucous tissue.

(3) The villous polyp is a pure papilloma developed from the mucous membrane of the rectum. It is soft in structure, presents the usual appearance of a papilloma, may have a pedicle, but is usually sessile. It is rare, is met with in adults, and is innocent. It gives rise to considerable bleeding, and usually to a mucous discharge, and the symptoms of a foreign body in the bowel.

Treatment.—The treatment is usually very simple, and involves an operation of small magnitude.

5. **Prolapse.**—In relaxed states of the sphincter muscle and coats of the bowel, loose folds of mucous membrane are liable to protrude, and require replacement. This protrusion and exposure of thickened mucous membrane, with or without internal hæmorrhoids, has been described as partial prolapse of the rectum. In the true or complete prolapse there is much more than an eversion of the lining membrane of the bowel. The gut is inverted; there is a 'falling-down' and protrusion of the whole of the coats—a change analogous to intussusception, but differing from it in the circumstance that the involved intestine, instead of being sheathed or invaginated, is uncovered and projects externally. In the majority of instances the prolapse, even when extensive, concerns the mucous membrane only.

Ætiology.—Prolapse is observed generally between the ages of two and four, but may occur later in life. In infancy it may be produced by protracted diarrhœa or by worms. The straining efforts to pass water in stone in the bladder also give rise to this affection in young subjects. In adults the descent results chiefly from a weakened condition of the sphincter and levator ani muscles. It is more common in women than in men, arising in the former from the parts being weakened in child-bearing. It may follow also upon dysentery, upon conditions producing straining, and upon rectal polyp. Young subjects generally outgrow this complaint by the period of puberty; and common as is prolapse in early life, it is rare in young adults.

Description.—The length of bowel protruded varies from an inch to six inches or even more. When not of any great length, the protrusion forms a rounded swelling which overlaps the anus, at which part it is contracted into a neck. In its centre there is a circular opening communicating with the intestinal canal. An inversion of greater length forms an elongated pyriform tumour, the free extremity of which is tilted forwards or to one side. The protrusion may present the usual florid appearance of the mucous membrane; or a violet livid colour from congestion, consequent upon contraction of the sphincter. The mucous surface is often thickened and glandular, and sometimes ulcerated from friction against the thighs and clothes. Thickening of the coats of the bowel accounts for the difficulty in reducing the parts, and in keeping them reduced afterwards, a trouble so often experienced in the treatment of these cases in children, the bowel being too large to be conveniently lodged in its natural position, and, like a oreign body, exciting the action of expulsion. An atonic or relaxed state of the sphincter muscle is shown by the facility with which one or two fingers can be passed through the anus even in young children.

Treatment.—In children irritability of the bowels and diarrhœa must be checked, and disordered secretions corrected by suitable remedies. In slight cases it will be sufficient to direct the nurse by steady compression to press the protrusion back within the sphincter. The relaxed state of the membrane may be treated with astringent injections of alum, or with a solution of tannic acid in glycerine, or with hamamelis. If the bowel slips down when the child moves about, rest must be insisted on. When the exposed surface is ulcerated, it may be painted with a solution of nitrate of silver, 20 grains to the ounce. The patient should be made to relieve the bowels in the recumbent posture. In adults, if no relief follows the removal of the apparent cause, the regulation of the bowels, rest, and the use of astringent applications, the complaint may be remedied by operation.

6. **Non-Malignant Stricture.**—Non-malignant stricture of the rectum is usually due to the development of cicatricial tissue, and has followed injuries, suppuration, dysentery, syphilis, and tubercular mischief. Mr. Cripps has shown that long-continued muscular spasm may play an essential part in the production of stricture.

Simple stricture is met with in adult life, is more common in women than in men, and is usually situated within three inches of the anus. The stricture may be *annular* or ring-like; or the obstruction may assume a *valvular* form; or a large part of the length of the bowel may be involved, producing a *tubular* stricture. The mucous coat above the stricture may be ulcerated. Often ulcerated apertures lead to fistulous passages, extending some distance, and opening externally near the anus or in the buttock, and, in women, in the vagina.

Symptoms.—The earliest symptom is habitual constipation, with difficult defæcation when the motions are solid. As the contraction increases, the constipation becomes more obstinate, and the stools are diminished in calibre, and are often voided in lumps. A brown slimy fluid escapes with the motions, and there is a burning sensation after stool, and flatulent distension of the colon. As the disease makes progress and ulceration ensues, the discharges become purulent and bloody, and the sufferings are much increased. There is sometimes so copious a discharge as to mislead the practitioner, the stricture being overlooked, and the case treated as one of protracted diarrhœa. The appetite may remain good, and the general health may be but little impaired; but in the course of time the derangement of the digestive functions, the irritation kept up by the disease, and the exhausting discharges, bring on symptoms akin to hectic. The appetite fails, the body emaciates, the abdomen becomes more distended, and the stricture directly or indirectly proves the cause of death. This is sometimes hastened by a lodgment of hardened fæces or some foreign body just above the stricture, so as to block up the passage, and occasion all the symptoms of intestinal obstruction. In patients with stricture small flattened excrescences are often observed at the margin of the anus. These cutaneous growths resemble collapsed external piles, except that they are redder in colour, and are kept moist by the escape of an irritating discharge from the bowel. Compared with cancer, the progress of the disease is very chronic, the edge of the stricture is hard and ridge-like, ulceration is absent or at least is not marked, induration is slight, there is less bleeding, and less fixity of the part.

A stricture in the lower part of the rectum can be easily detected by the finger. It must be borne in mind that the bowel is liable to be obstructed by disease of the neighbouring viscera—an enlarged or displaced uterus, fibrous tumours of this organ, an ovarian growth, pelvic hæmatocele, excessively hypertrophied prostate, or hydatid tumour between the bladder and rectum.

Treatment.—The main object in treatment is to dilate the contracted parts sufficiently for the free passage of the motions; and this is to be effected by mechanical means—by the frequent passage of bougies, or the occasional use of special dilating instruments. Means must also be adopted to relieve the irritability of the part, and to ensure the regular passage of soft evacuations. Cocaine, belladonna, or morphine suppositories at bedtime, properly selected aperients, careful dieting, and the daily washing out of the bowel, are the remedies required. In old inveterate strictures, wearing out the patient's strength, colotomy may be recommended.

7. **Ulceration.**—The chronic ulcers met with in the rectum are the following: The *tubercular*, the *syphilitic*, the *dysenteric*, those due to *injury* or *suppuration*, the *hæmorrhoidal*, which has the same pathological basis as the varicose ulcer of the leg, and the *follicular*, which involves the solitary follicles of the part. *Lupus* is also met with in the rectum, producing the destructive ulcer known by the French as *l'esthiomène*. It is merely an advanced form of the tubercular ulcer.

These ulcers have the physical characters of like ulcers met with elsewhere. The tubercular ulcer is very apt to perforate. The chief symptoms are a purulent discharge from the anus; motions loose and mixed, or coated with a slimy fluid and streaked with blood; soreness in defæcation;

and occasionally tenesmus. The characters, position, and extent of the ulceration can be ascertained by examination with the finger and with the speculum. The examination, to be satisfactory, must be conducted when the patient is anæsthetised.

Treatment.—The treatment depends on the nature and extent of the disease, and upon the constitutional condition of the patient. In severe cases the patient should be kept in the recumbent position, and the diet should be regulated. An exclusively fluid diet may be desirable in some cases. The bowels must be attended to. The local treatment consists of antiseptic or astringent injections or ointments. Weak solutions of nitrate of silver are of value, as are also injections of bismuth mixed with starch. Iodoform or other ointment may be applied by means of an ointment introducer.

T. B. Curling. Frederick Treves.

RECURRENT DISEASES. — Diseases which have a tendency to return after their actual or apparent cure or removal, either without any obvious cause, such as cancer or ague, or from some very slight cause, such as gout or rheumatism.

RECURRENT INSANITY. — *See* Insanity, Varieties of.

RECURRENT LARYNGEAL NERVE, Diseases of. — *See* Pneumogastric Nerve, Diseases of.

RED GUM.—*See* Strophulus.

REDUPLICATION.—A doubling. A term generally used in reference to the sounds of the heart. *See* Physical Examination.

REDUX (Lat., returned).—A term signifying the return of certain physical signs, after their temporary disappearance in the course of a disease; usually associated with crepitation in pneumonia, and with friction in pleurisy and pericarditis. Redux signs are, as a rule, significant of a favourable tendency in a disease. *See* Physical Examination.

REFLEX DISORDERS.—These constitute a very varied group of affections, most of which are individually considered in separate articles. But it will be useful here to say a few words concerning them as a group, in order that the mutual relations of many apparently discordant conditions may thus be set forth, from the point of view of their origin or pathogenesis.

Pathology.—The factors concerned in the production of a reflex disorder are in kind those which are needful for the production of a 'reflex action'—though in the former case such causes act for an inordinately long time, or else with an intensity which is altogether unusual. In each case we must have (*a*) afferent impressions resulting from the influence of a foreign body or a pathological state (such as inflammation or ulceration), acting as an irritant upon *afferent nerves*, either in some part of their course, or in their peripheric sites of distribution—whether such sites be situated upon the external surface of the body, or upon some part of one or other of the mucous surfaces within the body. Thus it happens that the determining cause may in some cases be associated with painful impressions, though in many other instances such impressions may be more or less completely absent. Occasionally mental emotions may take the place of peripheric impressions, as inciters of abnormal reflex phenomena.

The next essential factor (*b*) is that the afferent impressions (painful or non-painful) produced by the irritant or pathological state, should pass from the nerves, conveying them through a related *nerve-centre*, which, from one or other cause, chances to be in a state of exalted activity; and thence (*c*) be reflected along one or other set of *efferent nerves*, so as to produce effects of this or that order.

Varieties.—As efferent nerves are distributed to glands, and to muscles (both involuntary and voluntary), reflex phenomena may show themselves in one or other of two principal directions—that is, (1) by the modification of the quantity or quality of some *secretion*, or (2) by the production of spasmodic contractions in certain *muscles*, either (*a*) of the involuntary or (*b*) of the voluntary type. In these ways, multitudinous and varied effects are apt to be produced on different occasions, as may be gathered from the following brief illustrations.

1. *Modified secretions.*—The morbid effects belonging to this class of reflex disorders show themselves, for the most part, by a diminution rather than by an increase in the amount of the secretion of the gland whose functions are affected, as when irritation of some of the abdominal nerves leads to a suppression of the renal secretion, by setting up some form or mode of inhibitory influence. The action of cold upon the external surface of the body in producing an increased secretion of urine, is probably brought about by an augmented determination of blood to the kidneys, and not as a simple result of reflex action. The mental conditions of anxiety, fear, or terror do, however, often lead to an increased secretion of urine; and the increased secretion in these cases may be brought about by simpler and more purely reflex influences. Again, precisely the same mental states may lead to an arrest of the salivary secretion, as well as to such an increase of the intestinal secretions as to produce loose evacuations or actual diarrhœa. Other instances might be included under this head, but they are all of them phenomena the precise mechanism of which is comparatively obscure. Still in each case the mode

of production of the phenomena would seem to conform to the type indicated.

2. *Muscular spasms.*—The morbid effects belonging to this second class of reflex disorders are also variable in their occurrence, and more or less uncertain as regards their precise mechanism. Referring first of all (*a*) to the reflex spasms induced in involuntary muscles, it may be said that reflex spasms set up by some contiguous source of irritation are met with not infrequently in the urethra and neck of the bladder, in the sphincter of the vagina, or at the commencement of the œsophagus. They may also occur in the bronchi (as in asthma), or in portions of the intestinal canal (colic); likewise in the ureters or in the gall-ducts, during the passage of calculi along either of them.

As an instance of a spasm engendered in involuntary muscular fibres, under the influence of a mental emotion or state, rather than a peripheric irritation, one may cite the sudden contraction of the uterus in certain cases of abortion induced by fright, anger, or other powerful mental emotion. Again, acts of vomiting are produced occasionally by certain sights or odours.

On the other hand, tonic spasms of a reflex character chiefly occur in (*b*) the voluntary muscles (especially in children or in females of a nervous temperament), in the form of contractions of some of the muscles of the extremities, though at other times the muscles of the jaw or some of the muscles of the neck may be the parts involved. *See* SPASM.

Of infinitely more importance, however, are the multitudinous cases in which some sources of irritation, either within or on the surface of the body, occasion, in various more or less obscure ways, through the intervention of the great encephalic centres, convulsions or fits of one or other variety (*see* CONVULSIONS; and EPILEPSY). Here we have, as a result of the peripheric irritation, a whole series of spasms, partly tonic and partly clonic in character. It is worthy of note, too, that an irritant at the surface of the brain, in certain regions, is just as potential as an irritant acting upon the mucous membrane of the intestine.

But another class of reflex muscular spasms still remains, to which an immense amount of importance is attached by some pathologists, namely, those which are brought about through the agency of vaso-motor nerves acting upon the contractile walls of blood-vessels. It is well known that under the influence of direct irritation, vaso-motor nerves may cause small arteries and arterioles to contract to an extreme degree, and that this condition is apt to be followed by one of extreme dilatation of these same vessels. It is known also that under the influence of emotions the calibre of the vessels in certain parts of the body is apt to vary greatly. Of this we have examples in the temporary pallor of the countenance produced by fright, and in the suffusion of the face and neck, from unnatural fulness of vessels of these parts, in the act of blushing. On the other hand, it has been assumed that, as a result of some abiding irritation in the intestine, in the bladder, or in other parts, reflex contractions of the arterioles in certain regions of the spinal cord (also of an abiding character) may be brought about, so as more or less completely to annul the functions of this particular portion of the cord, and thereby to lead to paralysis of the lower extremities – that is, to paralysis of the limbs chiefly in relation with the region of the cord affected. This is the generally assumed mode of production of a so-called 'reflex paralysis.' Others, however, imagine that, in certain cases at least, such a paralysis may be brought about differently—not by the reflex action producing a spasm of vessels in a part of the spinal cord, but by a spasm of the vessels supplying the great nerves and muscles of the limbs affected. The anæmia, thus supposed to be induced in either case, is regarded as the cause of an ensuing paralytic condition. But the question as to the probability of the existence of 'reflex paralysis' need not be here discussed, since the arguments for or against the existence of such a paralysis which are applicable to one form of it are applicable also to another, and these are set forth in the article SPINAL CORD, Special Diseases of: 28. Reflex Paraplegia.

It does not seem to be imagined by anyone that a local irritation is capable of engendering a condition of paralysis by any direct inhibitory process. The intervention of altered conditions of vaso-motor nerves and of altered states of vessels seems to be postulated by all. Yet some such direct influence may, perhaps, be more possible in those related cases in which the starting-point or primary cause of paralysis is a mental state rather than a peripheric irritation—that is, in the ætiologically obscure cases described by Dr. Russell Reynolds as *Paralysis dependent upon Idea.* *See* SPINAL CORD, Special Diseases of.

It is right here, also, to mention a class of phenomena which have some analogies to reflex disorders, that is, the numerous cases in which, as a consequence of irritation in one or other region, *pain* is felt in some more or less distant part of the body, as when a stone pressing upon the neck of the bladder causes severe pain at the meatus urinarius, or when disease of the stomach or of the liver causes a pain which is felt in the scapular region.

H. CHARLTON BASTIAN.

REFLEXES, Spinal. — *See* SPINAL CORD, Diseases of.

REFRACTION, Disorders of.—*See* Vision, Disorders of.

REFRIGERANTS (*refrigero*, I cool).—Definition.—Remedial agents which lower the body-heat, either in health or in disease; or which allay thirst, and impart a feeling of coolness.

Enumeration.—The chief refrigerants are: The whole class of Febrifuges; Water; Ice; Effervescing drinks; Acidulated drinks; and the juices of Fruits.

Action.—As the name implies, anything may be ranked as a refrigerant which lowers the body-temperature, and we may here consider in how far the drugs described under Febrifuges have the property of cooling down the healthy organism. Quinine and alcohol have but a slight and transient lowering effect, and salicylic acid has none at all; and this is readily explained, if we believe that their antipyretic properties in fever depend on their destructive influence over the protoplasm or products of septic ferments.

Refrigerants, however, are popularly held to be those drugs which relieve the thirst of the fever-stricken patient, by moistening his dry lips and cooling his parched tongue. Ice or iced drinks manifestly fulfil these indications; and acids well diluted, which are often the most grateful of all, act very efficiently by directly stimulating the salivary secretion.

R. Farquharson.

REGIMEN (*rego*, I govern).—This word is not uncommonly used as synonymous with hygienic management. In a more restricted sense it is applied to the regulation of diet, both in health and disease. *See* Diet; and Personal Health.

REGURGITATION (*re-*, again; and *gurgito*, I swallow).—This word is technically applied to the reversal of the natural direction in which the current or contents flow through a tube or cavity of the body. Thus the food may regurgitate from the stomach into the œsophagus and mouth; the bile from the duodenum into the stomach; and blood from the aorta or pulmonary artery into the ventricles, from the ventricles into the auricles, or from the heart into the veins, when the respective valves are incompetent. *See* Heart, Valves and Orifices of, Diseases of; and Rumination.

REHME (Oeynhausen), in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

REICHENHALL, in the Bavarian Alps.—Common salt waters. *See* Mineral Waters.

REINERZ, in German Silesia.—Chalybeate waters. *See* Mineral Waters.

RELAPSE (*re-*, back; and *lapsus*, slipping).—The return of a disease, which has apparently ceased, during or immediately after convalescence; or of a particular symptom in the course of a disease. Relapses are well exemplified in typhoid fever and acute rheumatism.

RELAPSING FEVER. — Synon.: Famine Fever (Irish writers); Fr. *Fièvre à Rechute*; Ger. *Hungerpest.* Also many other names, according to the localities where it has prevailed as an epidemic.

Definition.—A continued contagious fever; characterised by absence of eruption, and a tendency to relapse at intervals of from five to seven days, and for an indefinite number of times, accompanied during the paroxysms by a spirillum, and generally occurring as an epidemic.

All medical writers, from the earliest times, recognise the existence of a relapsing form of continued fever; but this disease had until recent years been included under the general term 'Continued fever.' Even in the great Irish famine fever of 1847, many of the Dublin physicians did not sufficiently distinguish between typhus and relapsing fever; and we find a statement often made that the fever relapsed into typhus, or that typhus relapsed into a form without spots. There is no doubt that typhus and relapsing fever co-existed at the time of the Irish famine, as they have invariably done at all times and places in seasons of great scarcity.

Geographical Distribution.—Northern Europe seems to be the favourite habitat of relapsing fever. It has been met with in America, but not as an epidemic, having been imported from Europe, and not showing a tendency to spread. An epidemic outbreak occurred at Peshawur in the Punjab, and also in Egypt. Epidemics have been more common in the British Isles than elsewhere. The most extensive epidemics have arisen in Ireland in times of famine, and extended thence to England and Scotland. An epidemic was confined to Scotland in 1843, and another to London in 1868.

Ætiology.—*Predisposing causes.*—Males suffer more from relapsing fever than females, in the proportion of about 1·5 to 1. The disease is most common between the ages of fifteen and twenty-five. Season seems to have little effect, but it appears to be more prevalent in winter than at other seasons, because the other predisposing causes are more intense at that time of the year. All the causes which predispose to contagious zymotics favour more or less the prevalence of relapsing fever. The most powerful, however, are scarcity of food, overcrowding, and want of cleanliness.

Exciting causes.—Relapsing fever is contagious, and has always been found to spread in proportion to the facilities for communication. It has been transported from long distances by affected persons; it attacks attendants on the sick, and persons not predisposed when they are exposed to its contagion; and may be communicated by fomites. It seems to act through but a short distance. The period of incubation is uncertain, sometimes being apparently almost absent, at other times stated to extend to fourteen or twenty-one days.

Famine and its consequences, or famine alone, is a cause for the origin of relapsing fever *de novo*. Some doubt the truth of this statement, but it is usually received by writers upon the disease. The evidence in favour of famine as a cause rests upon the 'fact that after it has been absent for many years, it breaks out on each occasion under precisely similar circumstances' (Murchison). The circumstances preceding an outbreak are invariably failure of crops, and consequent famine. Relapsing fever, although usually prevailing among overcrowded persons in large towns, must not be considered to depend upon this condition, except so far as overcrowding favours the spread of contagion. The overcrowding in towns during an epidemic results from the same cause as that producing the fever; namely, the scarcity of food in the country, which drives people into the towns.

Anatomical Characters.—These are not marked, except where complications have caused death. The liver and spleen are both found enlarged in all cases, especially the latter organ. The digestive organs exhibit nothing particular, except in those cases where there has been long deprivation of food, or where dysentery or diarrhœa has accompanied or preceded the disease. A spirillum—*spirillum* or *spirochæte Obermeieri*—is found in the blood of patients suffering from relapsing fever. This micro-organism decreases as the paroxysms subside, and is absent during the intermissions. The spirillum was discovered by Obermeier of Berlin in 1872, and the discovery was further confirmed by Engel in 1873. A full account of this organism is given under a special heading. *See* Micro-organisms.

Symptoms.—The invasion of the disease is usually marked by rigors, frequently of a trivial character, amounting only to slight chilliness. This is followed by debility and giddiness; extreme weakness is not so marked as in the early stages of other forms of continued fever. There is headache, followed after a few hours by hot skin; the temperature rises to about 105° F., or sometimes, it is stated, as high as 108°; the pulse rises to from 110 to 130, occasionally counting 140 at an early stage of the disease. The tongue is covered with a moist creamy fur, which in severe cases becomes brown and dry in the centre, and in the worst forms becomes black all over. There is great thirst, as in all febrile diseases; loss of appetite; some abdominal tenderness, especially in the epigastric region; occasionally nausea, and more rarely vomiting; the bowels are usually confined, but in some cases diarrhœa prevails. In such cases the diarrhœa is of a dysenteric character, and is probably due to the dysenteric tendency which usually prevails in time of famine, when relapsing fever is prevalent. The skin generally presents a jaundiced hue; and careful examination will detect more or less enlargement of the liver and spleen. There is great muscular and articular pain. The pain in the back is frequently of the most intense character. Headache is more complained of than in the other forms of fever. There is sometimes, but not as a rule, delirium towards the end of the first week.

In from five to seven days from the invasion of the disease, the symptoms suddenly subside, and the patient quickly becomes convalescent, being for the time apparently well. This convalescence is frequently accompanied or preceded by a critical evacuation from the bowels, kidneys, or uterus, or by profuse diaphoresis. It may be permanent, but more commonly the patient remains well for a few days or a week, and then suddenly relapses, and passes through all the symptoms previously detailed. There may be a second or a third relapse, and even a fourth has been recorded. At no time during the progress of the disease is any specific eruption developed, although on the second or third day a reddish mottled rash has been met with, which, however, is irregular in its appearance, development, and duration, and usually terminates in desquamation. Purpuric spots have been sometimes, and sudamina very frequently, met with.

Complications. — Pulmonary complications are not so common in relapsing fever as in typhus or enteric fever. Bronchitis, pneumonia, and laryngitis may occur, especially bronchitis, but these complications are not severe. Cardiac, arterial, or venous affections are rare, with the exception of hæmorrhages, which must be considered as being connected with the purpuric tendency which usually prevails in times of scarcity. Nervous complications are more rare than in any other form of adynamic fever. Dysentery and diarrhœa in some epidemics have proved to be most serious complications, and are of frequent occurrence whenever relapsing fever prevails. Abscess and other suppurative forms of inflammation are not common. In pregnant females attacked by this fever abortion usually occurs at an early stage of pregnancy; and premature labour, with death of the fœtus, and considerable danger to the mother, in the later stages of pregnancy. Death of the mother has sometimes happened from *post-partum* hæmorrhage.

Diagnosis.—Relapsing fever is most likely to be mistaken for other forms of continued fever, and may be confounded with the eruptive fevers in their earlier stages, especially small-pox. It differs from typhus in having a higher temperature and quicker pulse at the outset; in the absence of the specific eruption, of the extremely heavy aspect of the patient, and of the delirium of typhus; in the presence of extreme pains in the back, vomiting, and jaundiced tinge of the skin; and finally in the sudden cessation of symptoms, and the tendency to relapse.

Relapsing fever differs from enteric fever in the suddenness of its onset, enteric fever having a slow invasion; the want of the marked and extensive daily variations in temperature; the absence of the characteristic abdominal symptoms and eruption; and the absence of the localised iliac tenderness and the peculiar diarrhœa of enteric fever. The tongue also serves to distinguish relapsing from enteric fever; in the latter having a well-marked red tip and edges, in the former a light covering fur. Relapsing fever at its commencement has been confounded with small-pox, on account of the extreme pain in the back and marked vomiting which accompany both these diseases, but the appearance of the specific eruption will soon decide the question.

Prognosis, Duration, Terminations, and Mortality. — The prognosis of relapsing fever is usually favourable, the mortality being low, from 1·2 to 2 per cent. in London, up to 4 and 4·5 per cent. in other places; the average rate being about 4 per cent. The chief causes influencing the rate of mortality seem to be the prior state of the patient, and the duration of the disease before medical relief is applied for. Purpuric symptoms, severe dysentery or diarrhœa, serious hæmorrhages, or extensive chest-complications, always indicate a grave prognosis.

Treatment.—The treatment of the disease must be preventive and curative. The chief promoting causes of the disease being famine and contagion, the means for prophylaxis are obvious. The active treatment must chiefly be directed towards the relief of symptoms, and sustaining the strength of the patient. The use of quinine and mineral acids in the earlier stages, and a plentiful supply of light and nourishing food in the later, will be found sufficient. A considerable amount of the success of treatment will depend upon the dieting of the patient. It must be kept in mind that most of these patients have been in a state of starvation. It will be necessary, therefore, to carefully and gradually increase the supply of food. The food at first must be of a most digestible and fluid kind, which may gradually be altered to a diet of a more solid and general character. Dysentery has not infrequently been caused by the sudden feeding of patients suffering from relapsing fever in its early stages. Milk, light starchy puddings made with milk, thin custards, and finally chicken, chops, and general diet will be found the best course in this disease. Stimulants may be occasionally requisite, but are seldom necessary in any quantity, or for a length of time.

T. W. Grimshaw.

RELAXATION
RELAXED (*re-*, again; and *laxo*, I loose).—These words signify a condition of looseness, and are used somewhat vaguely in a variety of associations. Thus we speak of *general relaxation*, to express a want of muscular tone or vigour. *Local relaxation* refers to a condition of abnormal looseness of a part, as of a joint, muscles, the uvula, or the throat, which are then said to be *relaxed*. Another signification of the term 'relaxation' is that of looseness of the bowels, as in diarrhœa.

REMEDY (*remedium*, a cure). — A remedy properly signifies a therapeutic agent which possesses a recognised influence in preventing, relieving, or removing a particular morbid condition. Thus vaccination is a remedy for small-pox; quinine for ague; mercury and iodide of potassium for syphilis; and opium for pain. *See* Disease, Treatment of.

REMISSION
REMITTENT (*re-*, again; and *mitto*, I send).—A disease is said to be remittent when it is characterised by periodical diminutions of symptoms, followed by exacerbations, as in remittent fever and neuralgia. The period during which the symptoms are in abeyance is called a *remission*. *See* Remittent Fever.

REMITTENT FEVER. — Synon.: Bilious Remittent; Fr. *Fièvre Rémittente*; Ger. *Bösartiges endemisches Fieber*.

Definition.—A paroxysmal fever of malarial origin, in which the paroxysms do not intermit, but only, as the name implies, remit.

General Observations.—Remittent fever is the most severe of the class to which it belongs; it is a more acute affection than intermittent fever, more severe in its symptoms, more rapid in its course, and the direct mortality is ten times greater than in any other form of malarial fever. It is commonly known in India as *jungle fever*, because it is in jungles there at certain seasons of the year that it is most frequently contracted. It often obtains local names derived from places notorious for producing it, a practice productive only of confusion and misapprehension. It is sometimes said to hold a middle place between intermittent and continued fever; the more nearly it resembles the latter, the more dangerous it is.

In other words, the less distinct the periods of remission, and the longer the stage of exacerbation, with its high temperature, and other disturbances of the system which characterise that stage, the greater is the risk of such blood- and organic changes as are incompatible with life.

Remittent fever is usually seen in its gravest forms in hot climates, but has often been very fatal in malarial regions in temperate climates, as in Walcheren. This, in unhealthy countries, is often the first form of fever that attacks new-comers, but such are seldom exposed to second attacks; in other words, there is in this type less tendency to a recurrence of the disease than in the intermitting form. It may be that the extremely energetic character of the symptoms in the remittent type is more effectual in destroying, altering, or 'eliminating' the poison, than the milder intermittent attack. In 1865, out of 3,199 cases of remittent fever admitted into the military hospitals of Algeria, only 359 had second attacks; while out of 15,080 cases of intermittent fevers, 4,295 were re-admitted with the same type of fever (*Statistique Médicale de l'Armée*, 1865). The medical officers of our army in Spain observed that their men, on entering a malarial locality, generally suffered severely from the remittent form, while the inhabitants of the country were only affected by the intermittent type. Survivors, however, who remain in the locality, become, like the inhabitants, only liable to the milder type of the disease.

Ætiology. — Remittent fever is found whenever its specific cause is generated in sufficient concentration to excite it (*see* Intermittent Fever; and Malaria). It prevails in the malarial parts of the Old and New World. Our armies have suffered from it both in temperate and hot climates; in the East and West Indies, and, with extreme malignity, on the West Coast of Africa. It is a common disease in the malarious parts of Italy; and the French army has suffered much from it in Algeria. It is seen in the deltas of great rivers, in the *terais* of India, in jungles, and in other districts in the same country long left uncultivated.

Anatomical Characters. — The morbid anatomy of remittent fever is the same as in intermittent fever; the difference is only in degree. Congestion of the mucous coat of the stomach and duodenum, with softening, is more marked than in other types of malarial fever, as well as enlargement of Brünner's glands. The pigmentary degeneration of the spleen and liver is more intense, often extending also to the brain and spinal cord, giving them a bronzed appearance. At a recent *post-mortem* examination the micro-organisms characteristic of malaria will be found in abundance in the blood generally; also especially in the spleen, and in the vessels of the brain and liver. In pernicious types the vessels are actually obstructed by these organisms.

Symptoms. — *Premonitory.* — These are much the same as in a severe intermittent.

Cold Stage.—The term is hardly applicable in this fever; the patient is sensible only of a slight sensation of chilliness, which very rarely passes into rigors. Nevertheless, the thermometer indicates a temperature above the normal, and in the hot stage this quickly rises to 106°, 107°, and sometimes to 110° F.

Hot Stage.—As this develops, the whole system is profoundly disturbed. There is the high temperature already indicated, which, when fully developed in the worst cases, approaches within three degrees of that in which the albuminoid constituents of the muscular tissue begin to coagulate. This grave symptom is seen in its utmost intensity in those who have exposed themselves, perhaps after indulging in alcoholic liquor, to a powerful sun, without reasonable precautions. With this there is necessarily pungent heat of skin; an intensely flushed face; severe headache; pain in the back and limbs; quick respiration; a pulse of 120 or more; a foul, dry, and bile-tinted tongue; a sense of oppression at the epigastrium, with fulness and tension in that region; and violent vomiting, which brings no relief to the gastric oppression.

This vomiting is one of the most distressing symptoms; the quantity of fluid vomited far exceeds what has been taken by the patient; at first it is colourless, then bilious, and sometimes bloody. In pernicious cases it closely resembles the 'black vomit' of specific yellow fever. With the above symptoms there is an anxious countenance, and much restlessness. In this condition the patient remains from six to twelve hours.[1] Then the more urgent symptoms abate; the temperature falls two, three, or more degrees; the skin becomes slightly moist, far short of the profuse sweating in an intermittent fever; headache sensibly diminishes; and the nausea, vomiting, and epigastric tension either cease or sensibly abate. This is the *remission*, always anxiously looked for, not only as a relief to the patient, but as a precious time for treatment. In bad cases, when the other symptoms remit so little as to escape the notice of all but an experienced observer, the thermometer will indicate at least an attempt at a remission. This lasts from two to twelve hours; the longer it is, the more favourable is the prognosis. A feeling of chilliness then returns, quickly followed by the hot stage, with all its distressing symptoms. This is the *exacerbation* of systematic authors, which in its turn gives way to the remission.

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[1] The description in the text applies to the disease in its most acute form.

A morning remission in this fever is so invariable as to be a point of diagnostic value, and it is an old rule in military practice so to time the morning visit as to ensure seeing the patient while it lasts. The exacerbation usually returns about noon, and in severe cases lasts till midnight. Sometimes two exacerbations occur, one at noon, the other at midnight, with a slight evening, and more distinct morning, remission.

The *skin* sometimes assumes a yellow tint, and if there be with this anything resembling black vomit, a false diagnosis of yellow fever may be made. The term 'yellow remittent' is correctly enough applied to such cases, but the resemblance between these and cases of specific yellow fever is only superficial.

Hiccough is a troublesome symptom, and if it appears late in the disease, and continues during the remission, is not a favourable one.

The *bowels* are usually constipated, but in pernicious cases the motions sometimes become very loose, bloody, and offensive, a condition of evil omen.

Jaundice is rare, although, as already said, the skin has often a yellowish tinge, more dependent on blood-changes than from an icteric cause.

Hepatitis.—The only cases of suppurative inflammation of the liver, occurring in the course of remittent fever, that have come under the writer's observation, were brought to Netley from the Gold Coast, where this serious complication appears common.

Delirium.—Except in men who have lived imprudently, and have indulged freely in alcohol, active delirium is rare. In all malarial fevers, the symptoms and lesions in remittents point more to implication of the abdominal organs than of the nerve-centres.

The *urine* is acid, scanty, and high-coloured, rarely albuminous—so rarely, that its absence is a point of diagnosis between malarial remittent and specific yellow fever. During the hot stage the secretion of urea is greatly increased, but lessened when convalescence sets in. In two very severe cases treated by the writer in India, there was profuse secretion of bloody urine throughout, which lasted until convalescence set in.

The *adynamic form* of remittent fever is one of great gravity. It is becoming every day more apparent that in bygone years—and perhaps even now in India—cases of enteric fever have been, and are, mistaken for malarial remittent. The diagnosis is not so easy as it may appear to those who are familiar with enteric fever pure and simple, as seen in temperate climates. There are cases of a mixed nature, in which a thread of malaria, so to speak, runs through the symptoms and obscures them. The term 'typho-malarial' has come into use in India to distinguish this class of cases, which are as difficult to treat successfully as to diagnose clearly. French and Italian writers would apply their favourite term 'pernicious' to such cases, which are characterised from an early stage by great prostration; brief and uncertain remissions; a quick and compressible pulse; a black and dry tongue, the teeth being covered with sordes; rapid respiration; epigastric tension and oppression; the bowels being loose, and the motions bloody, with a disposition to hæmorrhage from the mucous surfaces generally. Such cases are often fatal, and *post-mortem* examination, in addition to the common lesions of malarial fever, reveals ulceration of Peyer's patches.

Duration.—The duration of a remittent fever is from five to fourteen days; but, as in all miasmatic fevers, it is much affected by the action of remedies. In the worst forms death is rare before the eighth day.

Diagnosis. — 1. From *specific yellow fever.* — Remittent is paroxysmal; yellow fever is continued. Remittent has a morning remission; yellow fever has not Hæmorrhage from any source is exceptional in remittent; in yellow fever it proceeds from mouth, nose, eyes, ears, bowels, and even the urinary passages. Even in the worst remittents albuminous urine is rare; it is the rule in yellow fever. Over remittent fever the power of quinine is beyond question; the drug is powerless in yellow fever. Death in the worst remittents is rarely seen before the eighth day; in specific yellow fever it is common on the third day. The mortality rate in yellow fever is often 40 per cent. of those affected; that of remittent does not in ordinary circumstances exceed 4 or 5 per cent., and is often less. Yellow fever is portable and contagious; remittent is neither. Yellow fever has a special habitat of its own, and can only exist as an endemic disease in countries where the mean temperature does not fall below 72° F. Lastly, specific yellow fever has never established a footing on the shores of India, where malarial remittent is an endemic disease.

2. *Enteric fever*, pure and simple, ought not to be easily confounded with remittent. It is marked off by the difference in the thermometric curve: in enteric fever, the rise of temperature is slow; in remittents it attains its maximum in a few hours. There is also the characteristic eruption (not, however, invariably present in enteric fever in India), the iliac gurgling, and the peculiar stools of typhoid, all absent in remittent. As mentioned above, the diagnosis is not so easy when the peculiar symptoms of malarial mask or obscure those of enteric fever. Still, due observation of the peculiar combination of symptoms will enable careful practitioners to make a good practical diagnosis, and to regulate their treatment accordingly. It may seem unscientific to speak of two specific diseases existing together, and as it were

struggling for the mastery in the system. The writer's belief is, that in the doubtful cases the real disease is enteric fever, the symptoms being merely modified by malaria, in the same way as they are in many other diseases.

Prognosis.—This is favourable when the remissions are distinct; when each succeeding exacerbation diminishes in force; when the skin acts freely; and when the urine deposits the sediment described as critical in intermittent fever as the attacks pass off.

Faint and uncertain remissions; a tendency to collapse at the close of an exacerbation; the sudden setting in of dangerous complications; the predominance of typhoid symptoms; suppression of urine; and a general disposition to hæmorrhage from the mucous surfaces, are all signs of evil omen.

Treatment.—After a large experience in the treatment of malarial fevers in some of the most unhealthy regions in the East, the writer desires to place on record the fact that he has never seen any but disastrous results from treatment based on the belief that remittent fever is an inflammatory disease. The practitioner who keeps this in view, and acts on the principle of saving power as much as possible, will save more lives than the man who, alarmed by the violent disturbance of the system, attempts to calm it by lowering treatment; or the other, who, halting between two opinions, seeks to cure his patients by an incompatible mixture of depressing and conservative remedies. With the reservations already given when treating of intermittent fever, no better combination of a purgative with quinine can be given, to begin the treatment, than Livingstone's, described in the article on that disease; but whatever be the purgative selected, it should be suited to bring away copious bilious discharges, which will greatly mitigate the vomiting, and it should be combined with quinine. A good formula is one for a five-grain pill consisting of calomel, compound extract of colocynth, and powder of scammony, with a drop or two of any aromatic oil; this acts effectually on the whole tract of the intestine, usually without nausea or griping, and a like quantity of quinine may be added.

Two courses are now open to the practitioner. One is to postpone the further administration of quinine until the first remission. In the other the exacerbation is disregarded, and quinine is given in full and effective doses at once. If the first plan be decided on, much may be done to promote the comfort of the patient, to lower the temperature, and thus to hasten the period of remission. In strong men, when the temperature is high, exceeding 105° F., with headache, violent action of the heart, rapid respiration, oppression, and restlessness, drop doses of the tincture of aconite every quarter of an hour, until ten or twelve doses have been taken, calm the patient, reduce the force of the heart's action, assuage the headache, and sometimes in a marked manner relieve urgent and distressing symptoms. Used in this way, and its effects watched, aconite is a valuable and safe remedy, and, acting in the same way, it is as useful in specific yellow fever. It has also this great recommendation, if cautiously used, that it leaves no sting behind.

When the temperature rises, as it often does, to 105-6° or 110°, more energetic means are called for. The patient should be placed in a bath at 90° F., which should be cooled down until the thermometer indicates a temperature 15° below the normal temperature of his body. The effect of this in calming the patient, relieving the oppression, and checking vomiting, is often very striking. When removed from the bath, the patient should be wrapped in a blanket. In adynamic cases, where the use of the bath is not deemed prudent, the same good effects may be brought about by sponging the surface with water, the temperature of which is gradually reduced as directed above. This, in most cases, is certainly the safest practice.

On the first appearance of the remission, quinine must be given by the mouth, bowel, or skin. If there is no vomiting, by the mouth; if the remedy will not remain on the stomach, then it must be given by bowel or skin. Of the inconveniences and occasional danger of the latter method, the writer has spoken in the article Intermittent Fever, to which the reader is referred.[1] If the hypodermic method is ever justifiable, in the face of the danger of inducing tetanus in the manner described, it is in the grave and pernicious forms of this disease, when life is threatened, and time presses. If the remedy is given by mouth or rectum, in severe cases, not less than half a drachm should be introduced into the system during the remission. It is in remittent fever of the urgent kind under notice that Warburg's tincture already mentioned (*see* Intermittent Fever) is most useful. As is now well known, the active ingredient in this remedy is quinine; and, if used as directed in the article referred to, it is as safe as it is effective.[2] American physicians appear, in treating this disease, to follow chiefly the second plan mentioned, and, trusting to the known property of quinine to diminish and not to increase temperature, they give it during the hot stage. The great difficulty here is the vomiting; during the exacerbation it is almost impossible to get anything to remain on the stomach. It must then be administered by enema to the extent of half a drachm, half the quantity being given in the same way three hours before the return of the exacerbations. Full doses of from twenty to thirty grains of the bromide of potassium should be given with the quinine, to calm restlessness and promote sleep. The above treatment must be persistently followed day by day until the fever is overcome.

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[1] If the hypodermic method is used, the neutral sulphate of quinine is the safest form, in doses of six grains; the utmost care being taken to perfectly sterilise the syringe and needle.

[2] Spurious imitations of this tincture have brought this remedy into disrepute. As used by the writer, it was always obtained direct from Warburg himself.

It will be seen from the above remarks that obstinate vomiting is not only a source of extreme and exhausting distress to the patient, but also one of the chief embarrassments of the practitioner. The means advised above are often effectual in checking it, and they may be supplemented by the use of ice when available, by external stimulants over the stomach, or by the application of cloths sprinkled with chloroform over the same region. Drop doses of Fowler's solution of arsenic have been found by Bellot the younger effective in checking this distressing symptom in yellow fever, and the same remedy may possibly be of use in cases resisting other means. But in the writer's experience vomiting, as a rule, subsides with the other symptoms, when the exacerbations are controlled by quinine. What was said, under the head of intermittent fever, of the danger of pausing in the use of quinine, to treat this or that complication, is most emphatically repeated here.

On the first sign of collapse in any stage, recourse must be had to stimulants; white wine whey is an excellent vehicle for the administration of alcohol, if that be called for; good champagne, if available, or the best Rhenish wine within reach, often answers admirably, and is keenly relished. Livingstone's party used bitter ale, and speak in praise of it as a stimulant grateful to the patient, 'frequently remaining on the stomach when all others are rejected.' The large experience of such intelligent observers on such a subject is worthy of respect. It is hardly necessary to dwell on the necessity of sustaining the patient during the remission by a diet adapted to the irritable condition of the stomach. With one remark—one pregnant remark by the Rev. Horace Waller, the fellow-traveller, friend, and biographer of the illustrious Livingstone—we shall close this article: 'One thing, however, must be strongly urged: it is that all notions about not being able to "stand quinine," that it "flies to the head," and so forth, must be banished as utter nonsense. In Africa everyone can stand quinine; there is scarcely a disorder there in which it is not positively required.' The writer adds from his experience that this is as true of malarial regions in other parts of the world as it is of Africa.

W. C. Maclean.

REMOTE CAUSES.—This expression is used as a synonym for predisposing causes. *See* Disease, Causes of; and Predisposition to Disease.

RENAL CALCULUS.—Synon.: Nephrolithiasis; Fr. *Calcul Rénal*; Ger. *Nierenstein.*

Definition.—A concretion formed by the deposit of one or more of the solid constituents of the urine. It differs only in size from the gritty particles called 'gravel'; it may be single, or there may be many; it may be present in one or both kidneys at the same time; and it occurs at all periods of life, from the fœtus *in utero* up to the extremest old age.

Ætiology.—The majority of urinary calculi are primarily formed in the infundibula or uriniferous tubes of the kidney; and are caused by precipitation, in the nascent state, of uric acid or oxalate of calcium. This precipitation may be due to real excess of the insoluble uric acid, to high acidity, to poverty in salines, to low pigmentation, or to deficiency of the water of the urine; but the precise form and proximate cause of the deposit are determined by the presence of a colloid matrix, composed of mucus or blood-globules, or other animal basis (*see* Calculus). Increase by gradual accretion goes slowly on until blockage of the duct occurs; the calculus is then either floated by the urinary stream into the pelvis of the kidney and onwards through the ureter, or it becomes impacted in some part of its transit, and develops into a full-formed renal stone, which, minute at first, may grow to enormous proportions.

Varieties.—By far the most frequent variety of renal calculus in this country is that composed of uric acid; in the Eastern counties, where stone is most common, it is very rare indeed to find in the adult any other primary form. Even in children, in whom oxalate of calcium is not uncommon, uric acid is the most prevalent. It is thought by some pathologists that oxalate of calcium forms the first starting-point even of uric acid stones, but this statement lacks proof. The sparing solubility of uric acid and of oxalate of calcium is probably the cause of their greater frequency in calculi; but other agents may occasionally be found to constitute the primary nucleus of renal stone, such as cystine, carbonate of calcium, phosphate of calcium, either by itself or in combination with the ammonio-magnesium phosphate, forming what is designated the fusible calculus, and urate of ammonium or the mixed urates. The phosphates and urates, however, are more likely to occur as secondary than as primary deposits. Mixed or alternating calculi are frequently met with, in which are seen alternate strata or layers of uric acid, oxalate of calcium, and phosphates, the latter generally constituting the external part.

Pathological Effects.—The action of a calculus on the structure and condition of the kidney depends much on its size. At first it may produce irritation and local congestion, possibly leading to actual inflammation, and even abscess within or external to the capsule. This may happen when the stone develops in the tubular or secreting structure; but when it remains and enlarges in the pelvis of the kidney, chronic pyelitis is more likely to ensue, with changes of an atrophic character. The pelvis dilates; pressure comes to be slowly exerted on the renal structure, causing wasting, until but little secreting tissue is left; and a large stone remains, occupying the pelvis and branching into the calyces, in shape resembling a cauliflower, and with little covering beyond the capsule of the kidney.

Symptoms.—The genesis of renal concretions is always unrevealed by symptoms; their retention and development up to a considerable size or in great numbers may be unsuspected and unnoticed; and even their transit and escape through the urinary passages may be painless. Usually, however, there is some degree of lumbar pain, generally restricted to the side affected, spreading more or less to the front of the body, and down towards the groin and bladder. The pain is apt to be aggravated by exercise—especially by carriage exercise, and it is liable on such occasions to become very severe; so also when, from any cause, it is disturbed in its bed, or makes a fruitless attempt to enter the ureter (renal colic).

When a stone of some magnitude is passing down the ureter, symptoms of a very acute character usually ensue. The pain rises to intense agony in the loin, and along the course of the ureter down to the bladder and testicle; frequently there is sickness or vomiting; the patient is bathed in perspiration; and he sometimes passes into a state of fainting and collapse. The bladder is frequently irritable; the urine is smoky from the presence of blood, or of elongated clots; or almost pure blood escapes. These symptoms may come on suddenly; may last a few hours or a few days; and may end as suddenly when the calculus reaches the bladder.

The changes produced in the urine by renal calculus may be very slight. Hæmorrhage is the most common and most characteristic; sometimes it is in quantity enough to render the urine smoky or like porter; at other times it can only be detected by the microscope. When it exists in any palpable amount, albumen will, of course, be present too. Pus, mucus, and epithelium will show themselves when the calculus has produced some degree of pyelitis. In long-standing cases a tumour may be felt in the situation of the kidney. The patient resting on his back, and the knees being drawn up, the practitioner with one hand behind presses the kidney forwards, and with the other in front presses it backwards below the margin of the ribs. He may thus, in young and thin persons—aided, perhaps, by the administration of ether—differentiate a renal stone from any of the usual kinds of renal tumours.

Diagnosis.—Renal calculus may be mistaken for various diseases: (1) Bilious attacks, intestinal colic, or perityphlitis. The sickness and pain in the flank are present in all, but in nephritic colic the pain is apt to be more located in the loin, although this is by no means always so. The presence of hæmaturia will be conclusive. In typhlitis and perityphlitis there will be fever and local tenderness. (2) Obscure pain in the back, due to chronic lumbago or neuralgia. In these conditions the pain is generally across the back, and not unilateral; it is aggravated by movements of the affected muscles; and there is no hæmaturia or other urinary complication. (3) Cancer or other renal tumour. Pain and hæmaturia are characteristic of both stone and cancer, but in calculus the health is generally good, while in cancer it is always deteriorated. In stone there is seldom any tumour, and when it does exist it must be of limited size, and hard, whereas in cancer it is diffused, and may be soft.

Prognosis.—The frequent formation and escape of renal stones may continue for a great many years without any material injury to the general health. Even when blockage of the ureter takes place, leading to hydronephrosis and atrophy of the organ, or to nephritis or perinephritis with abscess, a fair measure of health may be preserved, provided the other kidney is in a healthy condition. When both organs are affected, or when complications arise, such as amyloid or tubercular disease, or chronic pyelitis, then the health steadily deteriorates, emaciation proceeds, with hectic and fatal exhaustion.

Treatment.—Bearing in mind that the large majority of renal stones are composed of uric acid, and that it is not difficult to form a correct diagnosis on this point, it will be necessary chiefly to consider the treatment of this form of concretion. Preventive treatment consists in a rigid limitation as to the *quantity* of food taken. It is customary to condemn a free use of animal food and highly seasoned dishes; but it should be borne in mind that stone prevails largely amongst the poor, who seldom can indulge in animal food to excess, and it is not infrequent in countries where no animal food is taken. Far more important is it, both as to food and drink, to observe a strict moderation as to the amount taken. In this way digestion and assimilation will be easy and perfect; crude matters will not find their way into the blood; the chemical conversion of uric acid will be complete; and precipitation in the uriniferous tubes will be obviated. When the proclivity to uric acid calculi is decided, or when a small stone is known to exist, the free use of diluents and alkaline remedies is undoubtedly of importance. The waters of Vichy, Ems, Contrexéville, and Neuenahr, taken freely at the springs, with or without baths, but with the great aid of change of air and mode of life, constitute the most efficient plan of treatment; but it must be admitted that in the majority of cases this good effect is only transient. Some high authorities recommend, in preference to the simple alkaline treatment, the use of those saline aperient waters the chief ingredient of which is sulphate of sodium, such as Carlsbad and Friedrichshall; and undoubtedly they have a most beneficial action, by promoting digestion and assimilation. But as with the alkaline remedies, whether natural waters or drugs, so with the salines, their action is evanescent. Leave them off, and let the patient return, perhaps to a place where calculus is frequent, or to habits of careless living, or to over-work, and the morbid tendency will almost certainly recur. If there are clear indications of the actual presence of a renal stone, composed of uric acid, of moderate size and recent date, the solvent treatment, as described by Sir William Roberts, should be fully carried out. It depends for its success on the known solubility of uric acid and its salts in alkaline solutions of definite strength, the most efficient being about sixty grains to the pint; above and below this strength the solvent power diminishes. The patient, if an adult, should take forty to fifty grains of the acetate or citrate of potassium in three or four ounces of water every three hours during the day, and once at least in the night; this plan should be continued for two or three months. During the treatment the urine should be frequently examined, and if any approach to an ammoniacal state should appear, the treatment must be suspended for a time. The effect of the treatment must be estimated by the diminution of lumbar pain, and by the escape of small calculi; no ill-effects are caused; seldom any indigestion; and no impairment of general health. Other drugs have been employed for the solution of uric acid, such as carbonate of lithium, phosphate of sodium, tartrates and carbonates of potassium and sodium, also carbonate of calcium and piperazin. Some years ago the writer conducted some experiments with prepared chalk, and found that when given to the extent of twenty to thirty grains in mucilage and mint water, three or four times a day, it had a most marked effect in quickly removing uric acid deposits, and it will have this effect even in the febrile state. It did not, in the quantities given, produce alkalinity of the urine, but it acted distinctly as a diuretic.

In the crisis of nephritic colic, narcotics are called for, in doses large enough and frequent enough to control the pain. If sickness is troublesome, morphine may be administered subcutaneously; or, if there be vesical irritation, by suppository. If the agony be extreme and in paroxysms, chloroform may be inhaled occasionally; while the hot bath, anodyne fomentations, and stupes are useful aids to relieve and soothe.

Surgical treatment of renal stone has of late years come prominently into notice. Incision in the lumbar region and removal of a stone is as old as Hippocrates, but nephrolithotomy and nephrectomy have taken their place amongst recognised surgical operations only within the last decade. For the conditions which justify and call for these operations, and for the steps to be taken in their execution, the records of surgery must be consulted. WILLIAM CADGE.

RENAL COLIC.—SYNON.: *Nephralgia Calculosa*; Fr. *Colique Néphrétique*; Ger. *Nierenkolik.*—The name commonly applied to the symptoms which arise when a renal calculus either passes, or attempts to pass, down the ureter. *See* RENAL CALCULUS.

RENAL DISEASES.—*See* KIDNEYS, Diseases of.

RENNES-LES-BAINS, in France (Aude). — Muriated alkaline and earthy sulphatic waters. *See* MINERAL WATERS.

RESISTANCE.—The sensation recognised by the fingers of the degree to which a part yields or resists when palpation or percussion is being performed. *See* PHYSICAL EXAMINATION.

RESOLUTION (*resolvo*, I loose).—The return of a diseased part to its natural condition; chiefly applied to the process of inflammation when it subsides gradually, and without the occurrence of suppuration or other unfavourable termination. *See* INFLAMMATION.

RESOLVENTS (*resolvo*, I loose).—Anything which aids the absorption of effused products may be included in this class of remedies; the most efficient being, externally, counter-irritation and poultices; and internally, mercury and iodide of potassium. Our knowledge of the precise mode of their action is still very vague. The subject of blisters and the like is considered under COUNTER-IRRITATION. It is generally held that mercury renders fibrin less cohesive; and that iodide of potassium—in virtue, probably, of the free iodine which is separated within the blood—has a special affinity for albuminous bodies, and for that form of lowly organised tissue which is so commonly produced in the tissues during the more advanced stages of constitutional syphilis. It is difficult, however, to discuss this therapeutical heading from a strictly scientific standpoint, deriving its origin as it does from a past epoch, when pathological science was still in its infancy, and when very active modes of treatment were held to possess virtues which further experience has not confirmed. Free bleeding and blistering, combined with copious salivation, were held in those days to have a most powerful influence in checking inflammation, and removing its products; and we are only now learning to assign to unaided nature the due share which she takes in effecting what we are accustomed to call the 'cure' of disease.

R. FARQUHARSON.

RESONANCE (*resono*, I sound again, echo).—Resonance signifies the character of the sound yielded on percussion over the greater part of the chest, and, within wide limits, of the abdomen also. The degree of resonance depends principally upon the proportion of air contained in the underlying cavities or organs. *Vocal resonance* is the voice-sound transmitted through the chest to the ear of the auscultator. It is increased or diminished in accordance with the physical conditions present in the chest-cavity.

Hyper-resonance is a term used to signify undue resonance over a given part.

Deficient resonance is commonly called *dulness*. Like *hyper-resonance*, it is often used in a relative sense, in comparing the percussion-note of different parts of the chest or abdomen. *See* PHYSICAL EXAMINATION.

R. DOUGLAS POWELL.

RESPIRATION, Disorders of.—A due performance of the function of respiration is essential to the well-being of the economy, and any derangement of this function is likely to be followed by more or less disturbance of the entire system, varying in degree and gravity, but often of a serious character. Moreover, the phenomena resulting from such a derangement are commonly of much significance in relation to diagnosis, prognosis, and treatment. Therefore, disorders affecting breathing demand attentive and careful observation and consideration in every case; while their general study by no means receives the thought and attention which its importance emphatically requires. In a short article it will be impossible to do more than give a very condensed summary of the subject. The several forms of disordered breathing associated with particular diseases are indicated in their appropriate articles.

Before considering the disorders of respiration, it will be well to call to mind the following points relating to the performance of the act in health. The average frequency of breathing is from sixteen to twenty per minute in adults, although this rate is easily disturbed temporarily by various physiological conditions. The function is powerfully under the influence of the nervous system, and is ordinarily carried on either by centric or reflex stimulation, without any conscious voluntary effort on the part of the individual. In ordinary respiration scarcely any movement or other sign of the act is observable to an onlooker, and the actual quantity of air changed with each breath is very small, amounting only to from sixteen to twenty cubic inches; but in this respect also the act is very liable to be disturbed, while a person is able voluntarily, without any difficulty, to breathe more or less deeply, performing 'extraordinary respiration,' and he may thus change large quantities of air, and call into play every part of his lungs. Remembering what respiration is intended for, the conditions required for its proper performance in connexion with the breathing-apparatus are, that there should be a sufficient supply of air suitable for the purpose, and an adequate passage for its entrance and exit; that there should be enough healthy lung-tissue; that the blood should pass freely through the lungs, and be within certain limits of a proper quality; that there should be no mechanical impediment to the free play of the lungs, especially if suddenly called upon to do extra work; and that the forces by which the respiratory movements are carried on, namely, the muscles, including the diaphragm, and the elasticity of the lungs and chest-walls, are equal to their requirements. If the act of breathing is systematically watched, it will be found that normally expiration is rather longer than inspiration; but there is no striking difference between the two divisions, the ratio being as twelve to ten in males, fourteen to ten in females. Moreover, the movements are both thoracic and abdominal, the former being distinctly made up of expansion and elevation during inspiration, of retraction and depression during expiration, especially when a full breath is taken. The intercostal spaces in most parts, as well as the supra-clavicular fossæ, seem to sink in during inspiration, so as to become more evident, this being more marked in proportion to the depth of the inspiration. It will further be noticed that the precise movements differ in different persons, and according to the extent of respiration. The lower ribs and diaphragm act principally in males and children during ordinary breathing; in adult females the respiration is upper costal. In extraordinary breathing the movements are chiefly upper thoracic in all persons.

Respiration is markedly influenced by physiological conditions, such as exercise, diet, sleep, and various other causes; these must be remembered and duly allowed for in considering its derangements.

With these introductory remarks, the

disorders of respiration may now be more conveniently studied.

Ætiology and Pathology.—The numerous causes and conditions which lead to disturbances of respiration can be brought within well-defined groups, and it is desirable in the first instance to study them from such a general point of view. This, however, only gives a superficial insight into the subject, and does not indicate the kind of disorder that is produced by each cause, or how it acts, while many conditions act in more ways than one; and, still further, in any individual case there may be more than one, perhaps several causes at work, all of which ought to be recognised. These causes and conditions may be summarised in the following manner, and it will be seen that several of them act indirectly on the respiratory process:—

1. *Conditions acting directly through the nervous system.*—These include: (*a*) Centric lesions in connexion with the brain, involving the respiratory centre, either directly or indirectly, such as injury, hæmorrhage, or a tumour. (*b*) Disease or injury of the upper part of the spinal cord, paralysing the nerves supplying the respiratory muscles. (*c*) Functional nervous disturbance, as from mere nervousness, emotion, hysteria, trance, or chorea. (*d*) Conditions affecting immediately the nerves concerned in respiration, either irritating or paralysing them, especially the pneumogastric, recurrent laryngeal, or phrenic nerves. These nerves may be themselves diseased, or affected by some neighbouring condition, such as a tumour. (*e*) Reflex causes, transmitted from the skin, as when cold water is dashed upon its surface; or from internal organs, as the stomach, intestines, or ovaries. It is important to remember that disturbances connected with the nervous system frequently aggravate disorders of breathing originating from other causes.

2. *Abnormal conditions of the blood.*—In this group are included conditions of the blood as a whole, namely: (*a*) Deficient quantity of blood, especially from a sudden or rapid loss. (*b*) Anæmia or hydræmia. (*c*) Deficient aëration. (*d*) A poisoned, impure state of the blood associated with narcotism, the anæsthetic state, pyrexia, the typhoid condition, uræmia, pyæmia or septicæmia, diabetes mellitus, and other diseases.

3. *Functional disorders, or organic diseases connected with the heart.*—These are common sources of disturbance of breathing of various kinds, depending upon the intimate relation of the nerves and nerve-centres governing the heart and respiratory organs; upon the effects the cardiac derangements produce as regards the pulmonary and bronchial circulation; or sometimes upon the direct interference by certain affections with the movements of breathing, by exerting pressure upon the lungs, especially the left, upon the left bronchus, or upon the chest-walls, and particularly the diaphragm. This last cause is only noticed in cases of great enlargement of the heart, or of considerable pericardial effusion. The breathing, however, is frequently disturbed in connexion with disorders of cardiac action; diseases of valves and orifices, especially the mitral and tricuspid; enlargements of the heart, particularly dilatation; cardiac degenerations; congenital malformations; and clotting of blood in the cavities of the heart.

4. *Abnormal conditions of the air inhaled.*—The physiological effects produced upon the respiratory act by various states of the air inspired are well known. These especially depend upon its composition; its temperature; its degree of moisture or dryness; and its condensation or degree of pressure. From a clinical point of view these effects have to be borne in mind, as they are more liable to be induced in certain diseases, and may also be made available for therapeutic purposes. The presence of certain gases in the inspired air materially affects the breathing, and some are in this way more or less poisonous. Solid particles floating in the atmosphere may also produce disorders of respiration.

5. *Conditions affecting the apparatus concerned in the respiratory movements.*—These refer to the chest-walls and the diaphragm, and they include: (*a*) Certain painful affections, causing the patient voluntarily or involuntarily to limit or modify the movements, such as the early stage of pleurisy, pleurodynia, or peritonitis. (*b*) Spasm or paralysis of the muscles, from any cause. (*c*) Organic changes, as undue softness or rigidity of the thoracic walls, cancerous infiltration, muscular atrophy or fatty degeneration, or acute or chronic inflammation of the diaphragm.

6. *Obstruction involving the main air-passages.*—This may be situated in the mouth, throat, nasal cavities, larynx, trachea, or primary bronchial divisions, and is due to a variety of causes, which cannot be discussed here further than to state that the obstruction may depend upon pressure from without; spasm or paralysis of the muscles of the larynx; some internal obstruction, whether from deposits, secretion, abscess (including also retro-pharyngeal abscess), foreign bodies, or new-growths; or organic changes in the walls of the tubes, leading to their constriction.

7. *Physical conditions independent of the respiratory apparatus, but interfering with it in various ways.*—These may lie within the chest, as in the case of thoracic aneurysm, or a mediastinal solid tumour or abscess. They act by compressing the lungs or heart, obstructing tubes, affecting nerves, or interfering with the moving apparatus. Or the cause of the disorder may lie in the abdomen,

such as excessive flatulence or tympanites, ascites, enlarged organs, ovarian tumours, or a pregnant uterus. They act mainly mechanically, by impairing the movements of the diaphragm. Breathing often becomes worse after food in cases in which it is difficult, in consequence of flatulent distension, especially when digestion is impaired.

8. *Conditions affecting the pleura.*—Any accumulation of air or fluid in one or both pleural sacs will necessarily tend to disturb respiration, as in pneumothorax, pleurisy, hydrothorax, or hæmothorax. It acts mechanically, and the degree of disorder will depend on the amount of the collection, the rapidity with which it takes place, the previous condition of the lungs, and other circumstances. Pleuritic adhesions and agglutinations also tend to embarrass respiration more or less seriously.

9. *Morbid conditions of the lungs.*—These have been left to the last, and it will be readily understood that all diseases of the lungs tend more or less to produce disorders of breathing. At the same time it must not be forgotten that these organs may be affected, even somewhat extensively, under certain conditions, without any obvious respiratory disturbance. Pulmonary diseases act in various ways, of which the most important are by affecting the circulation and the amount of blood in the lungs; by interfering with the entrance or exit of air through the bronchial tubes; by temporarily disabling or permanently destroying more or less of the pulmonary textures; or by influencing the respiratory act through its forces, and especially by the impairment or loss of the elasticity of the lungs required for expiration.

Classification.—The arrangement of the numerous forms of disordered respiration is by no means an easy matter, and may be founded on different plans. Before giving that which seems to the writer to be a practical arrangement, he would urge the great importance of endeavouring to recognise in every case, by due investigation, what is the real nature of the deviation from normal breathing, and not merely to call it 'dyspnœa,' or 'difficulty of breathing.' Moreover, it must be remembered that there may be more than one form of disordered respiration in the same case.

The disturbance of breathing may be sudden, acute, or chronic; and its several forms may be included under three main divisions, namely: (1) **Deficient Respiration.** (2) **Dyspnœa or Difficulty of Breathing.** (3) **Peculiar Disorders.**

1. **Deficient Respiration.**—This comprehends the following varieties:—

(*a*) *Slow breathing.*—The frequency of the respirations may be notably reduced, without any other obvious disorder. Or this may be associated with marked shallowness of the movements, so that in extreme cases breathing seems to have almost or entirely ceased, and can scarcely be recognised even by the most delicate tests. These deviations are observed in various conditions or diseases affecting the nervous system, such as hysteria, trance, shock or collapse, narcotic poisoning, and some cases of cerebral disease. They are accompanied by impairment or loss of consciousness, real or assumed, and with other varying symptoms. Sometimes the breathing is slow but deep, and may then be sighing, stertorous, or attended with flapping of the cheeks in expiration; this is noticed in apoplectic conditions. These disorders of breathing do not obviously disturb the patient.

(*b*) *Restrained breathing.*—By this is meant that the patient makes a voluntary and conscious effort to restrain or modify the act, because it produces or increases some painful or other morbid sensation. It may be obvious at once to the observer, or may only be revealed when the patient is made to take a deep inspiration. The respirations are often increased in frequency, but may be below the normal. The entire movements may be affected, or only those of either the chest or the abdomen, or even only of one side of the chest. The early stage of pleurisy, peritonitis, and angina pectoris afford examples of diseases causing this disorder of breathing.

(*c*) *Shallow and feeble breathing.*—The most striking feature in some conditions is the extreme feebleness and limitation of the act of respiration. This has already been alluded to, as noted in some cases of slow breathing, but the frequency is often much above the normal, and the class of cases now under consideration differ essentially from those previously mentioned. The disorder indicates gradual cessation of the respiratory functions and pulmonary action, becoming more and more obvious, and gradually terminating in death. Little or no air is changed, and at last the breathing becomes a mere ineffectual gasp. This form of disturbance is observed in persons slowly dying from various causes; in gradual filling of the air-tubes in fatal cases of bronchitis; and in cases of apoplexy or narcotism. It is often accompanied by rattling or gurgling *râles*, audible to the bystander, due to the presence of fluid in the air-passages, which become by degrees filled up. It may follow certain forms of dyspnœa.

(*d*) *Ineffectual breathing.*—The derangement thus named can only be recognised by making the patient attempt to draw a full breath. He may then be conscious of an inability to perform this act satisfactorily, or to expand the chest properly. What is more important, however, is that this impairment of the respiratory act is often evident on objective examination, when it is seen that in certain conditions the most powerful efforts to breathe produce little or no result, and the movements are obviously more or less ineffectual, either as a whole, unilaterally, or locally. This may arise from various causes, such as paralysis or spasm of the muscles, rigidity of the chest-walls, distension of the lungs in emphysema, pleuritic and other conditions interfering with their expansion, and certain morbid changes in these organs themselves. Ineffectual breathing is frequently associated with some form of dyspnœa.

2. **Dyspnœa or Difficulty of Breathing.**—Without making too marked a distinction between them, and remembering that they may be variously combined, there are certain forms of disordered breathing, usually characterised as *dyspnœa*, which deserve separate recognition.

(*a*) *Obstructive dyspnœa; Inspiratory dyspnœa.*—This signifies that there is some obvious impediment or difficulty presented to the transmission of air through some part of the air-passages in respiration. The nature and severity of the disorder vary with the seat, cause, and degree of obstruction. Thus it may be that a swollen tongue, enlarged tonsils or other throat-condition, or retro-pharyngeal abscess, blocks up the passage more or less completely, and the patient breathes through the nose, often with obvious difficulty; or if some air passes by the throat, it does so with much noise, especially when the patient is asleep. More or less obstructive dyspnœa may also depend on conditions narrowing or blocking the nasal cavities.

The most important form of obstructive dyspnœa, however, is that which is connected with the main air-tube, and it usually attracts immediate attention. It may be associated with the larynx or the trachea, or with both, and in the case of the larynx is liable to exacerbations. The gravity of the phenomena varies with the degree of obstruction, but they are more or less of the following kind. The patient is usually conscious of a difficulty in the passage of the air during respiration, referred to some spot, which may become very distressing; the act of breathing is usually more or less laboured, and this may culminate in a violent effort or struggle to breathe. The frequency of respiration is often below the normal, or at any rate it is but little increased, while the relative length of inspiration and expiration is disturbed. The difficulty may be experienced only during inspiration, or during both divisions of the act of breathing, but is usually most marked in inspiration, though occasionally during expiration. Various noises are produced by the passage of the air through the narrowed part, usually classed as *stridor*, the breathing being termed *stridulous*; and to an experienced and trained ear these become of great importance as indicating the existence and seat of obstruction. Signs of deficient aëration of the blood are very liable to accompany this form of dyspnœa; and in acute or sudden cases, or if the obstruction is very marked, there is danger of actual suffocation which may occur rapidly or even suddenly. Physical examination will indicate that air does not enter properly into the lungs, as evidenced especially by recession of the lower part of the chest during inspiration, particularly marked in children, in whom this form of dyspnœa is likely to lead to most serious consequences.

The obstruction may be situated lower down in the respiratory tract, either in one of the main bronchial divisions, or in the tubes distributed through the lungs, and then the character of the disorder merges in that of ordinary dyspnœa, except that it is likely to be attended with various noises, and that the physical signs of deficient entrance of air into one or both lungs are evident. When there are evident objective signs of deficient entrance of air into the lungs, the condition is termed *inspiratory dyspnœa.* This difficulty, however, may also depend upon weakness of the chest-walls, and of the inspiratory muscles, as in rickets.

(*b*) *Excessive breathing—Ordinary dyspnœa.*—This is the disorder usually met with in various degrees, and it implies that respiration is carried on in excess. The act may be too frequent, or too powerful, or both, so that more than the ordinary amount of air is changed in a given time. The movements of the chest are more or less free under different circumstances. In severe cases the patient is obviously distressed, and the act of breathing is laboured, and may be noisy. Then the alæ nasi are seen to work; the patient cannot speak except in broken sentences, owing to want of breath; and there may be signs of apnœa. This form of dyspnœa is familiarly illustrated by the effects of undue exercise, such as running. Clinically it is associated in different degrees with numerous conditions, such as nervous disorders; fevers and other blood-conditions; many cardiac affections; conditions interfering with the action of the lungs, such as pleuritic effusion or abdominal accumulations; and various diseases of these organs, impairing their functional activity, especially if acute, such as pneumonia or bronchitis.

(*c*) *Shortness of breath.*—While associated with other forms of dyspnœa, this disorder frequently exists alone in various degrees, and it may be of much consequence in drawing attention to disease of a serious character. Shortness of breath signifies that the breathing becomes more or less hurried, and the individual becomes conscious of dyspnœa, after making some effort which ordinarily does not cause any such effects, such as walking rather quickly or upstairs, singing, coughing, stripping, or even taking a few deep breaths in physical examination of the chest. When at rest he may feel perfectly comfortable, and breathing is quite natural, but it is easily disturbed in the ways above indicated. This disorder is observed in general debility; very markedly in pronounced anæmia; in many cardiac conditions, especially dilatation and degeneration; in pleuritic effusion frequently; and in many cases of chronic lung-disease, such as phthisis or emphysema.

(*d*) *Expiratory dyspnœa.*—In the form thus designated the difficulty is experienced during expiration, which becomes prolonged and laboured, in some cases extremely so, the extraordinary muscles of expiration being called fully into play. The relative lengths of inspiration, expiration, and the pauses are thus deranged, and inspiration may become extremely short, even a mere gasp. There is often a sense of discomfort or even distress, and this is liable in certain conditions to be increased by exertion, after taking food, or in certain postures. Expiratory dyspnœa may be a prominent feature in some cases of obstruction of the air-tubes; but is essentially connected with impairment of the expiratory elastic force of the lungs in cases of emphysema, and of the chest-walls when they are rigid, these two conditions often going together. These causes are frequently aided materially by blocking-up of the bronchi, as the result of bronchitis; or by spasmodic contraction of these tubes, in connexion with asthma.

(*e*) *Orthopnœa.*—This is almost always combined with one or more of the other forms of dyspnœa, and the term indicates that the patient can only breathe at all, or at any rate with any degree of comfort, when the body is in a more or less upright posture. In some cases it is sufficient if he is propped up; in others he has to sit bolt upright in bed, or to bend forwards; in others still he is obliged to sit up altogether in some kind of chair, or even to stand, this being the only posture in which breathing can be carried on with any comfort. Cases of extensive cardiac disease, of acute pericardial and pleuritic effusion, of acute pneumonia, of asthma, and of aneurysmal or other thoracic tumours, afford illustrations of the causes of this disorder.

(*f*) *Paroxysmal dyspnœa.*—This may be of various kinds, but, as its designation implies, it signifies that the dyspnœa comes on mainly or entirely in fits or paroxysms. It is chiefly exemplified by paroxysms of laryngeal dyspnœa; by some cases of cardiac dyspnœa; and, above all, by fits of bronchial asthma. *See* ASTHMA, SPASMODIC.

3. **Peculiar Disorders.**—It is scarcely practicable to bring these under any definite subdivisions, and it will suffice to notice the very curious and often indescribable disorders of breathing observed in certain nervous cases; the interrupted, jerky, sighing, or yawning respiration which may be present in various conditions; and the peculiar disturbance generally known as *Cheyne-Stokes respiration*, but also termed *rhythmic dyspnœa.* This is rare, but may occur in connexion with certain cardiac diseases, especially fatty degeneration; Bright's disease; injury to the brain; and cerebral hæmorrhage, or other brain-lesions. It is characterised by the breathing at intervals becoming by degrees more and more rapid and deep up to a certain point; and then subsiding in the same gradual manner, until finally there is a complete cessation of respiration, with a dead silence, the pause lasting a variable time, and then the same series of phenomena being repeated.

EFFECTS.—Many of the disorders of breathing which have now been considered are not attended with any obvious effects, and are practically of little or no consequence. Moreover, it must be noted that patients may become so accustomed even to marked derangements of the function of respiration, that they are not conscious of any injurious results therefrom. Most individuals under such circumstances, however, are conscious of more or less discomfort or other sensations, referable to some part of the respiratory apparatus. These are very unreliable and vague in their meaning; but there are effects which give important information in many cases, and which depend either upon the want of due aëration of the blood, or upon the interference with the general venous circulation which disorders of breathing so frequently induce. These will vary, not only with the nature of the disorder, but also with its degree, and the rapidity with which it is set up. Thus there may be actual suffocation, sudden or rapid, or a condition approaching more or less that of asphyxia or apnœa (*see* ASPHYXIA). Or a chronic state of venous congestion and venosity of the blood may be set up, indicated by a tendency to cyanosis, with enlargement of the visible superficial capillaries; general chilliness and coldness of the extremities; mental apathy or dulness, with headache and other signs of morbid blood-supply to the brain; general languor, laziness, and muscular weakness; dyspeptic disorders; changes in the urine; and other well-known phenomena. In cases where the respiratory functions are chronically affected in children and young persons, in such a way that the blood is never properly aërated, growth and development are markedly impeded. Patients suffering thus may present a peculiarly stunted appearance. The features tend to become permanently thick and coarse; and the ends of the fingers and toes often become clubbed. In certain forms of dyspnœa the fat of the body tends to disappear; while the muscles of respiration not uncommonly become hypertrophied from excessive use.

TREATMENT.—The indications to be fulfilled in treating disorders of respiration, and the measures by which these are to be carried out, must obviously present considerable variety in different cases; and it will only be practicable here to offer a few general hints on the subject. In the first place, no treatment whatever may be called for in some instances; while in other cases nothing can be of any service. The primary indication should always be to attend to the cause of the disorder, and by curing, removing, or alleviating this, the disturbance may often be got rid of or materially diminished. This may be illustrated by treatment directed to laryngeal obstruction, anæmia, pleuritic pain or effusion, bronchitis, or cardiac derangement. By improving the condition of the blood when anæmia is present, breathing is frequently much improved, even when actual disease exists which disturbs it, such as phthisis or cardiac mischief. Attention to the condition of the air inhaled is in some cases of much importance, as regards its purity, temperature, degree of moisture, pressure, and other points. It must be remembered that some forms of dyspnœa actually require an atmosphere which contains an abnormal proportion of carbonic acid. Great advantage frequently results from giving proper instructions to patients as regards posture, avoidance of exertion, diet, the act of coughing, or even the act of breathing itself. This is especially important in certain forms of paroxysmal dyspnœa; and any cause which is known to produce any such attack should be carefully avoided. Moreover, the patient may sometimes be materially assisted in the act of breathing by mechanical means. Not uncommonly active measures are called for, for the purpose of relieving some more or less urgent form of dyspnœa. For this purpose various means are indicated in different cases, such as venesection, or local removal of blood from the surface of the chest; dry-cupping over this region; the internal administration of antispasmodics, stimulants, pulmonary sedatives, or other appropriate agents; inhalations of different kinds, in the form of gas, vapour, or smoke; subcutaneous injections of morphine or other active drugs; or the application to the chest of sinapisms, hot poultices, fomentations, or turpentine stupes. Treatment directed to the asphyxial condition may be urgently demanded, especially artificial respiration (*see* ASPHYXIA); and operative procedures, such as laryngotomy or tracheotomy, or intubation, may be called for in cases where the main air-tube is obstructed. In chronic cases, where the respiratory functions are imperfectly carried on, the conditions resulting therefrom must be remembered, and as far as possible obviated. Warm clothing is essential under such circumstances; and, if practicable, a residence in a genial and warm climate is often of the greatest practical service.

FREDERICK T. ROBERTS.

RESPIRATORY MURMUR.—The sound heard on auscultation over the lungs in respiration. *See* PHYSICAL EXAMINATION.

RESPIRATORY ORGANS, Diseases of.—SYNON.: Fr. *Maladies des Organes de la Respiration*; Ger. *Krankheiten des Respirationsapparates.*—The diseases which must be referred to in this article are those involving the special organs by which the function of respiration is performed. These comprise, first, the lungs, in which the process of respiration takes place; secondly, those organs through which the air is brought into contact with the blood, that is, the air-passages, and the agencies by which the movement of the air is effected; thirdly, indirectly, the organs by which the blood is brought into contact with the air, that is, the heart and blood-vessels.

FREQUENCY AND FATALITY.—GENERAL ÆTIOLOGY.—Before enumerating the several morbid conditions of the respiratory organs, it will be well to indicate the importance of this class of diseases—an importance which is due partly to the remarkable frequency with which they occur, and partly to the great fatality by which they are attended.

On reference to the returns of the Registrar-General, we find that, whilst during twenty-five years 5038·7 per million of persons living died of zymotic diseases, no fewer than 5840 died of diseases of the respiratory organs (including phthisis, and excluding the organs of circulation). This report further shows that the two great classes of diseases, the zymotic and respiratory, together accounted for almost one-half of all the deaths from every cause, including accidents. It must be remembered, further, that these figures represent only the number of *deaths* from these diseases, and that they give but a rough indication of the number of instances of sickness more or less grave, existing at the same time, from the same causes.

When we come to investigate more closely the nature of these diseases, it is not difficult to account for the frequency with which they occur. Complicated, delicate, and sensitive as the respiratory organs are in structure and function, including the pulmonary circulation, and the important changes in the blood which occur in the capillaries of the lungs; controlled, as the respiratory system is, by the nervous system, itself subject to a great variety of influences of a morbific character; dependent for the performance of the healthy act of respiration upon the continual movement of the mechanism which admits air to the lungs, namely, the chest-walls and the respiratory passages; affected also by the temperature of the air, subject as it is to great variety, by its purity, liable as this is to be contaminated by noxious gases, micro-organisms, and other impure particles, as well as to be damaged in its quality by alterations as regards dryness or moisture—it is easy to understand how the respiratory organs should become so frequently the seat of disease. Besides the more important influences to which we have referred, it will suffice to mention the effect that is exerted by such factors as occupation, age, sex, and climate. These several ætiological points will be found fully discussed in the articles Climate; and Disease, Causes of. The influences of inheritance and diathesis also contribute powerfully to the causation of disease of the respiratory organs, more especially as predisposing elements in the production of phthisis, although the influence of both can be traced in certain other morbid states, such as bronchitis and asthma.

General Pathology.—The respiratory organs are liable to the several forms of injury and of disease which affect the other organs and tissues of the body. The injuries, including wounds and the presence of foreign bodies, are chiefly of surgical interest. The chief diseases are: (1) disturbances of circulation, including inflammation and its effects; (2) degenerations; (3) new-growths; (4) malformations and malpositions; (5) deformities; and (6) nervo-muscular disorders.

1. Disturbances of the circulation are found more especially in the mucous membrane of the air-passages, in the substance of the lungs, and in the serous coverings of these organs. Thus we have, as instances of inflammation, specific or otherwise—coryza, laryngitis, and tracheitis (including croup and diphtheria); bronchitis, in its several and varied forms; pneumonia, in its different varieties, and pleurisy; ulceration, which may occur in any part of the tract; and gangrene, especially of the lungs. Congestion more generally affects the lung-substance, but it is also to be met with in the mucous membranes of the passages. Hæmorrhage may occur from any portion of the air-passages, or from the substance of the lung itself, as the result of congestion, of tubercular disease and its effects, of disease of the heart, of diseases of the blood-vessels of the lungs, as well as from other causes. Thrombosis and embolism may be found in connexion with the pulmonary artery and veins.

2. Examples of degenerative disease are presented by the indurations which the cartilaginous tissues of the larynx, trachea, and chest-walls undergo; in the degeneration which is traceable in the air-cells in connexion with emphysema; the pigmentary and calcareous changes found in the bronchial glands and lung-tissue; and the caseous degeneration of inflammatory and new growths, such as tubercle.

3. The most important of the new-growths are tubercle; malignant disease in its several forms, whether primary or secondary, that is, extending from surrounding parts; syphilis in its various stages, more especially when affecting the larynx; polypi, adenoid over-growths, and other non-malignant formations in connexion with the nasal passages and throat; and hydatids.

4. Malformations and malpositions of the lungs and air-passages are of rare occurrence, and are of most importance when portions of the lungs are undeveloped, as in atelectasis.

5. Deformities implicate most frequently the walls of the chest.

6. Lastly, there are the various nervo-muscular affections comprehended under the names of whooping-cough, nervous aphonia, spasmodic cough, laryngismus stridulus, hiccough, spasmodic dyspnœa, including asthma, paralysis of the laryngeal muscles, of the walls of the chest, or of the diaphragm; also pleurodynia and intercostal neuralgia.

Although we have thus spoken of the several portions of the respiratory organs, and the diseases which affect them, as having, so to say, separate relations, we find no such isolation existing in the natural history of their diseases. Thus, for example, we seldom find inflammation of the lung in the absence of an affection of the pleura; whilst, when the like process affects the air-passages, it is rarely limited to one part, such as the larynx, trachea, or bronchi, without involving others, and it frequently passes on into the substance of the lung itself. Again, one morbid process may be, and is very frequently, associated with others: thus inflammation may lead to degeneration of tissue, or *vice versâ*; new-growths may give rise to obstruction of breathing, to inflammation, and frequently to hæmorrhage; and nervo-muscular affections may be either the cause or the effect of similar disorder or disease. Here, too, we have to observe the relation between heart-disease and disease of the lungs; likewise between morbid states of these organs and diseases of the abdominal organs.

General Symptomatology.—The special symptoms of disease of the respiratory organs are founded essentially on disturbances which prominently affect their functions. Thus we have: (1) Disorders of the respiration, which are discussed in a separate article. (2) Obstructions and consequent disturbances of the circulation, which cause (*a*) congestion of the superficial or deep-seated organs, including the heart itself, the cavities of which may become dilated; and (*b*) hæmorrhages, especially hæmoptysis. (3) Disorders of secretions, and morbid products, giving rise to varieties of expectoration of more or less importance, as symptomatic of different forms of disease (*see* Expectoration; and Sputum, Examination of). (4) Cough, a symptom seldom absent, and presenting many varieties. It is sometimes entirely referable to nervous disturbance and of a reflex character; whilst at other times it is the means by which secretions are expelled, which might otherwise accumulate, and lead to further embarrassment and distress (*see* COUGH). The diseases of the respiratory organs are often attended by local and constitutional disturbance, as are diseases of other organs, such as pain, fever, wasting, and general debility, which will vary according to the nature of the morbid process and the part involved, as will be found fully described under special headings.

PHYSICAL SIGNS.—The function of respiration is so intimately associated with physical conditions and mechanical actions, that the respiratory organs afford special materials for the application of the principles of physical diagnosis, and the employment of clinical apparatus, including the rhinoscope, the laryngoscope, the stethoscope, the stethometer, and other instruments. The movements of air and the resonance of the voice through the several classes of air-passages, and into the minute textures of the lungs, cause characteristic sounds which are readily recognisable by the ear. These sounds become modified by the presence of disease, and afford characteristic evidence by which its existence and nature may be determined. The size, shape, and movements of the chest-walls afford also available evidence in physical diagnosis. Valuable information is afforded by a part that is resonant becoming dull, or by a part which should be dull becoming resonant. For further information on these points, *see* PHYSICAL EXAMINATION.

TREATMENT.—The diseases of the respiratory organs must be treated, whether for their prevention or for cure, on those general principles which are applicable to the treatment of the diseases of other viscera; with such modifications as may be called for by the special structure and function of the organs themselves, and by any special features which disease affecting them may present. These general principles, and their particular applications, are so fully set forth in the articles which treat of the several diseases of the different parts of the respiratory system, that it is not necessary to discuss them again here.

But, seeing the extreme frequency with which disease of these organs occurs, and its grave results, affecting alike the young and the old, those who labour and those who pursue only pleasure, those who live in cabins and those who live in castles—for *æquo pulsat pede pauperum tabernas regumque turres*—we may enter a little more fully on the subject of their prevention.

The principles which must guide us in this direction, independently of those which fall under the head of general hygiene, are fully treated of in other articles. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

1. The first point to be insisted on is that a supply of *uncontaminated air* is essential for the prevention of lung-disease. Impure air is found in the homes of the poor, and in their close and crowded workshops; but it also abounds in the assembly-room, the banqueting-hall, and such-like places. The remedy for this evil will be found when people are made to feel that pure air is as essential to health and life as is unadulterated food; and when those who construct houses are convinced that they have no more essential duty to perform than that of devising means for the removal of impurities, and for the supply of pure air as well as pure water.

2. Pure air, however, can only be utilised by *freedom of the respiratory movements.* Many employments and trades involve constrained positions, which, no doubt, are often unavoidable; but even in such cases a knowledge of the fact that such positions are hurtful, with a desire to remedy the evil, will frequently suggest means for its mitigation. Like results follow a very different source of restriction on the movements of the chest, namely, the use of stays and other articles of dress, which not only compress the chest-walls and prevent their free movements, but even displace the contained organs. Much harm may also result from a practice which is called 'setting up' or drill in the army. The recruit is required to 'throw back the shoulders,' a position in which the pectoral muscles are made to act as constricting bands. The drill-sergeant aims at expanding and throwing forward the chest-wall, which he does not effect by merely throwing back the shoulders. This object can only be accomplished by teaching the person drilled to take deep inspirations, and to carry the chest-walls forward. The frequency with which diseases of the lungs, and of the organs of circulation within the chest, occur in the army is a recognised fact, which may in some degree be explained by this objectionable system of drill.

3. In the prevention of chest-disease it is necessary to guard against *vicissitudes of atmosphere and temperature.* This fact is more readily admitted than its teachings are adopted. Many delicate persons may escape lung disease by wintering abroad. Most persons cannot entirely avoid exposure to these vicissitudes, but even in such cases counteracting influences are often practicable, and should always be employed. Again, there are those who, not always from necessity, having respired heated air, perhaps for hours, suddenly expose the delicate respiratory mucous membrane to cold air, or the heated surface of the body to a chilling draught. Disease thus originated is within the knowledge of all of us, and all know that such results might have been obviated by forethought. Lastly, there is the necessity for protecting the organs within the chest

by suitable covering. Suitable, for example, as is the dress worn by ladies during the day, the dress, or rather the undress, of many in the evening would seem almost designed to leave uncovered and unprotected, both front and back, as much as possible of the space which contains the lungs. Many instances of grave disease have thus originated. The remedy is not far to seek, in resisting the objectionable rules of fashion.

If more attention were given to obtain pure air for respiration, and to secure freer action of the respiratory organs, and if more precautions were practised in guarding against the effects of atmospheric changes, it is but a truism—which will not lose in force by being repeated here—to say that diseases of the respiratory organs would be infinitely less frequent in their occurrence than they are, and less serious in their results.

Finally, if these remarks apply, as they do, to the strong and healthy, it is unnecessary to urge the absolute necessity of insisting upon the practical suggestions which they convey in the case of persons whose respiratory organs are either constitutionally delicate by inheritance, or have been previously weakened by disease. Such are the chief victims of chronic lung-disease; and in no class of disease is prevention so absolutely essential.

RICHARD QUAIN.

REST, Therapeutics of.—In considering rest as a therapeutic agent it is requisite to understand its nature, its varieties, the indications for its use, and the ways of employing it. There are three chief varieties: (1) Rest of the *whole body* by sleep; (2) rest of the *mind*; and (3) local rest of a *diseased organ* or *inflamed part*. Of any of these, but of the third in particular, the practitioner may directly avail himself in the treatment of disease. The *modus operandi* of these varieties of rest consists in allowing the impaired, perverted, or lost functions of a part, or of the whole of the human frame, to be reinstated by maintaining the equilibrium of demand and supply. Hence it is only by availing oneself of the *physiological* properties of the component parts of the body, that rest becomes a therapeutic agent; and it must be borne in mind that *physiological* rest does not mean another variety, but rather that it regulates the employment of one or more of these varieties; and that, whether applied to the whole frame, to the mind, or to a localised part, it is the agent, in the guiding hands of the practitioner, which cures.

1. *Rest of the whole body and mind: repose in sleep.*—This form of rest, which is so necessary to the well-being and the due performance of the several functions of the human body, accomplishes two ends: the arrest of further waste of nerve-force and tissue-metamorphosis—a checking or 'diminution of chemical action' (B. Jones); and the repair of the organs employed in maintaining daily life. Rest of sleep, in a healthy man, does not of itself restore energy to the weary limbs, or vigour to the exhausted frame—it does but place the patient in the best possible condition for nature's recuperative powers to exercise their sway without detraction or interruption. Sleep may be looked upon as both a preventive of disease, and a curative means. The want of sleep and its attendant physiological processes of repair to the growing tissues of an infant—arising from whatever cause it may, such as teething, gastric catarrh, flatulence, or worms—becomes of itself a direct cause of arrest of development and of wasting diseases, and lays the seeds of future misery and early death. A healthy adult can for a time, with impunity, do without much sleep; but it should not be forgotten that the want of it acts as a great predisponent to the infection of fever and all contagious diseases, and that in any diseased condition, if continued for any length of time, it becomes a direct cause of death.

2. *Rest of the mind: relaxation.*—The light story, the strains of music, the change of scene and society, are familiar to all as among the many ways by which rest is given to the overworked brain and careworn mind.

The waste of nerve-force attendant on long and deep thought, and the many strains put upon the brain in these days of emulation and hurry, must be repaired, in like manner as muscular waste, by sleep and cessation from all mental work for a time. In too many cases has it happened that insomnia, the first indication of the disturbance of that equilibrium of the mental state comprehended in the term 'sanity,' has ended, before long, within the portals of an asylum, in epilepsy, insanity, or imbecility.

Hence, 'in all diseases,' writes Hilton, 'of no matter what nature, of the cerebro-spinal system, when the evidence of disease is in deranged function, it becomes our duty to look upon and treat the altered nerve-substance as we do contusion and laceration of soft parts and congestion of organs, and to give the brain absolute rest, to rely on nature's power to repair the injury or disturbance, and to avoid stimulants, which excite rapid circulation, as much as possible. The brain disturbed in its vital endowment becomes unequal to even its ordinary duties. It recovers itself slowly; it then soon becomes fatigued from use; and if claims are made upon it too soon after injury—that is, before structural and physiological integrity are re-acquired—the patient is very likely to suffer from serious disease of the brain. The brain requires absence from occupation, or rest, for its complete recovery, and this should be in proportion to the severity and duration of the symptoms it presents; in fact, the length of time which has been required by nature for the repair of the injury must be in proportion to the severity of the local injury; and the more severe the injury the longer the time required for perfect recovery of the functions of the brain. If this principle were only adopted generally and the plan carried out, we should not witness so many chronic diseases of the brain.' *See* Personal Health.

3. *Local rest.*—This, which may be called *mechanical rest*, is well known to every surgeon to be an agent of supreme value in the treatment of wounds, fractures, displacements, or inflammation of joints; as it is obvious that every movement to which a wounded or inflamed part is subjected must act on the one hand like the repetition of the original injury, and on the other hand like a continuance of the irritating cause. Thus rest is not only a negative advantage, as saving the patient from renewed injury or irritation, but a positive remedy, as it diminishes the heat of the body, reduces the pulse, and alleviates pain. Rest is of so much value in the treatment of inflammation, that in some instances no means will advance the cure without it, and numerous injuries of the body, external or internal, would do well with perfect local rest and nothing else.

It was on this principle that Pott treated all fractures of the extremities, by placing the limbs in a position of easy flexion, and thereby the muscles which had been thrown into spasm by the fracture were relaxed.

To a physician mechanical rest is an invaluable agent, and yet its benefits are not recognised in a practical way at all as frequently or as fully as they should be.

Application.—The application of rest in diseased conditions of the different parts of the body is so varied, and the cases in which it should be employed are so numerous, that it would be impossible to enumerate them all. In surgical practice rest is constantly used in the treatment of injuries and diseases. Here we shall only deal with its employment in medical practice, and shall select a few examples out of many to illustrate its benefit in different regions of the body.

A. **Diseases of the Respiratory Organs.**—The objects of the treatment by rest may be stated to be (Roberts): (1) To maintain structures, which are actually diseased, or in danger of becoming so, in as quiescent a state as possible; in short, to try to produce mechanical rest, as is ordinarily done in the case of a diseased joint. (2) To check or limit the entrance of irritating gases—be they noxious, or simply of a different degree of temperature or humidity from that of the internal part with which the air comes in contact. (3) To quiet the circulation through the organs which are being placed in a condition suitable for repair.

1. *Acute inflammation of the larynx and bronchi.*—The patient is to be placed in an equable and moderately high temperature, and the atmosphere impregnated with moisture; all speaking or using the voice must be forbidden, while the patient's wants may be made known by means of a slate and pencil (Hilton).

2. *Acute capillary bronchitis.*—In this disease, while *general* rest is to be maintained, the indications to relieve the congested right heart, and to remove the mucus which is causing the symptoms of asphyxia, predominate; and *physiological* rest cannot be obtained by mechanical rest alone. Here relief is attainable by restraining on the one hand the outpouring of mucus into the small tubes of the lung, and getting rid of that which is already poured out, by means of alkalis and stimulating expectorants; and by maintaining, on the other hand, the forces of the circulation, and relieving the overloaded right heart, by hydragogue cathartics, diuretics, and diaphoretics.

3. *Pleurisy.*—In addition to keeping the patient quiet, restraining breathing, and forbidding conversation, the most effectual way of employing rest to the inflamed surfaces of the serous membrane, is by mechanically fixing the side with adhesive plaster, as we would do for an inflamed joint. The forms of pleuritis to which this is most applicable are: Acute general pleurisy, seen early; dry pleurisy of a small area; that accompanying pneumonia, the result of a fractured rib; and in the advanced stages of phthisis pulmonalis, where fits of coughing and pain are produced by stretching of the bands of organised lymph which bind the costal and visceral layers together. The plan proposed by Dr. F. Roberts, and which has answered remarkably well in the hands of the writer, is as follows: Apply two or three layers of plaster, cut in strips of about four inches, thus: the first strip is laid on obliquely in the direction of the ribs, the second across the course of the ribs, the third in the direction of the first, the fourth as the second, and so on until the entire side is covered. A strip is also passed over the shoulder, which is kept down by another fixed round the side across its ends. Each strip should be long enough to extend from the spine to the sternum.

4. *Phthisis pulmonalis.*—The stage at which mechanical rest becomes a decided therapeutic measure is that of breaking down of the lung-tissue, and the formation of large cavities. Its application at an earlier stage is also useful in relieving the distress of breathing; but it seems most suitable as a means of checking the short hacking cough, and the stitch-like pains, produced by stretching of those parts of the lungs which

have been united by adhesive inflammation to the costal layers of the pleura. By means of strapping the upper part of the chest, corresponding to the disease, with diachylon spread on leather, and filling all the hollows previously with cotton-wool, so as to prevent all motion on inspiration or expiration, rest and quiet are obtained, and not only is cicatrisation encouraged, should such have commenced, but the risk of either hæmorrhage by rupture of an artery, or the laceration of the pleura pulmonalis and consequent pneumothorax, is averted.

B. **Diseases of the Heart and Blood-vessels.**—1. *Pericarditis.*—The mode of applying rest in this disease must necessarily be different from that which obtains in pleurisy, as actual arrest or even limitation, to any degree, of the heart's action—which theoretically and by analogy might be expected to be followed by the best results—would of course be out of the question. Rest must therefore be differently attained, by general rest and quiet, and by physiological medication. The advantages of perfect rest in the horizontal position are evident, as by it the attrition of the inflamed surfaces against each other is lessened by some 17,280 beats in the twenty-four hours, and thereby the tendency to effusion diminished, and resolution encouraged. The medicine above all others to produce physiological quiet is opium. When not otherwise contra-indicated, and when carefully watched, it is to be used freely, in grain doses every second or third hour, as it is remarkably little liable to produce narcotism.

2. *Internal aneurysm.*—For a long time, until recent years, this disease was looked upon as beyond the reach of medicines or cure. Valsalva saw the clue to treatment, and attempted to induce rest and such a state of the general circulation that the aneurysmal sac might be filled by the fibrin of the blood; but the means he adopted were not physiologically correct, and to Mr. Tufnell of Dublin is due the credit of having so modified the treatment as to obtain that rest which alone can cure the aneurysm. Tufnell's method may shortly be stated to be as follows: The patient is to be placed in a bright airy room on a prepared bed or couch, on which he must be contented to remain for eight or ten weeks. He must thus lie in the horizontal position, and not even for a moment assume the erect posture. Accordingly, the bed must be so constructed that the requirements of nature can be attended to without alteration of position. The diet is to be restricted to a minimum of solids and fluids. The patient's mind is to be freed from all anxiety, and pain and sleeplessness relieved by opium. The object of these means is to give rest to the aneurysm (1) by reducing the absolute quantity of blood circulating, without taking any of its ingredients from it by bleeding; (2) by rendering the blood hyperinotic; (3) by diminishing the rate and force of the current through the sac. The horizontal position in a healthy individual makes a difference of at least twelve cardiac beats a minute less than the erect position, and in disease this difference amounts to twenty or even forty beats. Taking it at the lowest rate of difference, it is evident that in the horizontal position the pulse-wave passes 17,280 times less through the body in the twenty-four hours. The aneurysmal sac is proportionately less often distended, and the threatened breach in the wall of the artery is averted by layers of fibrin deposited by the more slowly moving and concentrated stream.

C. **Diseases of the Abdominal Viscera.**—In the therapeutic consideration of disease of these organs the principle of rest is not less plainly indicated than in the other parts of the body we have discussed; and by neglect of so simple and yet so potent an agent all other treatment may signally fail to relieve or to cure.

1. *Diseases of the stomach and intestines.* The whole basis of treatment often depends upon strict diet, and in some cases temporary total deprivation of food, enemata supplying the requisite nourishment. Local rest can best be obtained by the physiological action of opium upon the vermicular movements of the intestines, and by avoiding all irritants or purgatives. Opium may be required in full doses, so as to arrest all peristalsis; and thus an inflamed or ulcerated surface is placed at rest, and nature is enabled to prevent perforation, and cure the disease. It cannot be too strongly stated that the injudicious employment of purgatives in threatened perforation is not only unscientific, but the worst possible practice, as it is almost sure to result in the death of the patient. This line of treatment by rest holds good in simple or cancerous gastric ulcer, Curling's ulcer, typhoid ulceration, and that due to inflammation of the appendix vermiformis. The practitioner will find it also his best guide and indispensable aid to cure in perityphlitis, hepatic abscess, ileus, after operations for hernia, and in various other conditions.

2. *Inflammation of the kidneys.*—As the skin and bowels may vicariously perform many of the excretory functions of the kidney, the first indication in acute nephritis is to relieve and rest that organ, by general rest, local depletion, and by calling vigorously upon the skin and intestines. In some cases where the equilibrium of secretion and excretion is thrown much out of balance, and where convulsions and dropsy point to an hydræmic and toxæmic state, we should use venesection as the readiest and most efficient means of attaining our object, of curing by rest.

J. Mager Finny.

RESTLESSNESS. — This signifies a condition of constant movement; the movements being random and non-purposive, or only semi-purposive and fitful in character. The condition itself may be due to the most various causes. Thus it may be met with in children who are the subjects of connate mental defects, and who are scarcely ever at rest during their waking hours; or it may be seen for a time, and especially in 'nervous' people under conditions of extreme mental excitement. In various forms of delirium, or of mania, either subacute or acute, restlessness also exists to a well-marked degree. Where it occurs in fevers to a notable extent it usually co-exists with delirium. Restlessness is likewise a prominent feature in patients who are suffering from severe and abiding pain in almost any part of the body; or in those who have suddenly lost large quantities of blood, either from the uterus or elsewhere. *See* JACTITATION.

TREATMENT.—This being a mere symptom, dependent upon very many totally different underlying conditions, its treatment in each particular case resolves itself into the treatment of the general condition upon which the symptom is dependent.

H. CHARLTON BASTIAN.

RESUSCITATION (*re-*, again; and *suscito*, I stir up).—DEFINITION.—The recovery from suspended animation or apparent death. In these conditions, of course, all signs of circulation and respiration have disappeared, but usually the failure of one function has preceded the other. For the purposes of treatment we may regard as (A) *syncope* those cases where the lips and mucous membrane are found pale and exsanguine; and as (B) *asphyxia* those where they are dark-coloured.

A. **Syncope.**—Syncope may arise (1) from mental emotion, sudden pain, or shock; (2) from drugs and poisons, including anæsthetics, especially chloroform; (3) from hæmorrhage, or anything which reduces the due supply of blood to the heart; and (4) from fatty degeneration or dilatation of that organ.

TREATMENT.—Place the patient horizontally on his left side, with the pelvis and feet raised. Nélaton has urged complete inversion of the body, but by its interference with the free action of the diaphragm this method may be injurious. The windows of the room should be opened; the face fanned; and a little cold water may be sprinkled on the forehead. Smelling salts being held to the nostrils, if natural breathing has not returned, begin *Howard's method* of artificial respiration: *Position of patient.*—Face upwards; a hard roll of clothing beneath thorax, with shoulders slightly declining over it. Head and neck bent back to the utmost. Hands on top of head. Strip clothing from waist and neck. *Position of operator.* — Kneel astride patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rest upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers dipping into the corresponding intercostal spaces. Fix your elbows firmly, making them one with your hips. *Action of operator.*—Pressing upwards and inwards towards the diaphragm, use your knees as a pivot, and throw your weight slowly forwards two or three seconds, until your face almost touches that of your patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this movement as before, continuing it at the rate of seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural.

This method is said to keep the passage through the larynx free without the aid of an assistant or any contrivance for the purpose, and is recommended for that reason. Artificial respiration must precede the use of the stomach pump, and be continued until either the pulse or natural respiration returns. Keep up the temperature of the body by hot blankets or hot bottles. Stimulating the heart by galvanism has been recommended, but it is a doubtful remedy. It is not easy to make it produce general and effective contraction, such as would cause the blood to move forward, and, failing to do this, it probably does harm by exhausting the irritability of those parts which it does excite. Ether, or nitrite of amyl, may be held to the nostrils. A little brandy and hot water, eau-de-Cologne and water, wine, or other stimulant, as sulphuric ether or sal volatile, is now to be given, with care that none of it enters the trachea. If swallowing is impracticable, inject warm fluids into the rectum. In cases of syncope from loss of blood, transfusion may be required. *See* TRANSFUSION.

B. **Asphyxia.** (a) *Asphyxia neonatorum.* The mouth and nostrils of the infant should be wiped dry; and the body freely exposed, whilst the head is allowed to fall back over the hand which supports the nape. A few drops of cold water may be sprinkled upon the chest, and the face should be fanned or blown upon for one minute only. Next inflate the lungs by blowing into the nose and mouth; and then squeeze the trunk. The body should now be immersed in water at 100°, from which the chest should be raised every half-minute and sprinkled with cold water. Sylvester's method of artificial respiration is the best. Marshall Hall's and Howard's methods may be used after the first inspiration has occurred, or together with mouth-to-mouth insufflation (*see* ARTI-

FICIAL RESPIRATION). Experiments made by Dr. Champneys show that Hall and Howard's methods of artificial respiration are absolutely useless as a means of directly inflating the lungs of still-born children; and also that Sylvester's method, and its modification by Bain and Pacini, introduce more air than any other method.

(b) *Asphyxia from breathing noxious gases.*—The body should be brought into fresh air; artificial respiration at once commenced, whilst an assistant should blow into the nostrils three or four times; and hot blankets and hot-water bottles applied.

(c) *Asphyxia from mechanical obstruction of the air-passages.*—The cause of obstruction must be removed, if possible, by adopting the inverted position of Howard's method. Coins or plum-stones may thus dislodge themselves. In the absence of forceps, a button-hook or the handle of a tablespoon may be useful, especially in the removal of a lump of hard food. Laryngotomy or tracheotomy must be performed the instant the pulse becomes imperceptible at the wrist.

(d) *Asphyxia from poisons or anæsthetics.*—In the asphyxia of advancing coma from narcotics and anæsthetics, the breathing may stop from failure of the medulla and respiratory tract. In this case artificial respiration, by simply compressing the chest at intervals of five seconds, may suffice, but very often there is the mechanical obstruction in the larynx to be considered. If raising the chin and throwing the head back do not effect a free passage of air, Howard's or some other method of artificial respiration should be commenced (*see* ARTIFICIAL RESPIRATION). It is well to understand that when the muscles of the larynx are paralysed, the glottis becomes valvular in action or partially so—that is to say, it permits air to pass outward freely, but only a weak current of air to pass inward. A strong current brings the sides together and gives rise to complete obstruction. This is chiefly caused by the drawing together of the relaxed arytæno-epiglottidean folds of mucous membrane; and in order to obviate this kind of obstruction, the folds should be tightened, by throwing back the head and raising the chin as far as possible away from the sternum. This will render it unnecessary to catch hold of the tongue with artery forceps, the treatment usually recommended.

(e) *Asphyxia from drowning.*—In asphyxia from immersion in water there are two serious complications, namely, first, the presence of water and mud in the air-passages, and, secondly, the depressing effect of cold. With the view of more effectually removing the water from the air-tubes, Howard gives the following rules: *Position of patient.*—Face downwards. A hard roll of clothing beneath the epigastrium, making that the highest point, the mouth the lowest. Forehead resting on forearm or wrist, keeping mouth from ground. *Position and action of operator.*—Place left hand, well-spread, upon the base of the thorax to the left of the spine; the right hand upon the spine, a little below the left. Throw upon them, with a forward motion, all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds by a sharp push, which helps you back again into the upright position. Repeat this two or three times, according to the duration of the immersion, and then resort to the method described in the treatment of syncope.

The following rules have been published by the Royal Humane Society. They recommend the Sylvester method, but probably this and the modification by Bain, in which the anterior fold of the axilla on both sides is grasped with the clavicle and pulled upwards, are less useful than the Howard plan, which favours the patency of the air-passages.

Directions for Restoring the Apparently Dead.

I. If from DROWNING OR OTHER SUFFOCATION, OR NARCOTIC POISONING.—Send immediately for medical assistance, blankets, and dry clothing, but proceed to treat the patient INSTANTLY, securing as much fresh air as possible.

The points to be aimed at are—first, and immediately, the RESTORATION OF BREATHING; and secondly, after breathing is restored, the PROMOTION OF WARMTH AND CIRCULATION.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for at least an hour.

Treatment to Restore Natural Breathing.

Rule 1.—*To maintain a free entrance of air into the windpipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue, and keep it forward: an elastic band over the tongue and under the chin will answer this purpose. Remove all tight clothing from about the neck and chest.

Rule 2.—*To adjust the patient's position.*—Place the patient on his back on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades.

Rule 3.—*To imitate the movements of breathing.*—Grasp the patient's arms just above the elbows, and draw the arms gently and steadily upwards, until they meet above the head (this is for the purpose of drawing air into the lungs); and keep the arms in that position for two seconds. Then turn down the patient's arms, and press them gently and firmly for two seconds against the sides of the chest (this is with the object of pressing air out of the lungs. Pressure on the breast-bone will aid this).

Repeat these measures alternately, deliberately, and perseveringly, fifteen times in a minute, until a spontaneous effort to respire is perceived, immediately upon which cease to imitate the movements of breathing, and proceed to INDUCE CIRCULATION AND WARMTH.

Should a warm bath be procurable, the body may be placed in it up to the neck, continuing to imitate the movements of breathing. Raise the body in twenty seconds in a sitting position, and dash cold water against the chest and face, and pass ammonia under the nose. The patient should not be kept in the warm bath longer than five or six minutes.

Rule 4.—*To excite inspiration.*—During the employment of the above method, excite the nostrils with snuff or smelling-salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them.

Treatment after Natural Breathing has been Restored.

Rule 5.—*To induce circulation and warmth.*—Wrap the patient in dry blankets, and commence rubbing the limbs upwards firmly and energetically. Promote the warmth of the body by the application of hot flannels, bottles, or bladders of hot water, hot bricks, &c., to the pit of the stomach, armpits, between the thighs, and at the soles of the feet. Warm clothing may generally be had from the bystanders. When swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. Sleep should be encouraged. During reaction large mustard poultices to the chest will relieve the distressed breathing.

II. If from INTENSE COLD.—Rub the body with snow, ice, or cold water. Restore warmth by slow degrees. It is dangerous to apply heat too early.

III. If from INTOXICATION.—Lay the individual on his side on a bed with his head raised. The patient should be induced to vomit.

IV. If from APOPLEXY or SUNSTROKE.—Cold should be applied to the head, which should be kept raised. Tight clothing should be removed, and stimulants cautiously used.

How soon should alcoholic stimulants be given? Certainly not until natural respiration has been induced; and in cases of narcotic poisoning, not until consciousness has been restored. If, on the return of consciousness, the patient is in pain or faint, the inhalation of a few drops of ether or smelling ammonia is indicated. In the absence of these a few teaspoonfuls of brandy may be given. Hot tea and coffee should be the first refreshment swallowed, and in general it should not be pressed upon the patient, as vomiting is more exhausting than waiting a few hours for food. J. T. CLOVER.

RETCHING (A.-S., *hræcan*).—An ineffectual effort at vomiting, sometimes accompanied by the expulsion of gas from the stomach. *See* VOMITING.

RETENTION (*re-*, back; and *teneo*, I hold).—This word is employed in medical science to imply that some material, whether solid or liquid, which ought to be discharged, is retained or kept back in a cavity or canal, either natural or artificial. Thus we speak of *retention of urine*, *fæces*, *menses*, and *bile*; and also of *pus* under certain circumstances.

RETENTION OF URINE. — *See* MICTURITION, Disorders of.

RETINITIS. — Inflammation of the retina. *See* EYE, AND ITS APPENDAGES, Diseases of.

RETRACTED ABDOMEN. — The abdomen as a whole presents under certain circumstances more or less depression of its anterior wall, when it is said to be *retracted*, and this may reach such a degree that the region becomes 'boat-shaped,' and its anterior boundary sometimes seems almost to come into contact with the spinal column behind. The bony prominences of the crest and anterior angles of the ilium, the pubes, Poupart's ligament, and the lower margin of the chest often stand out prominently. In some instances the retraction is partial, involving the lower part of the abdomen, while the upper part is distended.

A retracted abdomen frequently renders it more easy to investigate by physical examination the contents of this cavity; and it must be remembered that the condition may be associated with diseases of abdominal organs, which can then be readily detected, or even with abdominal tumours. It may, however, also itself give information of importance in diagnosis. The chief conditions under which a retracted abdomen may be met with, so as to be of clinical importance, are as follows: (1) In certain cases of disease of the brain or its membranes, and especially acute tubercular meningitis. (2) In some forms of intestinal colic, particularly that form associated with lead-poisoning – the so-called *painter's colic*. (3) As a part of marked general emaciation from any cause, but especially that due to starvation, or to chronic diarrhœa from intestinal ulceration and other conditions. (4) In connexion with chronic diseases of the œsophagus, stomach, intestine, or pancreas, causing obstruction in some part of the alimentary canal, so that food cannot be taken in, or is prevented from passing along the tube. Here the retraction is also partly due to the general emaciation.

(5) As one of the consequences of chronic peritonitis. It will be seen, from a consideration of the causes just mentioned, that retraction of the abdomen immediately results either from a spasmodic contraction of the intestines and abdominal muscles; general wasting; absence of food from and contraction of the alimentary canal; or peritoneal adhesions. It may be mentioned that marked temporary retraction of the abdomen is sometimes noticed in connexion with the act of breathing, in consequence of disordered action of the diaphragm. *See* DIAPHRAGM, Diseases of.

FREDERICK T. ROBERTS.

RETRACTED CHEST.—*See* DEFORMITIES OF THE CHEST.

RETROCEDENT (*retro*, back; and *cedo*, I go).—A term employed in connexion with certain acute diseases, when their prominent external manifestations disappear or, as it were, go back. Retrocession is often associated with the simultaneous occurrence of internal disturbance. The phenomenon is observed in gout, rheumatism, certain skin-diseases, and the eruptive fevers.

RETROFLEXION (*retro*, back; and *flecto*, I bend).—A form of displacement in which an organ is bent backwards upon itself. *See* WOMB, Diseases of.

RETRO-PHARYNGEAL ABSCESS.—SYNON.: Post-pharyngeal Abscess; Fr. *Abcès Rétro-pharyngien*; Ger. *Retropharyngeal Abscess.*

DEFINITION.—A collection of pus in the loose areolar tissue which connects the pharynx with the muscles lying upon the vertebral column, namely, the longus colli and the rectus anticus major.

ÆTIOLOGY.—This is a somewhat rare affection, and is more commonly met with in children than in adults, more particularly in those of a strumous diathesis. Idiopathic inflammation of this tissue, though usually assigned as one of the causes of the affection, is not often seen. More frequently the inflammation (and resulting abscess) is a secondary disorder, dependent upon an inflamed condition and suppuration of a post-pharyngeal gland, or caries of some of the cervical vertebræ or their cartilages. Amongst other causes, pyæmia has been noted. The disease has also been observed as a sequela to some of the acute fevers, notably scarlet fever; and, rarely, as a consequence of disease of the nose.

SYMPTOMS.—As in all disorders where inflammation plays a part, so here, the onset of the disease is marked by increase of temperature and pulse, nausea, general restlessness and malaise; and already some amount of soreness of throat is complained of. The degree of pyrexia and constitutional disturbance will vary with the condition and constitution of the sufferer. Soon this soreness of throat develops into the true characteristic pain on making the attempt to swallow, a symptom which is never wanting, and which goes on gradually, though slowly, augmenting, till almost complete dysphagia is established. Accompanying this, or soon after, is observed a peculiar stiffness of the neck, which, coincidently with the difficulty in swallowing, becomes more apparent with the progress of the disease. A certain amount of swelling of the neck may also be observed, specially towards the angles of the lower jaw. Difficulty in breathing is another prominent symptom of the disorder, which, more particularly if the abscess be large, becomes greatly aggravated when the patient assumes the horizontal posture. On first looking at such a child with its embarrassed respiration, its anxious expression, its cyanotic lips and cheeks, one might well be excused for momentarily diagnosing the case as one of croup, were it not that, loud and hurried as are the respirations, they are not of a whistling character. Here also the voice is altered: at first hoarse and indistinct, it assumes what is described as a snuffling tone, or a toneless character. On inspecting the throat, a round swelling is observed in the posterior wall of the pharynx, occupying the centre of the pharyngeal space, or more to one side, whereby the cavity is greatly diminished in size. The mucous membrane presents a livid colour. On passing the finger over the root of the tongue and beyond the soft palate, this swelling will be felt to be either hard and tense, or soft and somewhat indistinctly fluctuating, according to the stage of the disease. When the enlargement attains an extraordinary size it has been seen to project in front of the soft palate. A quantity of mucus usually fills the mouth. All attempts at swallowing are fruitless.

PROGNOSIS.—The prognosis in retro-pharyngeal abscess is always doubtful. Most usually well-pronounced cases terminate fatally—invariably so if the disease depends upon caries of the vertebræ.

TREATMENT.—Little can be expected in the way of arresting the disease. Usually it is well-pronounced before the physician is called to see the patient; and as it is most commonly met with in children, early diagnosis, before the formation of pus, is less easy. If pus have not yet formed, the part may be painted with weak solution of iodine. To enable the patient to swallow food, and to reduce infiltration, a 10 per cent. solution of hydrochlorate of cocaine may be applied. Ice may be freely administered, and is most grateful to the patient. So soon as the presence of an abscess is distinctly established, surgical interference must at once be had recourse to. Sustaining treatment is urgently demanded.

CLAUD MUIRHEAD.

RETROVERSION (*retro*, back; and *verto*, I turn).—A form of displacement in which an organ is turned back. *See* WOMB, Diseases of.

RE-VACCINATION.—The operation of repeated vaccination. *See* VACCINATION.

REVULSENTS (*revello*, I draw away). This term dates from the time of the humoral pathology, and signifies therapeutical measures which draw the humours from the part affected. Any detailed consideration of such supposed effects could only be interesting from an historical point of view.

R. FARQUHARSON.

RHEUMATIC ARTHRITIS.—SYNON.: Osteo-arthritis; Rheumatoid Arthritis; Rheumatic Gout; *Malum Coxæ Senile*; Fr. *Rhumatisme Noueux*; *Usure des Cartilages Articulaires*; Ger. *Arthritis Deformans.*

DEFINITION.—A disease of the joints, the essential nature of which is unknown; characterised by chronic inflammatory and degenerative changes, involving the various articular structures; and leading to deformity.

ÆTIOLOGY.—In a considerable proportion of cases, rheumatic arthritis follows ordinary acute rheumatism immediately, or it appears after an interval of several years, during which time chronic rheumatism of a milder degree may have been complained of. Persons of all ages may suffer, but the disease generally begins between twenty and forty. It is commonly believed to be more frequent in women. Depressing influences of all kinds, including acute diseases, menstrual disturbances, chronic uterine disease, frequent pregnancy, puerperal disease, superlactation, the menopause, prolonged physical exertion, privation, unhealthy surroundings, and mental distress unquestionably act as predisposing factors. The disease is hereditary, in the same form or as acute or chronic rheumatism. Gout is very often present in the family history, and not uncommonly tuberculosis also.

The influence of cold and damp as exciting causes is very marked. In some instances injury of a joint is the starting-point of the morbid process. Occasionally it follows gonorrhœal rheumatism.

ANATOMICAL CHARACTERS.—Two well-marked forms of rheumatic arthritis are met with, according as a single joint only, or several—perhaps all—of the joints are affected. The anatomical characters are identical in the two forms.

Examined at an *early* stage of the morbid process, an affected joint is found to be enlarged; the synovial membrane, capsule, and ligaments being distended and stretched by a considerable amount of effusion. The synovial membrane is hyperæmic, swollen, and thickened; its fimbriæ are enlarged and vascular; intra-articular fibro-cartilages, ligaments, and tendons are vascular and softened; and the articular cartilages are partially removed, leaving a roughened, vascular, porous-looking surface behind.

In the more *advanced* stage of the process the effusion is considerably less, or may be completely re-absorbed; and the capsule and ligaments are much thickened, or even partially calcified. The intra-articular structures, including fibro-cartilages, ligaments, tendons, and articular cartilages, may have disappeared in great measure, leaving little or no trace behind. Peculiar bodies, consisting of pendulous masses of fibro-cartilage, are attached to the interior of the synovial membrane; more rarely they are free. The articular cartilages, where their opposed surfaces are in mutual contact, are replaced by an ivory-like layer of bone; whilst at other parts the surfaces present a pink coloration, with small spots of more intense hyperæmia. The articular surfaces are variously altered in shape and size. Thus articular cavities are widened, and occasionally deepened, by enlargement of the circumference, in the form of 'lips,' or by the production of separate bony masses in the same situation. The heads of bones are enlarged; present similar 'lips' or sharp edges at their widened margins; become flattened at right angles to the axis of pressure; and thus preserve their relations with the corresponding cavities, but can be readily dislocated from them. The shafts of the bones may be considerably altered in shape, increased in size, and changed in density. The associated tendons are frequently dislocated from their course beside the articulations, and atrophied or actually absorbed. The corresponding muscles are similarly atrophied. Bursæ in the neighbourhood of joints may be distended with fluid, and contain fibro-cartilaginous bodies; periostitis may also occur. The anatomical changes in this disease frequently present a remarkably symmetrical distribution. Peripheral neuritis occasionally accompanies the arthritic lesions.

SYMPTOMS.—The symptoms of rheumatic arthritis in its condition of full development are exceedingly characteristic. The patient complains of pain and stiffness in connexion with one or more joints; and on examination these are found to be swollen, more or less deformed, and tender. The history of these changes in the joints proves to be that first one and then others of the articulations were the seat of acute arthritis, and became painful, tender, hyperæmic, and swollen; that the resulting enlargement had not completely disappeared before the acute symptoms recurred; and that, by a repetition of similar acute or sub-acute attacks, the joints have reached their present condition. Thus the disease, whilst chronic in its course, consists essentially at first of recurrent acute, or sub-acute, attacks, which increase in frequency whilst their effects persist, and so finally become fused, as it were, into a continuous whole.

The *local* symptoms and signs vary with the particular joint affected; but in every instance they are chiefly these—pain, tenderness, creaking on movement, impairment of mobility, enlargement, and deformity, in connexion with the joint, and atrophy of the associated muscles. The pain is generally distressing, and may render the patient's life miserable by its continuousness and severity, especially as it increases at night and prevents sleep. It is aggravated by movement, and there is tenderness on forcible disturbance of the articular surfaces rather than on pressure. Creaking or crepitation, audible and palpable, is a highly characteristic feature, which can be elicited and appreciated either by the patient or by the practitioner, and in the case of large joints may be so loud as to be audible at a distance.

The mobility of the affected joints becomes more and more impaired as the disease progresses—at first on account of pain, afterwards in consequence of anatomical changes. Thus the various joints may become fixed by a 'false' (very rarely a 'true') ankylosis, so that the hands cannot be closed; the wrists are immovable; the arms can hardly be removed from the side; the jaws are fixed; the head cannot be rotated; the patient may be unable to sit; and the knees, ankles, and toes may be similarly impaired in function.

The variety of deformity is almost endless; and the particular character it assumes depends as much on the joint involved as on the nature of the process itself. Thus the knee, elbow, wrist, and knuckles may present considerable intra-articular effusion, especially in the earlier stages; whilst the shoulder, hip, and intra-phalangeal joints exhibit more limited swelling and 'drier' signs. The terminal digital joints become cuboidal or 'nodous'; the middle digital joints assume a spheroidal shape, or are partially dislocated backwards or forwards; and the knuckles are the seat of a peculiar oblique dislocation of the fingers towards the ulnar side. The lower ends of the radius and ulna project backwards, and give a full appearance to the dorsum of the wrist, which may be further increased by extra-articular puffiness, carpal and bursal enlargements, and atrophy of the muscles of the hand and forearm. Altogether, the hands and wrists are the joints most frequently affected. The elbow-joint is swollen; and bursal collections—fluid and solid—develop over the olecranon. The shoulder presents signs of wasting, rather than of enlargement, due to atrophy of the deltoid and other muscles; the head of the humerus at the same time lies unnaturally forwards and upwards; and a corresponding depression is apparent behind. At the hip-joint the disease gives rise to flattening of the buttock, shortening of the limb, and eversion of the foot; enlargement can sometimes be felt in connexion with the head of the bone and acetabulum; occasionally the patient may be not only lame but unable to sit, and accordingly must either stand or lie constantly. The knee, a very common seat of the disease, is enlarged by the presence of considerable effusion in the earlier stage; and when this afterwards becomes absorbed, local bony growths are easily felt, giving increased breadth to the patella, and forming sharp crests at the lateral margins of the articular surface of the condyles. The disease, as it affects the ankle and foot, does not require special description. At the temporo-maxillary articulation rheumatic arthritis gives rise to obvious enlargement in front of the ears, and possibly to distortion or asymmetry of the chin. Prominent nodular swelling is the principal sign of the disease at the sterno-clavicular articulation. In the spine it chiefly produces rigidity, as well as pain locally and down the arms, and leads to a variety of permanent deformities, with which contractures and distressing spasms of the extremities are sometimes associated.

The *general* condition of the subject of rheumatic arthritis, when it is advanced, is one of debility and anæmia. The face is pale and expressive of suffering; the complexion is muddy. The skin is peculiarly inactive, and rarely perspires. The patient looks pinched, and complains of a feeling of cold; the extremities are often miserably cold and livid; and the palms of the hands are damp or even soppy. Pyrexia, rising to 101° with considerable remissions or intermissions, may be present in the active phases. Bodily activity is greatly impaired, owing to interference with the movements of the limbs; in many instances the patient is completely crippled and bedridden. Even the voice and the hearing may be impaired, from involvement of the laryngeal and auditory articulations. Pains in the muscles and along the nerve-trunks and in the extremities may accompany or possibly precede those in the joints. Myotatic irritability is frequently increased. The various bodily functions are feeble, and frequently deranged; and although the mind may be active, the condition is rendered wretched in the worst cases by pain, deformity, and helplessness. In a considerable proportion of cases (5·75 per cent., Brachet) the patient is the subject of chronic valvular disease of the heart. Dr. Kent Spender has drawn attention to the frequent occurrence in rheumatic arthritis of other symptoms variously associated with the disease: gastric crises; increased tension and frequency of the pulse, which may rise to 120 or more; excessive pigmentation of the skin, in the form of symmetrical patches, streaks, or spots; and yellow bruise-like blotches on different parts of the body.

Course and Terminations.—The course

of rheumatic arthritis has been already described. Unless it be treated early, the disease progresses essentially towards deformity. Death from rheumatic arthritis is rare; its other distressing effects have been sufficiently indicated.

Pathology.—Great diversity of opinion prevails as to the essential nature of rheumatic arthritis. Whilst most authorities acknowledge acute rheumatism as a cause of rheumatic arthritis, many of them regard it as simply one of the many possible sources of chronic articular irritation. The view most generally held in this country appears to be that it is a disease distinct from rheumatism and gout, with which it was confounded until the time of Haygarth (1805). Mr. Hutchinson maintains that, in a certain number of instances, there is an element of gout, as well as of rheumatism, in the disease. Dr. Ord makes light of the diathetic element, and attaches most importance to a nervous factor in the pathology of this disease, which he regards as a dystrophy of joints, muscles, and other associated tissues, traceable to direct or reflex affection of nervous structures, or to general nervous depression. Dr. Kent Spender also holds that the affection of the joints is merely one sign of a profound nerve-disorder. Dr. Archibald Garrod argues strongly in favour of the dystrophic theory of the disease. The writer's experience is in favour of the strictly *rheumatic* nature of rheumatic arthritis, as was maintained by Todd, and by Charcot and French authorities generally. In many cases he has found that the morbid process started in an attack of ordinary acute rheumatism, as was originally represented by Adams of Dublin. In numerous instances the family history is distinctly rheumatic. The frequent association of heart-disease is very important evidence in the same direction. Finally, no sharp line can be drawn between acute and subacute cases of rheumatism; between subacute and chronic cases of rheumatism; or between chronic rheumatism and so-called ,rheumatic arthritis.' Whatever, therefore, the essential nature of rheumatism may be, the writer holds that all the conditions named are expressions of one morbid process, which differ from each other partly in intensity, and partly in the manner of their evolution. Sir Dyce Duckworth considers it a manifestation of a basic arthritic stock or diathesis—a rheumatic branch of this stock, and therefore a true rheumatism.

Diagnosis.—The diagnosis of rheumatic arthritis necessarily depends upon the view entertained of its pathology. If considered a distinct disease, it is, as a rule, easily separated from gout by the entire absence of tophi about the joints and in the ears; by the history of the disease; and, in doubtful cases, by the absence of uric acid in the blood. From chronic rheumatism, as ordinarily defined, it is diagnosed by the amount of deformity present; but the writer holds that the two conditions are but different manifestations of the same morbid process. Chronic synovitis of traumatic or constitutional origin may be occasionally mistaken for rheumatic arthritis; but the presence of the latter disease in several joints, probably symmetrically, should remove all doubt. Rheumatic arthritis of the hip and shoulder has been described as 'dislocation' and 'intracapsular fracture.'

Prognosis.—The prognosis of this disease is favourable as regards life; but unfavourable as regards cure, comfort, or ability to follow active bodily employment. The prognosis is much better in the rich, who can seek relief by change of climate in the earlier stages, than it is amongst the poor, in whom the disease must in a measure be allowed to pursue its progressive course.

Treatment.—The treatment of rheumatic arthritis must be applied in two directions: first, to arrest, if possible, the morbid process; and secondly, to relieve the distressing symptoms. In a large number of cases the second indication only can be fulfilled, for the disease is frequently too advanced, or the circumstances of the patient are too poor, to afford a prospect of cure.

In the *early stages* of the disease much can be done by energetic treatment, which must be partly constitutional and partly local. If circumstances permit, the patient should be advised to visit, according to the season of the year, the baths either of this country, of Germany, or of France, in summer; or the Algerian springs, the French Riviera, or Italy, in winter. Buxton, Bath, and Strathpeffer are the best home baths. Aix-les-Bains, Aix-la-Chapelle, Baden-Baden, and Wiesbaden may be recommended from May till September. The other places named, especially Hammam R'Irha in Algiers, are winter resorts. At all properly appointed baths massage now forms a part of the treatment. The climate of Egypt proves beneficial in some instances. A voyage to the tropics or subtropics will suit other patients. *See* Mineral Waters.

The most valuable internal remedies for rheumatic arthritis are cod-liver oil, iron, and arsenic. Cod-liver oil should be taken regularly if the digestion permit. Either iron or arsenic, or the two combined, should be taken in full doses for periods of weeks or months, and their effects carefully noted. Sir Alfred Garrod especially recommends the syrup of the iodide of iron. For the acute symptoms, particularly pain, salicylates may sometimes be given with success. In obstinate cases a trial should be given to iodide of potassium and to guaiacum.

The diet should be carefully ordered. Whilst all excess is avoided, as well as indulgence in malt liquors, and rich, indigestible dishes, a generous supply of mixed animal and vegetable food, and wholesome stimulants, will be found to be most suitable. The patient should take advantage of every possible opportunity of enjoying daily outdoor exercise in fresh air and sunshine. The clothing must be warm, flannel or other woollen material being worn both summer and winter. Great care must be exercised to avoid cold and damp, in the routine of daily life, and in the choice of a residence.

The *local* treatment is to be considered of hardly less importance than the constitutional. On the first appearance of the disease, counter-irritation should be freely employed around the joints by means of tincture or of liniment of iodine, which may be used until the skin becomes of a mahogany colour. The joints should then be carefully protected by cotton-wool or flannel, and kept at rest by means of bandages or other means of support, according to the part that is involved. At the end of the subacute attacks of the disease, efforts must be made to restore the healthy nutrition of the affected joints by removal of the support, and by local stimulation and graduated exercise. The joints that can be easily reached should be thoroughly fomented night and morning, by wrapping a piece of dry cambric or flannel around them, and sponging water over this, as hot as can be borne. After ten minutes of such treatment the joints should be unwrapped, carefully dried, and then thoroughly rubbed, either with a stimulating liniment, such as the turpentine or acetic turpentine liniment, with a mild mercurial ointment, or with some bland oil, such as cod-liver oil or goose-grease. A light warm covering is then to be applied. The effect of local treatment of this kind, if pursued steadily, is often remarkable, mobility being restored in cases where the joints have been useless for months.

In very *advanced cases*, especially in old subjects, it is manifestly unreasonable to expect much improvement. Anodyne treatment is then chiefly called for, and a good deal can be done in this direction by suitable mechanical arrangements and well-chosen local applications, the preparations of opium being, of course, the most successful. Phenazone may relieve pains and spasms of the crippled limbs. The general health will demand support by a well-regulated diet and the internal treatment suggested above.

J. MITCHELL BRUCE.

RHEUMATIC FEVER.—A popular synonym for acute rheumatism. *See* RHEUMATISM, ACUTE.

RHEUMATIC GOUT. — A popular name for several kinds of chronic joint-disease, especially rheumatic arthritis and chronic rheumatism.

RHEUMATISM, Acute (*ῥεῦμα*, a fluxion).—SYNON.: Rheumatic Fever; Fr. *Rhumatisme Articulaire Aigu*; Ger. *Acuter Gelenkrheumatismus*.

DEFINITION.—An acute disease; caused by certain obscure diathetic, climatic, or infective influences; and characterised by fever, sweats, and acute shifting inflammation of the joints and related structures.

ÆTIOLOGY.—*Predisposing causes.*—Of the predisposing causes of acute rheumatism, the most important is inheritance, which can be traced in 27 per cent. of all cases ('rheumatic diathesis'). Previous attacks may be said to increase the liability to a return of the disease; but there is a limit to predisposition from this cause after several attacks. The great majority of first attacks occur in persons under the age of thirty; and the larger proportion of these between the ages of sixteen and twenty-five. At the same time, rheumatism is by no means uncommon either in children or in persons past middle life. Rather more males than females suffer; but, apart from other circumstances, the influence of sex is inconsiderable. Indeed, when all the varieties of the disease are included, it is more common in girls than in boys. Occupation and social position are important as predisposing causes. Laborious outdoor occupations, in which persons are exposed to chills, poverty, and the many evils associated with these, contribute to furnish the largest percentage of cases. Certain regions or districts, parts of districts, or even houses, appear to deserve the name of 'rheumatic,' from the number of residents who suffer from the disease, and from the probability that a person, otherwise predisposed to rheumatism, will be more likely to be attacked if he enter such an area.

Determining causes.—The most common exciting cause of acute rheumatism is exposure to cold and wet, or exposure to chill after severe exertion (*see* PERSONAL HEALTH: 5. Adolescence); but no definite ætiological relation can be traced between prevalence of the disease and weather or season. Rheumatism may suddenly make its appearance after a sprain or other injury to a joint, which may also determine the distribution of the disease in the articulations. Similarly, the order of invasion of the several joints is due in some instances to the amount of exercise to which they have been respectively subjected. An attack of acute rheumatism is occasionally referred to derangement of digestion, and of the functions of the liver, especially in subjects who have previously suffered. Indulgence in abundant, rich, or indigestible food will certainly determine a relapse in persons convalescing from the disease, and may possibly induce an attack in the predisposed. Bodily exhaustion or depressing mental influences, and acute diseases of other kinds, such as scarlet fever, erysipelas, and influenza, may excite rheumatism under similar circumstances. Exhaustion by lactation, or by chronic uterine disease, tedious convalescence, the puerperal state, and possibly simple despondency, may also act in this way in different instances. Some authorities regard the disease as infectious, and occasionally epidemic; others as caused by a drain poison. A specific micro-organism has been described as the *causa vera.*

Anatomical Characters.—The *post-mortem* appearances in acute rheumatism are, on the whole, remarkably negative, not so much on account of the absence of morbid changes in the affected parts, as from the slight degree to which these changes have advanced. On opening an affected joint, we find moderate hyperæmia, with occasional ecchymosis, of the synovial membrane and fibrous tissues connected with the articulation. The synovial surfaces present a somewhat opaque, granular, swollen appearance. A considerable amount of inflammatory effusion occupies the articular cavity. This is generally a thin, clear, alkaline, albuminous fluid; occasionally it is turbid, with flakes of fibrin and cell-products; rarely purulent. The cartilages connected with the joint probably share in the inflammatory changes, especially if the process be severe; and the associated soft parts, including the tendons and their sheaths, are very frequently hyperæmic, and the seat of effusion. In the subcutaneous structures in young subjects there may be found, over the articular ends of the bones, and connected with the fasciæ and with tendon sheaths, small nodules of fibroid tissue, with a translucent appearance. These present the microscopical characters of rapidly growing connective tissue.

A fatal termination in acute rheumatism is always the result of some complication, intercurrent disease, or injury; and in such cases the non-arthritic lesions are necessarily the most important. Of these the most frequent are inflammation of the heart and pericardium, and congestion or inflammation of the lungs. Inflammation of the pleura is less commonly found; in rarer instances inflammation of the peritoneum, bronchi, larynx, meninges, testes, and renal tubules. When pyrexia has been high the solid viscera present granular degeneration, and are prone to rapid decomposition; and in cases of hyperpyrexia the blood is fluid. The blood has frequently been subjected to chemical analysis, but without any positive result of a pathological kind. The reaction of the liquor sanguinis is alkaline, as in health. The fibrin has been said to increase in amount to 1 per cent. instead of ·2 per cent. The amount of urea is not above the normal. Neither excess of uric acid, lactic acid, nor any other abnormal principle has been found in the blood during an attack of acute rheumatism. The presence of micrococci, zooglœar masses, and bacilli in the blood and serum has been described, but not substantiated. The red corpuscles are rapidly diminished in numbers during the acute stage, and rapidly restored during convalescence.

Symptoms.—**General Description.**—After suffering for a time from aching pains in the limbs and trunk, flying pains and stiffness in the joints, malaise, chilliness, and sore-throat, the subject of an attack of acute rheumatism is seized with severe pain in one or more of his joints, experiences a chill or slight rigor, and is found to have several degrees of fever. The local and general symptoms quickly develop; and a striking picture is presented by the patient. He lies motionless in bed, flat on his back, with every joint at rest and carefully guarded. The neck, back, and legs are straight; the arms folded across the body, or extended along either side; the eyes alone are moved, and follow the practitioner as he approaches the bedside. The face is found bedewed with perspiration; and the rest of the body is profusely covered with sweat, which gives off a sour, acrid odour. The countenance is full, heavy, and expressive of a subdued feeling of pain and dread of movement; the complexion may be of a dirty, sallow colour, or even slightly jaundiced; the cheeks are probably flushed. The affected joints prove to be swollen and red; hot to the touch; remarkably tender; and the seat of pain, which varies much in character and intensity. One joint, or several, or nearly every joint in the body, may be found in the condition just described. The patient also complains of a feeling of illness, thirst, and anorexia; the tongue is foul and creamy; the throat may be somewhat sore; and the bowels are irregular. The pulse is frequent, soft even to dicrotism, and rather large. Respiration is somewhat accelerated; and there may be slight cough. The urine is scanty, high-coloured, very acid, and loaded with lithates. The skin is covered with perspiration, congested, and warm; and probably presents sudamina or miliaria in places. The patient's mind is perfectly clear, and his attention appears to be chiefly directed to the maintenance of the affected joints in the most easy position possible. Until successful in this endeavour he is restless and miserable; and even if he have obtained temporary relief and have gone to sleep, he is liable to be suddenly aroused by involuntary spasm of the muscles connected with the affected joints. The pain is so severe when the disease is at its height, that sleep cannot be obtained.

Such is the condition of a patient suffering from a fully developed attack of *uncomplicated* rheumatism. For a period, which would appear to be perfectly indefinite, these symptoms continue, varying considerably in intensity from day to day. But whilst the condition thus persists, the remarkable and characteristic fact is constantly observed in this disease, that the arthritic phenomena are at once transient and erratic, that is, that the rheumatism passes rapidly from joint to joint, the joints which were affected the one day being nearly well the next, and a fresh series swollen and painful. In this manner most of the joints of the limbs may have been affected in the course of a week, and the number of joints simultaneously affected is very variable. Thereafter the disease may make a further invasion of joints previously involved, and that repeatedly.

At last, the rheumatism appears to have exhausted itself: no fresh joint is attacked; and the parts last affected lose more or less completely the final traces, both objective and subjective, of the severe process which they have undergone. The patient now assumes a less constrained posture; the other symptoms decline; the perspirations disappear; the countenance becomes more bright; spirits and strength return; the tongue cleans, and the appetite is rapidly restored; the pulse falls in frequency; urine is passed in greater quantity, is less acid, and no longer deposits urates; and the temperature falls to the normal. The joints remain for some time, however, stiff, weak, and painful on movement. Relapse is not uncommon at this stage, or a little later. Anæmia and debility are almost constant sequelæ.

Analysis of Clinical Phenomena.—**Invasion.**—In the great majority of cases the patient gradually 'sickens for' acute rheumatism for several days before the symptoms are fully declared. He feels ill and out of sorts, chilly, indisposed to eat or work; sleeps badly; complains of sore-throat, aching pains in the limbs, and shooting shifting pains in the joints; and presents a sallow, patchy complexion, and a dull, heavy, yellowish appearance of the eyes. Altogether, the condition of the patient is very much that of the subject of a severe catarrh; the tongue, digestion, bowels, urine, and pulse presenting the ordinary characters of moderate fever. On careful examination it is found that the pains are of two kinds. The first kind are by far the more severe, and consist of severe muscular aching in various parts of the limbs and trunk; whilst the second kind are of the nature of flying pains in the joints or associated parts. The muscular aching appears to be similar to, or even identical with the 'break-bone' pains which are familiar in influenza, and in the invasion stage of some eruptive fevers. They are, therefore, not characteristic. The flying pains, which are, however, not always present —especially in first attacks, are actually situated in the articulations, for instance, the ankles, knees, or wrists, and are of the nature of sharp twinges, suddenly leaving one joint to return as quickly in another. Towards the end of the stage of invasion these pains become less 'shifting;' and when, as the patient will say, they have 'settled' in one or more joints, the rheumatism has passed into the second stage, that of the declared disease. Stiffness of the joints may also be present, especially in recurrent attacks.

In the invasion period the skin does not yet present the perspiratory activity which is so characteristic a symptom of acute rheumatism; but rather a moistness, greasiness, or oiliness, with heat and some congestion. The temperature is raised one degree or more. The sore-throat, which consists in pharyngeal catarrh, follicular tonsillitis, or even actual acute suppurative inflammation, is remarkably characteristic. The milder forms are soon lost in the more urgent symptoms.

The duration of the stage of invasion of acute rheumatism varies greatly, the flying pains in the joints 'settling' much more quickly in some cases than in others. In a small proportion of cases the disease is so rapidly developed that the stage of invasion is wanting. The patient on waking in the morning finds one or more joints affected; or he appears to be struck down during the day without the slightest warning; and instances are not unknown in which persons, thus suddenly seized with acute rheumatism, have been removed to hospital, for supposed sprain or fracture of the limbs. In rarer instances the feverish symptoms of the invasion stage may be well-marked without any pains whatever.

Declared Disease.—1. *Phenomena connected with the joints.*—The physical signs presented by a joint affected with acute rheumatism naturally vary much. The *swelling* is usually considerable, and is chiefly referable to effusion into the cavity of the articulation, fluctuation being frequently discoverable. It is rare for the periarticular effusion to be so abundant as to yield pitting on pressure. Neighbouring tendons and tendon sheaths may be swollen, as well as tender. The amount of intra-articular effusion (as well as the pain) greatly influences the position of the joint, but most joints are maintained in a position a few degrees removed from extension. Careful examination will determine the increase and the disappearance of the swelling, as the joints are attacked and recover respectively.

Pain is the most distressing of all the symptoms in uncomplicated rheumatism. It is always severe, and sometimes almost unbearable; but it varies with the different joints, and with the degree and duration of their involvement. In degree, it may be said to increase steadily for several hours; it remains excessive for a time; and it then slowly and steadily declines. Its character is very differently described by different sufferers. When a joint is attacked by rheumatism, the first sensation felt by the patient is one of soreness on movement. As the condition develops, the soreness increases to an ache of a subdued, throbbing character. In the course of a few hours the ache 'works up' into an intense pain, apparently associated with a feeling of cramp, the slightest movement of the articulation being almost unbearable. The severe pain now gradually declines—in some instances from the time the swelling reaches its height. After several hours the only pain that remains is a distressing sensation as if the parts had been severely bruised; and the effusion which accompanied the excessive pain having declined along with it, rest of the joint again becomes all-important, the very slightest movement being sufficient to restore the wearying ache. Finally, the pain completely disappears, and nothing remains beyond a feeling of stiffness and helplessness when the joint is moved.

Whilst the course of the pain of an acute rheumatic attack is usually such as has been described, it is greatly modified by a variety of circumstances, such as the particular joint affected, the age and sex of the patient, the condition of the nervous system, and the presence of certain temperaments. In some instances the pains are increased at night.

Tenderness is a constant and well-marked symptom of acute rheumatism. Reference has already been made to the effect of movement on the pain in its different stages, especially towards the end; and to the characteristic posture and anxious expression of the patient, who suffers intensely from the slightest shake of the bed, or even a footfall on the floor. Tenderness finally declines into the feeling of stiffness on movement.

The *redness* of a rheumatic joint is a simple pink blush of erythema, very rarely purpuric. Its intensity varies much, with the superficial or deep situation of the articulation, and it is therefore most marked in connexion with the joints of the hands and feet, the knees, and the ankles.

Heat of the affected joint is a well-marked objective sign of acute rheumatism. The skin over the articulation feels decidedly warmer to the hand than the surrounding parts; and this observation is confirmed by the thermometer.

The *electrical sensibility* of the skin connected with an acutely rheumatic joint has been described by Drosdoff as being remarkably diminished, the area of nervous alteration corresponding exactly with the area of redness, and its duration with the duration of the other local signs and symptoms.

The *favourite joints involved* in acute rheumatism are the larger articulations, especially the knees, ankles, wrists, shoulders, and elbows; the hip joint less frequently than the others. The fingers come next in order of frequency; then the toes; whilst the remaining articulations are more rarely affected.

Corresponding rather closely with the frequency of attack is the *favourite order of invasion*; the ankles being more frequently the first to be involved, then the knees, and so on. In other instances it is observed that the disease passes along the joints of the lower limbs, including the hips, to those of the upper limbs; frequently its distribution is symmetrical bilaterally; whilst in some cases it is unilateral, the homologous joints of the upper and lower limb being simultaneously invaded. The smaller joints suffer, as a rule, towards the termination of the attack.

2. *Subcutaneous nodules.*—In the course of acute rheumatism in children and adolescents, more especially in girls, crops of subcutaneous nodules are occasionally developed in connexion with the joints, tendon-sheaths, and bones. These nodules are small fibroid bodies, varying in size from a pea to an almond, and are readily discovered by stretching the integuments over the affected joint, which is best done by gentle flexion. They then stand out as pale elevations on the prominent ridges and prominences of the articulation; firm, scarcely movable, rarely tender, rounded in outline or occasionally acuminate. Several nodules are usually present on a single joint; but as they appear in crops, and have different stages of development, decline, and disappearance, their numbers and characters vary from day to day. The favourite joints affected are the elbows, knees, knuckles, wrists, and ankles. In connexion with the cranium the occipital region frequently presents a great crop of nodules. On the tendon-sheaths of the forearms and hands they are occasionally very distinct, and here they are movable. They have also been found on the vertebræ, clavicle, scapula, sternum, ribs, ilium, and long bones. A fact of significance is the usual association of subcutaneous rheumatic nodules, when they are large and numerous, with severe endocarditis and pericarditis.

3. *Disorders of neighbouring muscles.*—The muscular pains of the stage of invasion of acute rheumatism disappear in the declared disease, or are lost in the presence of more severe symptoms. They are replaced, however, by pains in the soft parts of the limbs related to the affected joints, especially the muscular insertions and fasciæ; and even the whole limb may ache, with much stiffness and a feeling of utter powerlessness. Painful twitchings are also common, especially during sleep; and when the acute pain has

passed off, marked muscular debility remains behind.

4. *Temperature.*—Acute rheumatism is attended by well-marked pyrexia, but this, like the disease as a whole, is variable in degree, course, and duration. The sudden invasion of the several joints, their speedy relief, the alternation of extreme bodily distress with comparative comfort, and especially the variety of pyrexic diseases with which the rheumatism may be complicated, would hardly lead us to expect a typical temperature curve. Nevertheless, in uncomplicated cases the fever follows a tolerably definite course. Pyrexia makes its appearance at invasion; it continues as long as the local symptoms preserve an acute or subacute character; and with them it declines and disappears. The *degree* of the pyrexia, in the great majority of cases, is in direct proportion to the severity of the joint-disease. Mild local symptoms—that is, moderate pain, short duration of symptoms in any given joint, and a small number of joints affected—are accompanied by moderate fever, ranging from 99° to 102° F. On the other hand, severe local symptoms—that is, severe pain, the full development of the several signs in the affected parts, and the simultaneous involvement of several joints—are attended by a temperature of 101° to 104° F. In another, but very small, class of cases the temperature, whatever it may previously have been, rises rapidly to an alarming height, so as to be entirely out of proportion to the joint-symptoms, which either continue as before, or even disappear. This condition of hyperpyrexia is regarded in the light of a complication, and as such will be presently described.

The *type* of the fever in uncomplicated cases is remittent, the thermometer rising ·25°, ·50°, or 1·0° F. in the evening. The primary elevation of temperature at the commencement of the disease is somewhat rapid; the decline or defervescence is decidedly more gradual, although it is generally irregular, being almost invariably broken by temporary rises, or interrupted by the supervention of some pyrexic complication. Brief recrudescences of fever, referable to excitement, exertion, or neglect of the primary alimentary and eliminative functions, are also common. The occurrence of a true relapse is marked by a return of pyrexia, which probably presents the same general characters as before.

5. *Skin.*—Profuse acid sweats constitute one of the characteristic phenomena of acute rheumatism. The brow is covered with drops which trickle down the face; and the whole body perspires profusely, and is bathed in an atmosphere of wet steam. Although usually universal, the sweats may sometimes be unequally distributed. It is doubtful whether any relation can be traced between the amount of perspiration and the hour of the day or night, the temperature, or the pulse; but it perhaps varies directly with the severity of the pain. The sweats continue throughout the whole attack, making their appearance at an early date, and disappearing gradually with the subsidence of the other symptoms. They do not intermit in the striking way of the sweats of the hectic or septic states, unless towards the end of a severe protracted attack, when the patient is greatly debilitated; but at certain parts of the day the skin may be found to be perspiring less freely, or even to be perfectly dry. The sweat of acute rheumatism possesses a peculiar sour, acrid odour; and this is so powerful, and pervades so thoroughly the neighbourhood of the patient when the blankets are disturbed, that the diagnosis of the disease can frequently be made from it alone. Like the sweat in health, it is acid in reaction, rarely alkaline from decomposition. No other test can be readily applied to it clinically. The rheumatic patient may complain of the unpleasant, but never of the 'weakening' effect of the perspirations which is observed in hectic fever; on the contrary, he may describe them as bringing great relief to the bodily condition. In less acute cases the skin may present a shiny or greasy appearance, rather than actual perspiration. When the sweats are severe, sudamina make their appearance, especially about the trunk; and in some cases the skin is covered with a profuse eruption of miliaria.

6. *Digestive system.* — The tongue is covered with a thick, white, moist fur, which varies closely with the rheumatic condition, and serves as a ready evidence of the same. The thickness of the coating is sometimes very great. Occasionally the tongue is dry; very rarely brown, baked-looking, or cracked. The sense of taste is, in a great measure, lost; thirst is urgent and difficult to satisfy; and the reaction of the saliva, or, more correctly, of the fluids of the mouth, is said to become acid. Appetite is lost, until the disease begins to decline, when hunger returns very early and urgently. Sore-throat occurs in some cases during the declared disease, but is much less common than in the stage of invasion. Sickness is rarely present. Dyspepsia, attended with flatulence, is common, unless the most digestible food only be given. Irregularity of the bowels is characteristic of acute rheumatism, either constipation or diarrhœa being almost constantly present; and the two conditions frequently alternate. Diarrhœa is perhaps more common in first than in subsequent attacks. The motions are dark and foul Pains in the belly are by no means rare and are frequently connected with diarrhœa, but they occur also in constipation; and at times they are accompanied by attacks of distressing flatulence.

7. *Circulation.* — The circulatory symptoms proper to acute rheumatism are modified by complications affecting the heart in a very large proportion of cases. When no special circulatory complication exists, the pulse is regular, 80 to 120, large, sometimes hard, more frequently soft or even dicrotic; but it naturally varies much with the severity and stage of the disease. The effect of the various complications on the pulse will be presently described.

8. *Respiratory system.* — The frequency of the respirations in uncomplicated rheumatism is somewhat increased; slight cough is occasionally present; and under these circumstances a few dry rhonchi may be heard over the chest. On the other hand, respiratory complications may be of a serious and even fatal character, and will demand consideration in their proper place.

9. *Urine.*—Throughout an attack of acute rheumatism the urine is scanty, high-coloured, and strongly acid; and it deposits a quantity of urates. Albuminuria is rare. Quantitatively examined, the urine is found to contain an actual excess of urea, and a considerable (but probably only a relative) excess of uric acid, sulphates, and colouring-matter (*see* SPECTROSCOPE IN MEDICINE); the water is below the normal amount; and the chlorides are diminished, although less so than in pneumonia. Lactic acid has never been found in excess. Any marked departure from these characters of the urine, especially in the appearance of more than a passing trace of albumen, is to be considered as a complication of the rheumatism.

10. *Nervous system.*—As a rule, consciousness and clearness of intellect are preserved throughout. Delirium is very uncommon; and when either delirium or stupor supervenes, it will generally be found that, in otherwise uncomplicated cases, the temperature has risen to an excessive height. Very rarely the pyrexia remains moderate in these circumstances, and such cases have been described by the name of 'cerebral rheumatism.' There is generally great distress of mind in acute rheumatism; and in other than first attacks, the previous experience of its severe and uncertain course and dangers, and the recollection of the pains and other sources of bodily discomfort, greatly affect the patient, and produce an amount of anxiety which is almost characteristic of the disease. Sleep is either impossible, or at best is constantly broken and unrefreshing, when the pain is severe.

11. *Expression.*—The debility or prostration, which forms an important element of fever from whatever cause, is present in acute rheumatism, but it is in great measure obscured by the expression referable to pain, and by the effort to preserve an easy position. Towards the end of an attack, when pain is subsiding and movement is comparatively easy, the patient and the practitioner begin to appreciate the degree to which the bodily weight and strength, and the richness of the blood, have been reduced. This loss is always great, and is sometimes extreme, varying, of course, with the severity and duration of the disease.

VARIETIES.—The description just given applies to a fully developed attack of acute rheumatism, without complication, of indefinite but not protracted course, and of favourable termination. It is only a minority of cases, however, that are of this nature. Occasionally the symptoms are very mild or the attack very short, in which event the rheumatism is said to be *subacute.* In another variety or 'type' of the disease, which is common in children, the articular manifestations are insignificant or even 'latent,' but cardiac, pleuritic, and other complications are severely marked, and the rheumatic process is peculiarly protracted in the form of relapses and recurrences. Again, as nearly as possible every second case proves to be *complicated* with some affection of the viscera, especially the organs of circulation and respiration. These departures from the 'typical' course of acute rheumatism, as it is called for the sake of description, will now be considered.

Subacute Rheumatism; Acute Rheumatism in Children.—Under the name of subacute rheumatism are comprised a variety of cases of the disease, which, whilst of comparatively little severity, exhibit the greatest possible differences in their other clinical characters. Several well-marked groups of these may be distinguished, and demand separate consideration.

(*a*) The *first* group of subacute cases is one in which the duration of the disease is unusually short—probably from one to three days. The number of joints affected is very small; and the general symptoms appear to be arrested before attaining any considerable severity.

(*b*) In a *second* group of subacute cases, after exceedingly mild invasion-symptoms, a single joint only is attacked, with little pyrexia, whilst the skin presents a shiny or oily dampness rather than true perspiration. The rheumatism disappears in a few days; or it shortly relapses in the same or in some other joint. This form of subacute rheumatism may be difficult to diagnose from gout.

(*c*) Widely different from the foregoing is another and the most common variety of subacute rheumatism. Such are many of the *recurrent* cases of the disease, and of the instances of first attacks in old subjects. It may be stated broadly that the first attack, or first and second attacks, of rheumatism are more severe than subsequent ones; that the severity diminishes with each recurrence of the disease; and that persons attacked for the first time after middle life suffer less than younger subjects. In all these cases, the phenomena connected with the joints, and the general symptoms, including the pyrexia and the sweats, are mild in degree, although by no means of short duration. In recurrent cases the patients are frequently the subjects of chronic heart-disease, in whom exposure to some of the determining causes of rheumatism has lighted up fresh endo- and peri-carditis, and therewith moderate fever and subacute rheumatism of the joints. The anxiety of the practitioner will be confined to the condition of the heart; but during the progress of the complaint, joint after joint may become painful, tender, slightly swollen, and red.

(*d*) *Acute Rheumatism in Children.*—There is a large and well-marked group of cases of rheumatism in children, in which the disease runs what may be called a *latent* course. The joints are so slightly affected that the characteristic signs and symptoms of rheumatism may be entirely overlooked. Children frequently pass through an attack of acute rheumatism without the true nature of the complaint being suspected by their medical attendant; and in other instances the diagnosis is first made on the discovery of one or other of its familiar complications, notably heart-disease. The child is feverish, and may or may not complain of pain and tenderness in the limbs, and of sore-throat. Moderate swelling and redness of the affected joints pass unheeded in the full and high-coloured body of the patient; and pain and tenderness in these subjects are either entirely disregarded, or referred to 'growing,' or to 'a cold.' Lastly, the sweats are much less profuse, or entirely wanting, the skin being hot, with but a moderate degree of fever. Whilst the disease in children runs this exceedingly mild course, but one which may develop a relapsing and recurrent type, it is accompanied, in a comparatively large proportion of cases, with acute cardiac disease—endocarditis and pericarditis—a fact which greatly increases the necessity for an early diagnosis. It is in these and other varieties in children that subcutaneous nodules are so often found; and pleurisy, erythema, and chorea may also be present. A more completely latent form of acute rheumatism has been described by Graves, in which articular symptoms are entirely wanting, whilst the other symptoms may be of the usual character, and follow the usual course.[1]

When these four prominent groups of subacute rheumatism have been described, there still remain a large number of mild cases, which are too indefinite to be treated of in a general article. All possible varieties of the disease will be encountered in practice, according as, on the one hand, the 'typical' course is pursued, or, on the other hand, the disease assumes a subacute character.

COMPLICATIONS.—Acute rheumatism is frequently accompanied by certain other affections, which modify its course, and greatly increase its gravity. The appearance of these complications is in every case anxiously apprehended; and the prevention of the most serious of them is regarded as the chief indication in the treatment of the disease. The principal are—inflammation of the heart and pericardium; hyperæmia and inflammation of the lungs, bronchi, and larynx; inflammation of the different serous membranes; various nervous affections, such as chorea, meningitis, and mental derangement; erythematous eruptions; scarlatina; albuminuria; hyperpyrexia; hæmorrhages; and, lastly, various concomitant or intercurrent conditions.

The relations of these complications to acute rheumatism are very various. The largest and by far the most important group, comprising cardiac inflammations, pneumonia, pleurisy, peritonitis, erythema nodosum, chorea, and meningitis, can only be described as having an intimate but still obscure *genetic relation* to rheumatism. This relation is indicated in many ways, such as the frequency of their occurrence during an attack of acute rheumatism; the comparative infrequency of certain of them in any other connexion; the manifest analogy that exists between the parts affected in some of them and the joints; the direct increase of their frequency with the intensity of the general rheumatic symptoms, that is, of the cause of the disease; the transient and migratory character which they may present, alternating as they sometimes do with each other and with the arthritis; their occasional occurrence before the joint-symptoms, or even without them, constituting acute rheumatism without arthritis; their appearance in the person of a blood-relation of a rheumatic subject; their amenability to anti-rheumatic treatment; and, lastly, their occurrence in the course of acute rheumatism as a part only of a manifestly general disease.

Other complications appear to be *effects* of rheumatism, such as albuminuria and mental disorder; and chorea is believed by some authorities to belong to this category rather than to the former. Scarlatina, dysentery, and profuse hæmorrhages are perhaps related to it *ætiologically*. Lastly, such complications as bronchitis, hyperpyrexia, and delirium tremens are to be considered as merely *concomitant* or *intercurrent* conditions.

The chief of these complications must now be considered in detail, in the order of their relative importance.

1. **Cardiac complications.**—These are by far the most frequent complications of rheumatism, being present in no fewer than 50 per cent. of all cases. The percentage of

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[1] *Clin. Med.*, p. 914, 1843.

acute cardiac disease is, however, less than this—almost certainly about one-third, the remaining cases being chronic, or chronic and acute cardiac disease combined. These numbers refer only to structural disease of the heart, namely, simple or ulcerative endocarditis, pericarditis, myocarditis, and the effects of these, singly or in combination. But, besides inflammatory affections, there may occur functional disorders of the heart, characterised chiefly by palpitation, cardiac distress, and the presence of various abnormal physical signs. According to some observers, the latter class are of as frequent occurrence as the former. It is more than possible that the evanescent cardiac murmurs by which they are recognised are sometimes produced by small vegetative growths on the valves which afterwards disappear.

The *circumstances* under which cardiac inflammation most frequently makes its appearance in acute rheumatism are—first, and specially, early age, rheumatic children rarely escaping disease of the heart, youths seldom, and the liability rapidly diminishing after the thirtieth year; secondly, severity of the rheumatic attack—with which the liability to cardiac complication increases directly—in the adult; thirdly, the female sex—women being more subject to rheumatic disease of the heart than men; and, fourthly, neglect of proper treatment during and after the attack.

The *time of appearance* of cardiac symptoms has been variously stated by different observers. As a matter of fact, they are generally discovered when the patient comes under observation; they certainly begin most frequently in the first week of illness; but they by no means uncommonly make their appearance in the second week, and may occur at any period.

Inflammation of the heart and pericardium are fully described under their appropriate headings (*see* HEART, Inflammation of: 1. Acute Endocarditis; 2. Ulcerative Endocarditis; and PERICARDIUM, Diseases of). The influence of the presence of cardiac complications on the course and prognosis of an attack of acute rheumatism is so important as to alter the whole aspect of the case, and to prove the chief cause of anxiety. Affections of the heart are by far the most common cause of death from rheumatism, immediate and remote; and even if they do not prove fatal, they constitute the most distressing of the remote effects of the disease. Rheumatic inflammation of the heart in children, like the arthritis in these subjects, is often slight at first, and is therefore liable to be overlooked or disregarded; but it is a process which—partly, no doubt, in consequence of this circumstance—may lead to grave disease.

2. **Respiratory complications.**—Diseases of the respiratory organs have been variously stated to occur in from one in every six to one in every sixteen cases of acute rheumatism; and in the larger proportion of immediately fatal cases they are the direct cause of death—frequently in association with endocarditis and pericarditis. The most common is pleuro-pneumonia; pleurisy alone the next; then pneumonia; severe bronchitis, pulmonary congestion, and laryngitis are more rare. They may probably occur at any period of the rheumatic attack; but the gravest forms will necessarily appear towards the termination, for the obvious reason that they so frequently prove fatal. The supervention of acute respiratory diseases is, as a rule, easily recognised by the appearance of their several symptoms and signs.

3. **Hyperpyrexia.**—This is one of the most alarming complications of acute rheumatism, but happily one of the most rare. The condition is fully described in another article (*see* TEMPERATURE). Hyperpyrexia may occur at any period of the disease; generally when the symptoms are fully developed; but even during convalescence. The principal indications of the approach of hyperpyrexia, which it is of the last importance to recognise, are flushing of the face; brightness and restlessness of the eyes; an eager, excited expression and behaviour; disappearance of pain and swelling from the joints, and arrest of the perspirations; delirium; and increase of the general symptoms of fever. On the occurrence of any of these symptoms in an otherwise uncomplicated case of acute rheumatism, the temperature should at once be taken, and the observation repeated every half-hour. If the body-heat prove to be over 103° F., and to be still rising, measures must be immediately adopted to prevent the hyperpyrexia, which is certainly threatening.

4. **Nervous complications.** — The reputed frequency of these complications has been greatly reduced since the discovery that the majority of the cases of so-called 'cerebral rheumatism' and 'rheumatic meningitis' are really instances of hyperpyrexia. These cases being excluded, the frequency of cerebral disturbance, in otherwise uncomplicated rheumatism, is not greater than in other pyrexial diseases. Cerebral embolism may occur from endocarditis; meningitis is very rarely observed; insanity has been described in connexion with acute rheumatism (*see* MANIA). Delirium tremens occasionally supervenes when there is a history of alcoholism. Other causes of delirium in acute rheumatism are pericarditis and the salicylates. Chorea bears a remarkable relation to acute rheumatism (*see* CHOREA). Occasionally it appears during an attack; and choreic twitchings may thus be the prominent symptoms during the first days of the illness, especially in children.

5. **Cutaneous complications.**—In a small proportion of instances, acute rheumatism, or a condition which practically cannot be distinguished from it, is associated with erythema; sometimes the arthritic symptoms, sometimes the skin-affection, being the first to appear, and the two conditions, or the erythema alone, being further associated with some of the complications already mentioned. Urticaria is less frequently seen in the same connexions. A remarkable condition, in which arthritic symptoms are associated with purpura, hæmorrhages, vascular thromboses, and possibly ulcerative endocarditis and its complications, is known as *peliosis rheumatica*, or *purpura rheumatica*. Sudamina and miliaria have been already noticed. *See* ERYTHEMA; PURPURA; and URTICARIA.

6. **Renal complications.**—Albuminuria does not occur in more than ½ or 1 per cent. of all cases of acute rheumatism; and the so-called 'rheumatic nephritis' has probably no real existence. The frequency of albuminuria is not greater than can be accounted for by renal embolism, the probable existence of chronic cardiac and renal disease, the possible association of scarlatina, and the presence of pyrexia.

7. **Serous inflammations.**—Peritonitis is a very rare complication, described chiefly by French writers. Rheumatic 'orchitis,' or inflammation of the tunica vaginalis, is occasionally met with. Rheumatic pleurisy and meningitis have been referred to.

8. **Gout.**—When acute rheumatism attacks a subject of the gouty diathesis, its symptoms may be considerably modified. The pain, swelling, and selection of particular joints have all a gouty character more or less; and whilst the disease is more amenable to treatment directed against the gout, it has possibly a greater tendency to lapse into a chronic affection of the smaller joints.

9. **Scarlatina.**—Scarlatina may be contracted in the course of acute rheumatism, or during convalescence. The occurrence of rheumatism as a complication or sequela of scarlatina—a much more frequent and important association—is discussed under SCARLET FEVER. The two diseases may mutually predispose to each other, by lowering the general health and increasing the liability to chill; but some authorities hold that many of the ordinary complications of scarlatina, as well as the arthritis, such as serous inflammations and nephritis, are essentially rheumatic.

COURSE, DURATION, TERMINATIONS, AND SEQUELÆ.—The course of acute rheumatism is extremely indefinite. The natural duration under expectant treatment is about three weeks. The average duration *of acute symptoms* under the same treatment has been estimated at nine days; it is rather less under certain other methods of treatment; and it is much prolonged by neglect. The entire duration *of an attack* is much greater than this, and necessarily less definite, namely, two to six or even ten weeks; and, speaking broadly, it increases with the age of the patient, up to middle age.

The patient being convalescent, a *relapse* of the disease by no means uncommonly occurs, after a few days or weeks. The fresh rheumatism may attain any degree, from a slight swelling, redness, and pain of a single joint, to a combination of the various symptoms, as severe as the first, or possibly more so, associated with fresh complications. Occasionally, two or even more relapses may occur.

Convalescence is generally protracted (before the health is perfectly restored); and it is very common to hear persons who have suffered from acute rheumatism state three or four months as the time they were 'ill.' Convalescence is accompanied by desquamation involving the hands and feet, and perhaps the body generally; and may be marked by obstinate anæmia. In many cases stiffness, pain, and weakness continue indefinitely in the joints and neighbouring muscles. Nodules may remain for months.

The great majority of cases of acute rheumatism ultimately end in recovery, the proportion of deaths as the immediate result of an attack being only about 4 per cent. On the other hand, a large number of persons suffer from remote effects of the disease, many of which are not only distressing, but likely to lead to death. Of the immediately fatal cases, the larger proportion terminate in the first or second weeks, and are associated with, if not actually due to, acute disease of the respiratory organs. The fatal cases which present cardiac disease, especially acute pericarditis, are scarcely less numerous. Altogether it may be said that from a half to three-fourths of all cases of death during acute rheumatism are referable to acute cardiac and pulmonary disease, either separately or combined. It is doubtful whether acute rheumatism *per se* ever proves fatal—that is, whether any patient dies from excessive pain, pyrexia, sweating, and consequent exhaustion. Hyperpyrexia is the most common cause of death next to pulmonary and cardiac complications. In a small number of cases, meningitis, acute alcoholism, and other complications lead to a fatal termination. In children the disease sometimes assumes an obstinately recurrent type, fresh inflammation of the heart and pleura, fresh nodules, and possibly chorea, making their appearance in various associations, and frequently leading to a fatal result.

The *remote consequences* of acute rheumatism are, on the whole, more serious than the immediate effects. In a few instances the disease leaves behind it a condition of joints which passes into 'chronic rheumatism' or 'rheumatic arthritis.' A more common effect is valvular disease of the heart, which is referable in the majority of instances to acute endocarditis occurring as a complication of rheumatism. It is impossible to estimate the number of cases of disease of the lungs, vessels, brain, kidneys, and other organs, which, in their turn, are caused by such heart-disease. It is also probable that the vessels suffer directly from the effects of rheumatism. When, in addition to these effects, we consider the debility, emaciation, and anæmia which it induces, the remote effects of pneumonia and pleurisy, of chorea, and of the other less common complications of rheumatism, as well as the liability to a return of the disease and its complications which seems to be engendered by a first attack, it is difficult to exaggerate the extent and seriousness of the ultimate results of this malady. *See also* TABES DORSALIS.

PATHOLOGY.—The pathology of acute rheumatism is still obscure, and in the present article it will be sufficient to enumerate the principal theories upon the subject.

1. *Lactic acid theory.*—Lactic acid accumulates in the body, and the symptoms are directly referable to the action of this poison upon the system (Prout, Todd, Richardson).

2. *Nervous theory.*—Chill of the peripheral parts of the body, especially of the skin and joints, causes disturbance of corresponding parts of the central nervous system; and this gives rise to pain and vaso-motor (?) or trophic changes of the same peripheral parts, and to fever (Canstatt; Seitz).

3. *Combination of* 1 *and* 2.—Chill causes accumulation or retention of lactic acid; this acts on the central nervous system; and the disordered nervous centres react upon the joints, &c., as in 2 (Senator).

4. *Combination of* 2 *and* 1.—Chill disturbs the nervous system; this disturbs metabolism generally; lactic or uric acid, or both, are retained, and act as poisons (Fuller, Latham).

5. As the result of chill, some poisonous product is formed within the system, which, according to individual proclivity or the nature of the products engendered, excites acute articular affection, or multiple neuritis, or acute spinal paralysis (Bastian. *See* NEURITIS, MULTIPLE).

6. *Infective theory.*—Chills are attended with the entrance of micro-organisms into the system, and endocarditis is the result. The joint-symptoms are secondary and embolic, as in pyæmic arthritis (Hueter).

7. *Germ theory.*—The disease is due to the presence in the blood of a micro-organism or a variety of micro-organisms (Salisbury, Immermann).

These organisms may enter the body by the tonsils, and their morbid activity may be confined to the lymphatic system, particularly the serous and synovial cavities (Mantle).

8. *Follicular tonsillitis* partially devitalises a number of leucocytes, which establish disorder of nutrition and perverted function in distant parts by accumulating within and without the capillaries, particularly when these are contracted by cold or by fright (Stewart).

9. *Malarial* or *miasmatic theory.*—Rheumatism is due to the presence in the system of a poison, which is of the nature of a miasm, entering from without. This miasm is generically allied to, but specifically distinct from, the miasm of malarial fever (Maclagan). Its development on the earth may be related to rainy weather; its dissemination to subsequent dry weather (Gabbet, Edlefsen, Pel).

Without attempting to criticise these theories, we may conclude that, whilst the true pathology of acute rheumatism cannot possibly be settled until the essential nature of fever is thoroughly understood, the most promising directions from which we may expect light to be thrown upon it are, first, the effect on the system of organic poisons, whether introduced from without, or produced within it as the intermediate products of nutrition; and, secondly, the intimate relation of the nervous system to the body-heat, to the skin, and to nutrition.

Under these circumstances it is impossible at present to estimate the respective significance and relative importance of the phenomena constituting the 'disease' rheumatism. But for the purpose of intelligible description, it is necessary that such of the phenomena as are only occasional in their appearance should be separated from such as are constant in a fully developed case; and that the latter should be treated as the essential symptoms of the disease, whilst the former are regarded as complications. The constant phenomena, in this sense, of acute rheumatism in the adult, are perhaps only three, namely, fever, sweats, and arthritis; whilst inflammation of the cardiac structures, lungs, and serous membranes would be included under the head of the occasional phenomena or complications. This plan of description of acute rheumatism has been adopted in the present article, for convenience sake only, and implies no actual criticism of the theories of the pathology of the disease just enumerated; although with several of them it necessarily cannot agree. It must also be understood that whilst these are the common manifestations of acute rheumatism, they do not constitute the disease, and, indeed, may all be present independently of it. The single symptom which, as far as is known, is peculiar to rheumatism, is the development and disappearance of subcutaneous nodules.

Diagnosis.—Although acute rheumatism can generally be easily recognised, its diagnosis is sometimes a matter of the greatest difficulty.

In the stage of *invasion*, it is most readily confounded with the acute specific fevers, including influenza and catarrh, in which pyrexia and aching of the limbs are prominent symptoms, and which are indeed at times complicated with rheumatism. If sore-throat be comparatively well-marked, and the development of the joint-affection slow, the practitioner may be led to diagnose simple catarrh instead of rheumatism, and to make light of a complaint which is about to develop into a serious disease. In every doubtful case a certain number of facts should be kept clearly in view, namely, the history of the attack; the possible occurrence of previous attacks of rheumatism; the family history; the absence of symptoms characteristic of other diseases, such as eruptions or coryza; the development of pain or tenderness in a definite joint, and acid sweats; and, most important of all, the discovery of the signs of inflammation of the heart.

In the second or *declared* stage, when one or more joints are involved, an entirely different group of diseases have to be diagnosed from rheumatism, namely, gout, 'rheumatic arthritis,' gonorrhœal rheumatism, pyæmia, glanders, and acute synovitis or arthritis of traumatic or diathetic origin. In doubtful cases the characteristic phenomena of rheumatism must be kept clearly in mind, especially the transient and erratic course of the arthritic symptoms, and the probable presence of cardiac complications.

Acute gout may generally be diagnosed by the sudden invasion at night of a single joint—probably the great toe, in a man of middle or advanced age; by the severity of the pain, which is relieved by the occurrence of a characteristic swelling of the part; by the history of previous attacks of the same description; by the insignificant amount of constitutional disturbance attending the arthritis; and by the strict localisation of tenderness, as compared with swelling, when the acme is passed. The discovery of uric acid in the serum will definitely settle the diagnosis of gout.

Pyæmia is usually associated with an injury or pre-existing surgical disease. Rigors are the rule, whilst they are the exception in rheumatism; the fever has a deeply remittent character; the sweats are distinctly intermittent: the arthritis is neither transient nor migratory, but may advance to suppuration of the joints; and symptoms of blood-poisoning, phlebitis, and extensive and multiple visceral disease shortly supervene. Still it is a fact, which cannot be insisted upon too strongly, that cases of pyæmia are frequently mistaken at first for acute rheumatism.

Gonorrhœal rheumatism may be recognised by being persistent, whether one or more joints be involved; by the type and degree of the pyrexia; by the absence of cardiac complications, as a rule; by the presence of conjunctivitis; and, most certainly of all, by the co-existence of a urethral discharge.

Rheumatic arthritis may be distinguished by the characteristic deformity of the joints.

For the diagnosis of glanders, *see* Glanders.

Ordinary *synovitis* is rarely multiple; is persistent and not migratory; and has an appreciable cause, whether traumatic or diathetic. *See* Joints, Diseases of.

The numerous difficulties which beset the diagnosis of subacute rheumatism, in children especially, have already been sufficiently dwelt upon.

Prognosis.—In a disease which runs so uncertain a course, and which may be complicated by such a variety of dangers, the prognosis is necessarily most uncertain. The proportion of fatal cases, and of cardiac complications, and the average duration of an attack, can easily be stated; but in a given case there is at first no positive means of foretelling what course the disease will run in any one of these respects. The prognosis must be specially guarded in persons worn out by mental or physical overwork or anxiety; in young women of full flabby habit, with tendency to anæmia and disturbance of the uterus, stomach, and circulation; and in women after delivery—all subjects in whom cardiac inflammation and failure, and pulmonary complications, are to be apprehended. Ill-declared, 'weak' symptoms, connected with the joints, indicating that the bodily strength and power of resistance are low, are less favourable than well-pronounced 'honest' pains and a warm sweating skin, which generally point to a favourable termination as regards life. It must, however, be observed that the risk of complications in some degree increases with the severity of the local symptoms. The probability of cardiac complications decidedly declines after the first week, but the possibility continues as long as fresh joints are being invaded. Rheumatism of the joints may be expected, on the whole, to run a mild course in children, but it must not be forgotten that the course of it may be protracted by the occurrence of relapses and recurrences; and that the danger of cardiac complications is very great. In old subjects it may be safely assumed that the disease will end favourably. The supervention of pulmonary complications, especially in association with cardiac disease, or of hyperpyrexia, should cause anxiety, as immediately threatening life. The prognostic significance of nodules is important. Remote danger from acute rheumatism is chiefly to be estimated by the occurrence of heart-disease, and by the nature of the same.

Treatment.—The difficulties which beset an attempt to give an exact estimate of the relative and absolute value of the different measures that have been proposed for the treatment of acute rheumatism, may be said to be almost insurmountable. Under the most favourable circumstances the number of carefully observed cases of any disease, subjected to a particular treatment, must be very large before a safe conclusion can be drawn respecting the result. The most favourable circumstance for therapeutical observations is manifestly uniformity of the course of the morbid process. This condition is as much as possible wanting in the problem before us. Rheumatism is a disease of practically indefinite duration, of infinite degree of severity, and beset with a number of complications. It is not always possible to estimate the duration of the attack when the case first comes under observation. Lastly, many of the recorded cases have been treated by such complicated methods, that it is frequently quite impossible to eliminate the respective effects of the various drugs administered. In approaching the question of the relative value of the different kinds of treatment, these facts cannot be kept too clearly in view, for perhaps no disease has been alleged to have been successfully treated by so many different remedies.

1. General treatment.—When called upon to treat a case of acute rheumatism, the practitioner must, in the first place, make certain special arrangements for the nursing of the patient. In addition to the ordinary measures proper in every case of an acute febrile disease which will probably prove of some duration, he must especially secure for the rheumatic patient perfect quiet, extreme gentleness of every necessary movement, and the prevention or relief of the discomfort attendant on constant and profuse perspirations. Next to a good strong nurse, and perfect hygienic arrangements of the sick-room, a proper bed is of the utmost importance in the general management of the case. The bed must be firm; standing on a firm floor; sufficiently narrow; and placed in such a position as to be readily accessible from either side, and to allow the attendants to reach any part of the limbs or trunk of the patient without interfering with the position and comfort of the other parts. Further, the bed must be 'made' as a 'rheumatic bed'; that is, a pair of blankets must be placed between the sheets—the one over, the other under the patient, so as to absorb the profuse sweat, and diminish the risk of chill from dampness of the linen. The patient should be furnished with a long flannel bed-gown, made to fasten with tapes down the front and along the arms, so that the chest or any joint may be reached with the least possible disturbance. Arrangements must be made for collecting the urine and stools in bed; and the use of a urinal and a bed-pan, or a properly arranged towel for these purposes, is imperative.

These nursing arrangements being completed, the physician may turn his attention to the consideration of the therapeutics proper of the case. Two indications have to be fulfilled, namely, first, the relief of local symptoms which may be urgent; and, secondly, the control of the morbid process and the removal of the general distress. An effort must be made to secure these ends by separate measures, or by following some system that will effect both. The various means at our disposal will now be considered, beginning with those which are at once the most simple and the most urgently required.

2. Local palliative treatment.—*Rest.* The most ready and satisfactory measure of a local kind for the relief of symptoms is the application of absorbent cotton-wool to the rheumatic joints. Cotton-wool is to be wrapped in some quantity around the parts, and secured by a moderately firm roller, or by a piece of warm flannel with the ends stitched together. The affected articulation is thus at once kept at rest and protected from cold and pressure; whilst uniform support is obtained. The relief obtained by this simple arrangement is often remarkable. The joints should be carefully sponged with warm water and soap, or warm water slightly alkalised with carbonate of sodium, before this or any other application; and the cotton-wool must be occasionally changed, especially if the perspirations be profuse. The principle of support and prevention of movement is more thoroughly carried out in a method of treatment that has found greater favour with Continental than with English practitioners. This method consists in placing the joints in splints, as they become affected; in bandaging them firmly; or in encasing them in plaster of Paris. The results are said to be very satisfactory; the pain being reduced to a minimum, the fever falling, and the course of the disease essentially shortened.

Anodynes.—When the pain is severe, and relief is not to be obtained by simple rest and protection, anodynes may be applied to the rheumatic joints. Opium in any of its ordinary forms, belladonna and its allies, and other familiar anodynes, may severally answer best in particular instances. These substances may be applied on the surface of lint, secured and supported by a bandage; or the affected part may be lightly rubbed or smeared with the anodyne preparation in the form of liniment, and then wrapped in cotton-wool or flannel, as already described. Heat is generally grateful to acute rheumatic joints, but in many cases it is felt to be useless in the acute stage unless it be quite extreme. Thus simple warm fomentations may give relief; but the patient may urgently demand their constant renewal, so that they may be almost scalding. There are obvious objections to such a plan of treatment. Extreme cold has been recommended by some authorities, notably Professors Esmarch and Hueter, in the form of ice. It is seldom used in this country.

A method of treatment once much in favour with some physicians consists in the application of blisters to the rheumatic joints. The blisters, usually of cantharides, are intended to act less as counter-irritants than as 'derivatives' or 'evacuants.' The late Dr. Herbert Davies, who introduced the blister-treatment in this country, contended that the rheumatic poison is especially abundant in the neighbourhood of the joints, and is actually separated with the blister-serum, and so removed from the body. In its original and complete form, the blister-treatment consists in applying a strip of cantharides plaster near every affected joint at the height of the inflammatory stage. In some cases the amount of blistered surface may thus be enormous. The serum is encouraged to drain away, and the surface heals in due course. It has been claimed for the blister-treatment that it relieves the pain, shortens the course of the disease, and lessens the tendency to cardiac complications. Of the first effect there is probably little doubt; the other effects are questionable; and statistics show that other methods of treatment are more efficacious in these respects. On the other hand, the danger of strangury, sloughing, and even pyæmia, and of the substitution of another form of severe pain for that dispelled, must be mentioned as objections to the employment of it. For these and other reasons, a modification of the blister-treatment has been proposed, probably at the sacrifice of the principle, namely, local blistering when a stimulant is demanded, in cases attended with much depression; when the joint-symptoms are unusually severe; when other less severe means have failed; or when the condition threatens to become chronic.

The local *abstraction of blood* by means of leeches, whilst it relieves pain, is very rarely called for, unless the arthritis be so severe and persistent as to threaten to lead to suppuration.

It is said that, in some cases, marked relief follows *galvanisation* of the rheumatic joints.

Certain lotions, of other than direct anodyne properties, have been recommended as local applications, to produce a specific effect upon the rheumatic joints, and thus indirectly afford relief. The chief of these are alkaline solutions, especially solutions of the carbonates of potassium and sodium, sopped into flannel wrapped around the joints. They may be combined with preparations of opium. Their value is somewhat doubtful.

3. **Medicinal treatment.**—The medicinal treatment of acute rheumatism should be commenced with a purge consisting of calomel or a mercurial and colocynth pill.

The use of the *salicylates* and *salicin*, introduced by Dr. Maclagan in this country, constitutes at present the routine drug-treatment of acute rheumatism; and the results obtained from it are certainly more favourable than from any other method. Fifteen to twenty-five grains of salicylate of sodium, twenty grains of salicylic acid, or fifteen grains of salicin, are given every one, two, three, or four hours, until the temperature falls to the normal, to establish rapidly the full therapeutical influence of the drug; after which the dose is very gradually reduced, so as to be simply sufficient to maintain the apyrexia and control the arthritis for several (seven to ten) days. Some authorities reduce the dose as soon as symptoms begin to yield. The salicylates are best given in watery solution, variously flavoured; salicylic acid in milk, or combined with solution of acetate of ammonium; and salicin in wafers, or in solution. Different practitioners prefer the different forms of the active substance; the salicylate of sodium is most extensively used. The salicylates reduce the temperature to the normal in the course of twenty-four to seventy-two hours, relieve the pain and other arthritic symptoms, markedly improve the condition of the patient generally, and diminish the risk of cardiac complications. The effect is most marked in first attacks, and in the early stages of an attack.

Unfortunately there are several drawbacks to the use of the salicylates.

The first of these is frequently urged as an objection to the employment of these agents. This is the fact that the rheumatism frequently returns as soon as their exhibition is stopped. On the second or third day after the disease has been checked, the symptoms may be again as severe as at first, the risk of cardiac complications again present. Thus it happens that, taking an average of a large number of recorded instances, the total duration of rheumatic symptoms is not less than nineteen days. Still, in a considerable proportion of cases no such relapse occurs, and the patients are completely relieved within forty-eight to sixty hours.

Secondly, whilst the salicyl compounds have a considerable influence in preventing complications, by rapidly controlling the specific morbid process, they do frequently fail to do so. Further, they appear to have little or no effect in subduing visceral complications that have already commenced. But if they do not arrest the endocarditis, pericarditis, or pleurisy, they will repeatedly dispel the arthritic symptoms that may recur again and again during the course of these internal manifestations of the rheumatism. The best rule to follow, therefore, is to restrain the arthritis and fever by means of sufficient but not excessive doses of salicylates, and to attend to the indications presented by any visceral complication that may arise. The salicylates will be resumed or increased, as the case may be, in the event of recrudescence, inasmuch as pyrexial rheumatism, however slight, always depresses the heart.

Thirdly, the salicyl compounds—particularly if abused—occasionally produce toxic symptoms, such as deafness, tinnitus, delirium, great frequency and weakness of the pulse, flushing of the face, lividity, sickness and collapse; and the termination may be fatal. The depressant action of salicylates on the heart and circulation is especially dreaded by practitioners, who are perhaps too ready to give them up for alkalis and quinine on the appearance of cardiac complications. In obstinately recurring cases, also, the protracted use of salicylates is believed to aggravate instead of controlling the rheumatism, by depressing the vitality of the patient. Of the two toxic influences, however, the salicyl compounds are, in the writer's opinion, less dangerous than rheumatism; and failure of the heart may be prevented by exhibiting digitalis, ammonia, strychnine, ether, or alcohol. Further, it has been determined that some of the worst of the toxic effects of salicylates were caused by impurities in the acid prepared artificially from phenol, and they are now removed in the process of manufacture. Salicylate of sodium can be given by the rectum to children or to adults when the stomach is intolerant of the drug.

Lastly, it must be confessed that in a very small number of instances the salicylates entirely fail to control the arthritis and fever. The practitioner ought not to conclude that this is the case until he has tried the effect of larger doses. Twenty-five or thirty grains of the sodium salt will often answer perfectly after twenty grains have been given without obvious effect. Salicin or salol (salicylate of phenol) may succeed under the same circumstances.

If the salicylates fail or disagree, recourse must be had to alkaline treatment or to some other method. Certain practitioners combine the full alkaline method with the salicylates from the first; others prescribe the alkalis in diminished doses, or equal parts of salicylate and bicarbonate of sodium. Possibly anæmia may be more marked, and convalescence more slow, after treatment with salicylates.

Before the introduction of the salicyl compounds *alkalis* were in general use in the treatment of acute rheumatism. The alkaline method consists in the internal administration of sufficiently large doses of certain alkaline salts, such as the carbonates, citrates, tartrates, and acetates, to render the urine quickly alkaline; in maintaining this reaction as long as the rheumatic symptoms continue; and in gradually allowing a neutral or an acid reaction to return by diminishing the dose as the disease declines. It is claimed for this method that, as the alkalis begin to exhibit their action on the system, the whole aspect of the case becomes more favourable, the general distress being alleviated, the temperature falling, and the local symptoms relieved; that these favourable effects continue to become more and more marked, until the rheumatic condition has disappeared; that the average duration of the attack is greatly shortened, not exceeding 6·75 days in the acute stage, and 13·5 days before the disappearance of pain; and that the proportion of complications is reduced as low as 2 per cent. only. In other words, it is asserted that in alkalis a direct antidote exists to the morbid influence (whatever that may be) which is the essence of rheumatism.

The plan of administering alkalis varies considerably. Some practitioners give large and frequently repeated doses, in order to obtain the speediest possible effect upon the system; others give a moderate amount, or variously modify the exhibition of the salts. Of the two plans, the first is unhesitatingly to be preferred. To obtain the full effect of potassium upon the system, not less than half a drachm of the bicarbonate in an ounce of water should be prescribed at once, either alone or with citric acid in the effervescing form; and the dose is to be repeated every four hours. An equal amount of the acetate of potassium may be added to each dose, if a still more rapid and powerful action of the alkalis be desired. The urine will probably become alkaline within twenty-four hours; and when once this effect has been obtained, it may very easily be kept up by continuing the alkalis at longer intervals, which may be further increased as the symptoms decline. The effect of the drugs upon the patient must be carefully watched, and the amount and frequency of the dose varied accordingly, or its administration stopped, if necessary. Finally, when the rheumatism is relieved, quinine may be added to the alkaline mixture; and as convalescence advances, the potassium may be entirely withdrawn. Constipation occurring in the course of treatment may be relieved by combining the tartrate of potassium and sodium, instead of the acetate, with the bicarbonate, tartaric acid being used to cause effervescence; or, if more obstinate, by a calomel and colocynth pill.

The alkaline influence upon the system may be further increased, in a very agreeable way, by supplying the ordinary effervescing potash or soda water as a drink, either alone, or combined with milk or with fresh lemon-juice. The patient may be encouraged to drink this in quantity, unless there be special indications to the contrary, such as cardiac distress. Should there be diarrhœa, lime-water may be substituted for the potash or soda water. Should alkalis persistently cause purgation, their administration must be discontinued.

A modification of the preceding plan has been highly recommended by Sir Alfred Garrod, and consists in the administration of quinine from the very first in combination with large doses of alkalis; as much as five grains of the alkaloid (thus in the form of a carbonate) being given every four hours.

The most obvious general remedies for the relief of symptoms are anodynes and antipyretics. So much benefit follows the use of opium in some cases, by relieving pain and diminishing nervous irritability, that it has acquired a reputation even as a specific. Although formerly given in large and frequent doses, such as a grain every three to eight hours, either alone or combined with mercury, opium is now seldom employed in acute rheumatism, except in the form of a moderate dose of Dover's powder, or of a morphine draught at night, to relieve pain and induce sleep. For these purposes it is employed by most practitioners, including those who adopt what they call the purely expectant method of treatment. The effect of the opium must be carefully watched, in the presence of the many complications which may possibly arise and contra-indicate its use.

Many other antipyretic remedies besides the salicylates have been recommended, such as phenazone, acetanilid, and phenacetin; quinine, tartar emetic, veratrum viride, digitalis, aconite, mercury, and various diaphoretics. The use of quinine has been already referred to. At the present time reliance is chiefly placed upon two powerful remedies of this class, namely, the cold bath or the wet pack, and salicylic acid.

The cold bath is the most powerful and speedy method of reducing the temperature in acute rheumatism, but is seldom resorted to except in cases of hyperpyrexia. When this condition threatens, the cold bath or the wet pack is to be unhesitatingly employed, in the manner described elsewhere (*see* TEMPERATURE). If the symptoms be less urgent, cold sponging of the trunk may be sufficient to reduce the temperature.

Hæmatinic remedies may be considered to be indicated by the great anæmia which accompanies and yet more markedly follows an attack of acute rheumatism. Dr. Russell Reynolds has recommended perchloride of iron in large doses; and favourable results have attended its administration.

Alcoholic stimulants, in moderate doses, are indicated when the symptoms are severe and protracted. Besides this routine use of alcohol, a special virtue was claimed for its free administration, as in other fevers, by Todd and his disciples, in preserving the strength and relieving the pain. Brandy must be ordered on general principles in cases attended with extreme depression, or with serious visceral complications, especially in the event of cardiac failure.

Tonics are indicated during convalescence; for example, quinine and iron, separately or combined either with alkalis or acids, and strychnine. Tonics must not be commenced too early.

Empirical remedies. — Lemon-juice appears to have proved successful in some cases of acute rheumatism in doses of eight ounces or less in twenty-four hours. Since the course of the disease is now known to be indefinite, the number of carefully recorded cases treated by lemon-juice is insufficient to permit a trustworthy inference to be drawn respecting its value. Similar doubts may be cast upon the alleged value of many other so-called remedies for the disease, such as propylamine and trimethylamine, in four- to eight-minim doses every two hours; nitrate of potassium to the amount of an ounce in the twenty-four hours; cynara or artichoke; and the cyanides of potassium and zinc. Colchicum was formerly given extensively in acute rheumatism, but has fallen into disrepute since this disease has been separated from gout. It may, however, be given with advantage for rheumatism in a gouty subject, to relieve pain. Guaiacum is useful in subacute lingering cases. Bromide of potassium has also been found very useful in American practice, probably by relieving pain and restlessness.

4. **Expectant treatment.**—Reference must here be made to the observations of the late Sir William Gull and Dr. Sutton upon the course of acute rheumatism when treated by simple rest, and the exhibition of a *placebo*. The comfort of the patient is secured by ordinary means; and small doses of opium are given to complete this effect when indicated. The results were favourable, but less so than those of several other methods of treatment, nine days being the average duration of acute symptoms. The number of cardiac complications was also small.

5. **Treatment of complications.**—For an account of the treatment of the complications of acute rheumatism, the reader is referred to the respective articles on each of these in other parts of this work (*see* HEART, Inflammation of; LUNGS, Inflammation of; PERICARDIUM, Diseases of; &c.). The plan of treatment which is being pursued for the rheumatism may have to be temporarily suspended, or possibly completely changed, on the appearance of any of these complications.

The state of the bowels requires the most careful attention. Constipation must be relieved by any of the ordinary means. Diarrhœa may be checked by lime-water or bismuth, or by a judicious dose of castor-oil, according to its cause. The surface of the body should be regularly sponged with a very weak tepid solution of an alkaline carbonate.

6. **Diet.**—The proper diet in acute rheumatism is the same as that in most other kinds of fever. The patient must be fed at short and regular intervals, night and day, with the most digestible forms of liquid nourishment; and may be encouraged to drink milk, or milk and soda-water occasionally. It must not be forgotten, however, that in all probability the system is already overloaded with the products of imperfect assimilation and transformation; that the digestive system is weak and irritable; and that the heart may be seriously affected by flatulence, and by the addition of much fluid or solid material to the blood. As the acute symptoms decline and appetite returns, fish, milk-puddings, and shortly afterwards chicken, sweetbread, and other 'light' articles of diet, may be cautiously allowed, and will be greatly relished. But, as a rule, the appetite returns before it can be safely indulged without risk of a relapse. Meat must be strictly forbidden until every rheumatic symptom has disappeared. Thirst is best relieved in the acute stage, as already stated, by aërated alkaline waters, either alone or in combination with lemon-juice or milk, the quantity given being regulated by the practitioner, and accurately recorded.

7. **General after-treatment.**—The general management of a case of rheumatism after the decline of the acute symptoms is scarcely less important than at the commencement of the attack. The patient should be encouraged to keep his bed for several days after the disappearance of the joint-symptoms; and this advice becomes imperative when cardiac complications exist. Rest and comfort of body and mind must be secured at this period, for the purpose of quieting the action of the heart, and allowing any endocarditic process that may affect the valves, and that probably outlasts the articular process, to subside quietly. The appetite must still be controlled, and daily evacuation of the bowels carefully attended to. All attempts must therefore be avoided at completing the cure of acute rheumatism within a certain small number of days. Even with these precautions, the first day of sitting up generally proves an anxious time to the practitioner in cardiac cases. Locomotion must be forbidden for several days, and permitted very gradually. When the patient is able to move about and go into the open air, the danger of a relapse during the first weeks must be carefully kept in mind. Sudden and extreme changes of temperature are especially to be avoided; and for this purpose the patient must be warmly clad, and studiously avoid draughts and exposure to cold in other forms. Hydrotherapeutic treatment is often successful in protracted cases, particularly if the articular symptoms are more prominent than the febrile. A course of baths and massage at Droitwich, Bath, or Buxton may give excellent results independently of medicine.

In the obstinately recurrent type of the disease occasionally met with in children and adolescents, our therapeutical resources and patience are severely taxed. In the majority of instances the heart is seriously involved, and demands chief consideration; but attempts to treat the cardiac disease are usually vain unless the associated rheumatism, *however slight*, be directly combated. The most rigid and continuous attention to diet, elimination, and rest, on the principles already laid down, is an indispensable element of the treatment—or, more correctly, the management—of rheumatism in this phase. As often as pain and pyrexia reappear, salicylates must be had recourse to if they can be borne, and iron and other tonics very cautiously resumed when the temperature has been reduced.

In persons who have suffered from acute rheumatism means ought to be adopted to prevent the return of the disease at a future time. The unfavourable influences to be chiefly avoided are cold and damp localities, exposure to wet, chill after exertion, free eating and drinking, and neglect of the liver and bowels. Woollen garments ought to be worn, summer as well as winter, in this country, of different thickness according to season and weather. These precautions are particularly important in the instance of rheumatic children. When the heart has been damaged in young subjects, so much attention is paid to the cardiac condition, with its attendant anæmia and impairment of nutrition, that the practitioner may forget that one of the greatest dangers to which the child is exposed is return of rheumatism and its complications.

J. Mitchell Bruce.

RHEUMATISM, Chronic.—Synon.: Fr. *Rhumatisme Articulaire Chronique*; Ger. *Chronischer Rheumatismus.*

Definition.—A disease of the joints, of chronic course; referable to certain obscure influences of a diathetic and climatic, or possibly infective nature; and characterised by various degrees of inflammatory and degenerative changes in the articular structures.

Ætiology.—The causes of chronic rheumatism, as far as they are known, are the same as those of the acute disease. The most powerful predisposing causes are inheritance, previous attacks of acute rheumatism, poverty, physical and mental exhaustion, and laborious occupations entailing exposure to chills. For the last reason men are more liable to the disease than women, and certain joints are its favourite seats. Chronic rheumatism is most common in middle life or advanced age, although by no means rare in young adults, and occasionally met with in children. Exacerbations of the symptoms are usually referable to exposure, and are accordingly most frequent and protracted in cold, wet weather. Occasionally they appear to follow influenza.

ANATOMICAL CHARACTERS. A variety of anatomical changes may be met with in chronic rheumatism, whilst in the least severe form of the disease no definite lesions of the articular structures can be discovered. In one form recurrent hyperæmia and effusion are found in connexion with the synovial structures, and with the articular and peri-articular tissues generally. In the most severe cases the joints are enlarged and deformed, in consequence of anatomical changes which appear to be identical with those of rheumatic arthritis. *See* RHEUMATIC ARTHRITIS.

SYMPTOMS. — The clinical characters of chronic rheumatism vary extremely in different instances. The leading symptoms of the disease are chiefly two, namely, pain and stiffness in connexion with the joints and associated structures, recurring indefinitely for any length of time, aggravated by cold, wet weather, and decidedly increased at night. More carefully investigated, the pains are found to have their seat in the joints, in the tissues of the limbs between the joints, or in both of these situations. Any or all of the articulations may be affected, but the site differs considerably in the different classes of the disease to be presently described. The pain is of a severe, aching, wearying character, attended with a sense of heaviness and uselessness of the limb; it is relieved by rubbing, and by exposure to a cold atmosphere; and is increased by slight warmth. Free use of the joint, although at first attended by much pain, often affords relief; whilst, on the other hand, undue exercise of the limbs during the day is liable to be followed by severe aching in the night. The affected joints also feel markedly dry and stiff, and creak on movement; but exercise or rubbing may remove these sensations.

These symptoms may last indefinitely for years, either recurring at intervals, especially in the winter and spring seasons, or being persistent almost day and night without intermission.

Such are the essential characters of chronic rheumatism. Its other features are so variable as to permit of the formation of several well-defined groups or degrees of the disease, as follows:—

First degree.—In this group of chronic rheumatic cases the pain and stiffness just described are the only articular symptoms present. No apparent anatomical change is produced, either in the joints or in the associated parts. The subjects of this form of the disease may be otherwise well, vigorous, and long-lived, in spite of the severe pains by which their rest is broken in cold, wet weather. They may or may not have, or have had, acute rheumatism.

Second degree.—In a more severe form of chronic rheumatism the pain is associated with obvious anatomical changes; and the disease assumes the character of a recurrent subacute rheumatism, making its appearance at intervals for years. The articular phenomena consist of redness, tenderness, and swelling, the hands being the favourite seat of the affection. These subacute attacks last for days, shifting from joint to joint; and leave behind them a distinct amount of swelling, which may not have completely disappeared before the next invasion. The process may thus, in course of time, lead to considerable enlargement, or even deformity, of the joints. In other subjects the joints slowly enlarge without pain.

Third degree.—Chronic rheumatism of the most marked degree generally occurs in persons who either have had, or may afterwards have, acute rheumatism; and is characterised by recurrent attacks of severe pain, tenderness, swelling, and hyperæmia of one or more joints, which lead to marked enlargement and deformity. A single joint may be affected at first; but the disease gradually invades the others, both large and small, until the whole articular system is involved. After some years the subacute attacks follow so closely upon each other, and their local effects are so marked, that the patient is never free from distressing pain; and the joints become ankylosed, dislocated, and otherwise disorganised. At the same time the general nutrition is gradually impaired; and the sufferer is anæmic, wasted, and debilitated. Chronic rheumatism of the most severe degree thus merges into, if it be not actually identical with, the class of disease known as 'rheumatoid' or 'rheumatic' arthritis. *See* RHEUMATIC ARTHRITIS.

It is necessary to understand that the division just made of the leading varieties of chronic rheumatism into three groups, according to its degree, has been employed for the sake of description only. In a large number of instances the disease possesses certain characters both of the first and second degrees; whilst it is evident that cases belonging to the second degree may very readily advance to the third.

COURSE AND TERMINATIONS.—The disease, as its name implies, is essentially chronic, generally lasting throughout the life of the individual whom it attacks, and leading to various conditions of debility and deformity, according to the degree of its intensity. In many instances the patient is rendered unfit for work; and such cases form a considerable proportion of the inmates of union infirmaries and other charitable institutions. Death as a direct result of the disease is rare.

COMPLICATIONS.—Myalgia and neuralgia, referable to rheumatism, are frequently associated with the arthritic trouble. Cardiac disease is met with in a considerable number of cases belonging to the third or most severe degree of chronic rheumatism, being usually referable to endocarditis, which complicated the original acute attack. Dyspepsia and calculous disorders are not infrequently seen in the subjects of the less severe forms. Iritis may be a very troublesome complication.

PATHOLOGY.—This disease is truly rheumatic in its nature, being intimately associated with acute rheumatism. In many of the best marked instances the patient has previously suffered from the acute disease, either immediately before or more remotely; in other instances one or more acute attacks occur in the course of the chronic disease. In another group of cases, a single member of a family will suffer from chronic rheumatism, ending in deformity, whilst his children, or his brothers and sisters, are attacked by the acute disease. The predisposing and exciting causes are also the same in acute and chronic rheumatism. Indeed, the two forms of affection run into each other in every particular, and are inseparably associated.

DIAGNOSIS.—If chronic rheumatism be regarded as a distinct disease from 'chronic rheumatic arthritis,' it is only in its most severe form that it can be confounded with the latter. A definite history of acute rheumatism; the presence of cardiac disease; and the non-involvement of such articulations as the jaw, the sterno-clavicular joint, and the spine, are considered to be features which render probable the diagnosis of true chronic rheumatism from rheumatic arthritis. But, in the opinion of the writer, the two diseases are identical.

The pain, swelling, heaviness, weariness, and weakness associated with varix of the lower extremities, sometimes resemble closely the symptoms of the milder forms of chronic rheumatism. Physical examination at once removes all doubt.

PROGNOSIS.—The prognosis of chronic rheumatism is favourable as regards life, but very unfavourable as regards cure; patients rarely losing the tendency to recurrence of pain throughout the whole of their life. Within a short time of the commencement of the disease it will be easy to discover which of the principal forms it is likely to assume; and the prognosis may be made accordingly.

TREATMENT.—The treatment of chronic rheumatism consists in (1) the relief of pain; and (2) the arrest of the rheumatic tendency, or the treatment of the disease proper.

1. *Palliative treatment.*—This chiefly consists in counter-irritation by iodine or cantharides; the application of anodynes, such as preparations of opium, belladonna, and chloroform; or friction with various stimulating liniments, containing camphor, soap, turpentine, or acetic acid. Regular warm fomentations night and morning, with very warm or even hot water, followed by rubbing and the application of a stimulating liniment under warm rollers, is one of the most efficacious methods of local treatment, the pains being prevented or relieved, and the stiffness removed often to a remarkable degree. Altogether, whatever view may be taken of the pathology of the disease, thorough local treatment of the joints and limbs will generally be attended with decided relief.

2. *General treatment.*—The most successful treatment of the condition of system with which chronic rheumatism is associated, is removal of the patient from the variable weather of England to the warm and settled climate of sub-tropical or tropical countries. In the case of the poor we have recourse to warmth of clothing and housing and relief from muscular exertion, as far as they can be secured, by admission permanently into charitable institutions. The subjects of chronic rheumatism require a nutritious, heat-producing, and at the same time attractive and digestible diet. Red wine may be allowed, the effects of it being watched. If acute symptoms, particularly pyrexia, supervene, liquid nourishment should be immediately substituted. The action of the liver and bowels must be carefully attended to. Iron, cod-liver oil, and arsenic are the drugs best suited to support the general health. Iodides and sulphur sometimes prove useful. Occasional large doses of salicylate of sodium will control more urgent symptoms. Courses of the mineral waters of Bath, Buxton, and Strathpeffer, in this country; and of many foreign baths, such as Aix-les-Bains, Royat, Aix-la-Chapelle, Wiesbaden, Baden-Baden, and Hammam R'Irha, prove invaluable in many cases to those who can afford to try them. As a rule, massage forms part of the treatment at these places; and passive movement of the joints, slowly but steadily increased in degree day by day, can be practised readily, with much hope of benefit. Exercise should be taken daily in the open air, unless the weather be unfavourable; and active movement of the affected joints may sometimes be carried out in spite of temporary pain. The ordinary Turkish bath may also afford temporary relief, if properly employed. *See* RHEUMATIC ARTHRITIS.

J. MITCHELL BRUCE.

RHEUMATISM, Gonorrhœal.—Synon.: Urethral Arthritis; Fr. *Arthrite Blennorrhagique*; Ger. *Tripperrheumatismus*.

Definition.—A kind of inflammation of the joints and associated structures, apparently infective in its nature, occurring in the subjects of inflammatory discharge from the genito-urinary mucous membranes.

Ætiology. This disease, as its name implies, is generally referable to the presence of gonorrhœa. Occasionally it appears to originate in other kinds of inflammatory discharge connected with the urethra, such as gouty or traumatic urethritis or gleet; whilst, on the other hand, it has been observed as a complication of gonorrhœal ophthalmia without urethritis. It is much more common in men than in women, apparently from the more thorough cleansing of the female urethra during urination. An affection of the joints which strongly resembles it, is found in connexion with chronic uterine disease, or in the puerperal state; but so-called 'chronic uterine disease' in women is unquestionably very often gonorrhœal. Either a rheumatic or a gouty history is frequently to be traced in the patient. Previous attacks powerfully predispose to the return of the disease on the recurrence of urethritis, even in a mild form. The observation has also been made that persons who have suffered from the disease are frequently found to be, and to have been, peculiarly susceptible of urethral inflammation; excessive sexual intercourse being regularly followed by discharge in such individuals. It is practically certain, however, that these excesses, this predisposition, and this 'susceptibility' are all to be accounted for by the actual presence of persistent gleet; in other instances the man is re-infected by the wife. Thus successive attacks of urethritis and gonorrhœal rheumatism in the husband, along with leucorrhœa, chronic uterine disease, and tubal, ovarian, and peritoneal disease in the wife, may be referable to a single remote infection. *See* Gonorrhœa.

Amongst exciting causes, the most important appear to be injury of a joint, such as a sprain; a drinking bout; and chill during the course of gonorrhœa.

Anatomical Characters.—In recent cases of this disease the structures connected with one or more of the articulations are acutely inflamed. The cavity contains a variable amount of serous effusion, according to its form and size; the knee, for example, being considerably distended, whilst the digital joints are more moderately enlarged. The various component parts are hyperæmic and swollen; and the peri-articular structures full or even œdematous. In more advanced cases the joints are found to contain either sero-purulent or purulent materials; the cartilages may be eroded; and finally the articulations may become completely disorganised or ankylosed. The gonococcus has been found in the intra-articular effusion (*see* **Micro-organisms**). The cardiac structures are very rarely affected. The eye may present the ordinary appearances of catarrhal (not gonorrhœal) conjunctivitis.

Symptoms. The disease, as ordinarily observed, commences at any period in the course of gonorrhœa—very frequently within a week of its appearance, but possibly not until it has degenerated into a slight gleet, or apparently disappeared. The patient is probably first aware of pain in the loins, or of swelling and pain in the soles of the feet, and very shortly these symptoms involve the ankles. In other instances the knees or wrist-joints suddenly become painful, tender, and swollen—possibly after strain or exertion. At the same time the patient is feverish, suffering from malaise and anorexia; the tongue becomes foul; and the pain, broken sleep, helplessness, gonorrhœa, and general illness give rise to restlessness and depression. Along with, perhaps even before, the articular symptoms, conjunctivitis sets in, affecting one or both eyes, and, although of a well-marked catarrhal kind, usually passes off in a few days with little or no treatment.

The physical signs connected with the joints are generally well-marked, the parts being hyperæmic and much swollen, both from intra-articular effusion and from exudation around. The amount of œdema of the dorsum of the hand or foot when the neighbouring joints are involved by gonorrhœal rheumatism, and of the upper part of the subcutaneous surface of the tibia when the knee-joint is affected, is often remarkable. The severity of the pain varies much. At times it is great, preventing sleep, especially as it is usually aggravated at night; in other instances it is extremely slight, and the condition is then more chronic in character. The pain is 'gnawing' or 'aching;' according to some patients, it is more severe before the swelling appears, according to others it is aggravated by the swelling. An important feature of the pains in gonorrhœal rheumatism is that in some cases they are not limited to the joints, but involve the fibrous structures, especially of the loins, the plantar and palmar fasciæ, the tendo Achillis, and the sheaths of nerves, such as the great sciatic. The muscles, or their aponeuroses, also appear to suffer; the fleshy parts of the arm, forearm, neck, and thigh, as well as the loins, being complained of. Frequently, indeed, the patient declares that the pains are universal. Stiffness is also felt, particularly when a joint or limb has been kept long in one position. Tenderness varies much, like the other phenomena, being exquisite in some instances, and entirely absent in others. Portions of the tendon-sheaths may be found swollen and tender.

The heart and pericardium are very rarely involved. *See* Heart, Inflammation of: 2. Ulcerative Endocarditis.

Such are the usual characters presented by a case of gonorrhœal rheumatism within the first week of its appearance. Under favourable circumstances the symptoms may decline; but in the majority of instances one joint after another is invaded by the morbid process, whilst those already attacked either slowly recover or continue affected, the disease becoming more extensive and protracted for several weeks or even months. Cases are met with in which all the joints of one or more limbs are simultaneously affected with gonorrhœal rheumatism, and have been so affected for ten to sixteen weeks; certain of the articulations being but recently invaded, whilst others are slowly recovering from the attack with which the disease commenced. In this manner every joint in the body may be invaded, including the jaw, the sterno-clavicular articulation, and the spinal column. The second toe is a favourite seat of the disease.

The class of case just described constitutes the most severe form of gonorrhœal rheumatism. Happily, in most instances the disease is much milder, only one or two joints being affected, and the process either ending with a sharp painful burst of acute synovitis, or, on the contrary, lapsing into a state of chronic intra-articular effusion, with neither tenderness nor pain.

When the disease is protracted, either in one or in many joints, the constitutional symptoms lose their acute character. There is little or no pyrexia; the appetite is fair; and the patient may even go about his work. But the health is gradually impaired, the patient being debilitated and depressed; in the most severe cases he may be completely crippled, unable to stand, write, or feed himself, and reduced to a condition of general helplessness and wretchedness.

Course, Duration, and Terminations.—The variable course of gonorrhœal rheumatism has been already sufficiently indicated. The duration of the disease is quite indefinite, varying from a few days to many months. The most unfavourable termination of the disease is ankylosis of the joints, with hopeless crippling; but this is rare. It never proves fatal directly. The disease, as already stated, is very liable to return. The urethritis is contagious, and the writer has seen husband and wife suffering together from the disease.

Pathology.—Opinion is still divided upon the essential nature of gonorrhœal rheumatism. Three leading views may be mentioned. It is believed by some pathologists that 'gonorrhœal rheumatism' is nothing more than acute or subacute rheumatism, associated with gonorrhœa or other similar discharge. Most authorities now recognise in the disease a kind of pyæmia, the gonococcus being the essential cause, and the seat of the primary infection being usually the urethra. The third view is perhaps not inconsistent with either of the other two. It represents gonorrhœal rheumatism as a trophic or nutritive disorder, due to reflex disturbance; the urethral inflammation affecting primarily certain centres in the spinal cord and brain, and the altered condition of these giving rise to the articular changes.

According to both the pyæmic and the trophic or reflex theories of gonorrhœal rheumatism, the joint-affection may originate in a purulent discharge from any mucous surface, the urethra included. Thus joint-disease has occasionally been observed in association with dysentery, and with chronic bronchitis. It is beside the purpose of the present article to enter into a discussion of these theories.

Diagnosis.—The diagnosis of this disease turns upon the existence of an urethral discharge in association with articular inflammation. The occurrence of the latter in young male subjects should always rouse the suspicions of the practitioner as to the presence of gonorrhœa; and he ought at once to ascertain, by careful inspection, the state of the urethra, never accepting the patient's statement on the subject. In some instances there may be but a trace of gleet, or the history of a recent gonorrhœa alone may remain. In doubtful cases the urine must be examined with particular care. It should be passed in the presence of the practitioner, and the first fluid ounce of it collected in a separate vessel and examined for products of urethritis that may be washed out, including muco-purulent threads from the prostatic portion of the passage. The previous occurrence of one or more similar attacks in connexion with gonorrhœa will confirm the diagnosis. Ophthalmia in association with subacute articular symptoms ought immediately to suggest the presence of gonorrhœal rheumatism. The suspicion of the gonorrhœal nature of arthritis is sometimes first roused by the failure of salicylates to give relief.

Prognosis.—The prognosis is generally favourable. In young, healthy subjects, under careful treatment, the disease will probably shortly subside. It will, however, prove protracted and obstinate under the opposite circumstances. Unless, also, cure be complete, the future is likely to prove a history of recurrences and accumulating misery. Gonorrhœal rheumatism increases in severity in subsequent attacks, and the prognosis is correspondingly more unfavourable. Another point which should be seriously impressed upon the patient, by way of warning, is that the risk of the recurrence of arthritis also increases with each exposure to gonorrhœal infection.

Treatment.—The treatment of gonorrhœal rheumatism is still unsatisfactory. Whilst some practitioners endeavour to check the urethral inflammation as speedily as possible, others strive to encourage the discharge. The former plan is unquestionably the more rational and the more successful. The treatment of the gonorrhœa or gleet must be assiduously persevered with. *See* Gonorrhœa; and Gleet.

At the same time, the attention of the practitioner will be anxiously directed to the joints. If the local symptoms be severe, absolute rest is necessary, the patient being confined to bed, and the affected limb protected by a splint in such a way that applications can be made to the joints. Anodynes may be called for at first, such as poultices, fomentations—simple or opiated, or a liniment composed of equal parts of extract of belladonna and glycerine. In other instances leeches may be tried; blistering in others, where there is either great pain, unrelieved by anodynes, or persistent effusion. In subacute cases with little pain or general disturbance, strapping may be sufficient—particularly with Scott's dressing; and in a more chronic form of the disease friction of the joint and associated parts, and moderate passive and active exercise, may effect a cure.

Internal treatment must be pursued simultaneously. In acute cases free purgation should be obtained at first, and this should be followed by a course of alkaline salines, either alone or in combination with quinine. Treatment specifically directed to the gonorrhœa is often required. If the disease persist, iodide of potassium should be given, combined with alkalis or with iron, according to circumstances; iron alone suits other patients well. Phenacetin and salicylates have appeared beneficial in some instances. In other cases mercurials effect a cure, especially if there be a syphilitic taint, which is not uncommonly the case. The diet must be carefully regulated in the different stages: at first 'low' and without stimulants; afterwards generous. In very chronic cases of gonorrhœal rheumatism, with threatening ankylosis, the patient should be sent, if possible, to a warm watering-place, and be subjected to a thorough course of treatment both externally and internally. Sea voyages very successfully fulfil the different indications for treatment in obstinate cases. *See* Rheumatic Arthritis.

J. Mitchell Bruce.

RHEUMATISM, Muscular. — Synon.: Fr. *Rhumatisme Musculaire*; Ger. *Muskelrheumatismus.*

Definition.—A disorder of fibro-muscular structures, characterised by local pain and spasm, and a certain degree of fever; and generally associated with the rheumatic diathesis.

Ætiology.—Muscular rheumatism is most frequently observed in the subjects of the rheumatic diathesis. It occurs in both sexes, and at all ages; children and adolescents being specially liable to rheumatic torticollis, and older subjects to lumbago and chronic muscular rheumatism of the limbs. The exciting causes are chiefly two: first, exposure to cold—above all, exposure of a muscular part to a 'draught' after exertion; and second, sprain or strain of the fibro-muscular structures. A peculiarly obstinate type of the disease has been observed as a sequela of influenza. Muscular pain, tenderness, and spasms are also common in the invasion of acute rheumatism, and in gonorrhœal and chronic articular rheumatism.

Anatomical Characters. — Nothing is known respecting the anatomical characters of muscular rheumatism, if, indeed, there be any discoverable change in the muscular or fibrous structures.

Symptoms.—The disorder usually commences with slight febrile disturbance, possibly accompanied by sore-throat. Either simultaneously, or in children after one or two days, pain is experienced in the region of some definite muscle or muscular mass, such as the sterno-mastoid or the muscles of the loins; and this speedily becomes so severe as to constitute the leading symptom of the attack. The pain is present only when the affected muscle is thrown into action, so that it may be perfectly relieved by relaxation or rest of the parts involved. The slightest movement, however, from the position of relief is instantly attended with excruciating pain, of a peculiar spasmodic character, which persists until relaxation is again secured. The constant effort to avoid pain gives rise to a feeling and appearance of stiffness, causing the patient to assume characteristic attitudes of the head, trunk, or limbs. Tenderness on grasping the muscle is occasionally well-marked. In some cases several of the joints may also be affected with pain and stiffness.

The constitutional symptoms of muscular rheumatism are generally those of mild fever. The tongue is furred; the appetite is impaired; the bowels are confined; the pulse is somewhat frequent, large, and soft; and there is a feeling of malaise. In other instances these symptoms are extremely slight or altogether wanting, the patient suffering from nothing more than local pain. Occasionally there is catarrhal ophthalmia. Subacute articular rheumatism and sciatica may be present as complications.

Muscular rheumatism usually persists for several days, and gradually declines, but in the milder cases it may last for weeks. One form of the disorder is essentially chronic, the patient suffering for years from pain in various fibro-muscular structures, especially those of the shoulder, arm, thigh and leg, during cold, wet weather.

Varieties.—The following local varieties of muscular rheumatism are recognised by special names:—

1. **Muscular Torticollis.** — Synon.: Acute Wry-neck; 'Stiff-neck'; *Caput Obstipum.*—Here the sterno-mastoid muscle is chiefly involved, but any or all of the cervical muscles may be painful. This form is most frequently observed in young subjects, and is often markedly recurrent. It is easily recognised by the fixed position of the head; and has to be diagnosed from spasmodic torticollis, sterno-mastoid tumour, sprain, tonsillitis, and spinal disease.

2. **Pleurodynia.**—The fibro-muscular structures of the chest-wall are the seat of rheumatism in this variety. Cough is a common exciting cause of the complaint, which is seen chiefly in adults. Pain is complained of in the chest-wall, usually on one side; in some instances it may be excruciating, and of a distressing, spasmodic character. On examination, we find that a particular intercostal space, or the origin of the pectoral or serratus muscles, is the seat of localised tenderness; and that every respiratory act causes lancinating pain in the same situation. The respiratory movements of the affected side are restrained; but the ordinary physical signs of pleural, pulmonary, and cardiac diseases are absent, as are also the *points douloureux* that characterise intercostal neuralgia. If the movements of the corresponding ribs be restrained by plaster or bandage, the pain is effectually controlled. The direct constitutional disturbance is generally not great, unless sleep be prevented by pain.

3. **Lumbago.**—The muscular and fibrous structures of the loins are here the seat of pain, most commonly the erector spinæ, less commonly the latissimus dorsi, or other smaller muscles in the same situation, on one or both sides. As the muscles of the back support the body in the erect position, and participate in the various movements of rising and bending the trunk in all directions, the patient may be compelled to remain at absolute rest in bed. More frequently he is able to move about, although with pain or in a stooping attitude. The amount of febrile disturbance is generally moderate.

Lumbago is easily recognised by the characteristic muscular pain referred to the loins, greatly increased by bending, straightening the back, rising from the sitting posture, or turning in bed; and by tenderness of the muscles on pinching, without the acute defined tenderness on pressure of abscess or neuralgia. At the same time it cannot be insisted upon too strongly, that careful examination of the back, of the abdomen generally, and of the urine, will be required to prevent the practitioner from falling into the not uncommon error of treating cases of serious disease as simple lumbago. Renal calculus, lumbar abscess connected with spinal caries, perinephritis, perityphlitis, abdominal aneurysm, disease of the rectum, uterus, or bladder, spinal meningitis, and small-pox, are the principal morbid conditions which must be borne in mind and excluded in every instance, before the diagnosis is settled. Pain in the loins is also a very common accompaniment of affections of the buttock and lower limbs, such as sciatica, rheumatic affections of the hip-joint, and perhaps lameness from any cause. It is also very frequently met with in gonorrhœal rheumatism.

4. **Dorsodynia.** — Synon.: Omodynia; Scapulodynia.—These names are given to rheumatism involving the structures of the upper part of the back and shoulders. It occurs chiefly in persons much exposed to the weather; and has to be diagnosed chiefly from rheumatism of the shoulder-joint, and certain less common forms of neuralgia connected with the upper dorsal nerves and arms, thoracic aneurysm, and diseases of the cord and spine.

5. **Abdominal rheumatism.** — Muscular rheumatism of the abdominal walls is occasionally observed, either alone or in association with lumbago.

6. **Cephalodynia.** — Muscular rheumatism may affect the scalp, giving rise to a dull, aching kind of headache, on the brow or occiput, aggravated by movement, and occasionally complicated with tenderness of the eyeballs and ophthalmia.

Diagnosis.—Speaking generally, muscular rheumatism has chiefly to be diagnosed from neuralgia, and, as a rule, this can easily be done by the paroxysmal character of the latter, the ætiological relations, and especially the physical signs. A very similar disorder occurs very commonly in gouty subjects. The practical diagnosis of the chief local varieties has already been sufficiently indicated.

Prognosis.—The prognosis of muscular rheumatism is highly favourable. Under careful treatment recovery may be anticipated in a few days or weeks. But the disorder is one which is peculiarly liable to recur on exposure to its exciting causes.

Treatment.—The treatment of muscular rheumatism consists in remedying the constitutional condition; and in relieving the local pain. At the very commencement of the illness, a hot-air or Turkish bath may answer both these indications, and give immediate relief. The first indication will, however, be generally best fulfilled by free purgation, followed by alkaline salines, such as the bicarbonate, citrate, or acetate of potassium, and solution of acetate of ammonium. In more feeble subjects quinine may be given in combination with alkalis; or iodide of potassium in protracted cases. The diet should be of the simplest character.

The best local treatment consists in absolute rest and warmth of the affected parts, which may be variously secured in different instances by confinement to bed, strapping, and plasters. Mustard is one of the most available and successful of remedies. Other counter-irritants or anodynes which give great relief are warm opiate fomentations, or liniments composed of extract of belladonna and glycerine, opium, aconite, chloroform, or camphor, or of various combinations of these. Liniments are more efficacious when sprinkled on the surface of a hot fomentation, firmly applied, than when rubbed into the part. If the suffering be great, a hypodermic injection of morphine and atropine should be given. Belladonna plaster gives at once relief and support in mild cases. The continuous galvanic current occasionally dispels the pain and stiffness almost immediately. A prolonged hot or mustard bath, carefully given, relieves some cases of lumbago. In obstinate cases cupping or blistering may be tried. The affected muscles must be kept warm and carefully protected from cold, especially in torticollis. When rheumatism involves the muscles of the limbs, warm anodyne liniments are the best local measures.

Great care should be exercised to prevent the recurrence of muscular rheumatism, by wearing warm woollen clothing; by avoiding exposure to damp and draughts; by attending to the digestion and the bowels; and by abstaining from severe, sudden, and awkward muscular efforts. In chronic or recurrent cases of the disorder, the patient should, if possible, visit some of the English or foreign baths indicated in the article on RHEUMATIC ARTHRITIS. J. MITCHELL BRUCE.

RHINITIS (ῥίν, the nose). — Nasal catarrh. *See* NOSE, Diseases of.

RHINOSCOPY (ῥίν, the nose; and σκοπέω, I examine).—SYNON.: Fr. and Ger. *Rhinoscopie.* — The nasal passages can be inspected from the front through the anterior nares, or from the back through the naso-pharynx. The former method is termed 'anterior rhinoscopy,' the latter 'posterior rhinoscopy.' Both methods are necessary for a thorough inspection of the nose.

Anterior Rhinoscopy.—In order to examine the nasal passages from the front, the observer should be seated upright facing the patient. It is always better to employ reflected light, in the same manner as for examination of the larynx (*see* LARYNGOSCOPY). Having concentrated a bright circle of light on the patient's nose, we can obtain a view of the interior of the vestibule by making the patient tilt the head slightly back, and raising the tip of the nose with the thumb. In order to examine the interior of the nasal fossa, a speculum must be used to dilate the cartilaginous aperture. There are several different forms of nasal speculum, but Duplay's bivalve speculum is perhaps the most generally useful. The speculum should be inserted gently with the thumb and forefinger of the left hand, and the blades separated slowly, the patient's head being tilted slightly backwards while this is being done. The anterior end of the inferior turbinated body will first attract attention, forming a rounded prominence projecting from the outer wall. If the patient's head be now tilted a little forwards, the convex surface and lower border of the inferior turbinated body can be traced backwards for a considerable distance, or even for the whole length, presenting usually an irregular wavy outline. The floor of the nasal passage can often be traced to the posterior extremity; and, if a strong light be directed back along the floor, the posterior wall of the pharynx can sometimes be discerned. If the patient's head be thrown backwards, the middle turbinated body will be seen above and behind the inferior. The anterior border, and the angle between this and the inferior, are the parts chiefly seen. Between the middle turbinated body and the septum is a narrow space, known as the olfactory slit, which can only be imperfectly illuminated. When the patient's head is thrown well back, the fore part of the roof will be brought into view, but the superior turbinated body cannot be seen.

The actual extent of the parts seen by anterior rhinoscopy varies much in different cases. A deflected septum is a serious obstacle. Vascular turgescence of the inferior turbinated body, especially at the anterior end, often interferes with the view. This swelling can be reduced by the application of a 5 per cent. solution of the hydrochlorate of cocaine.

Posterior Rhinoscopy.—By this method the posterior nares and naso-pharynx can be inspected. A small mirror, about half or five-eighths of an inch in diameter, is used in the examination. A small laryngeal mirror serves the purpose, but the mirror should be attached to the stem at more nearly a right angle than is usual for laryngoscopy, and it is convenient to have the handle slightly bent to follow the curve of the tongue. A rhinoscope such as Michel's, however, is much more convenient. In this instrument the mirror is in the same plane as the handle, and can be raised to any angle by pressure on a spring.

The patient sits upright, with the head inclined slightly forwards, and is directed to open the mouth and breathe quietly and naturally. The light is concentrated from a reflector on the palate and pharynx, in the same manner as in laryngoscopy. The tongue must generally be depressed with a spatula. One with the handle at right angles to the blade is most convenient. The rhinoscopic mirror, previously warmed, is introduced rapidly, with its reflecting surface upwards, to one or other side of the uvula, close to, but not touching, the wall of the pharynx. By depressing the handle or by pressing on the spring, according to the form of rhinoscope used, the mirror can be made more vertical, and by various movements of the mirror an image of the different parts can be obtained. Difficulties may occur in the examination. The commonest is the drawing up of the uvula and soft palate against the pharyngeal wall as soon as the examination is begun. The patient should be directed to breathe quietly through the nose, and the effort to do this will cause the velum to hang away from the pharyngeal wall. If this do not succeed, the patient should be made to emit the French nasal sound *en*, or *on*. This will often succeed in giving a view of the parts. Painting the throat with a 10 per cent. solution of the hydrochlorate of cocaine will often be an assistance. In certain cases, where the depth of the pharynx is small and the soft palate long, a view can only be obtained by drawing the soft palate and uvula forwards by means of a Voltolini's palate-hook.

Only a limited portion of the post-nasal region is seen reflected in any one position of the mirror. When the mirror is first raised into a nearly vertical position, the posterior surface of the velum is brought into view. By inclining the mirror to a more horizontal position, the septum appears as a sharp, whitish ridge, which serves as a landmark to the parts in this region. On either side of the septum, the ovoid openings of the nasal fossæ, the choanæ, may be brought into view by slightly turning the mirror. Each choana is largely occupied by the posterior ends of the turbinated bodies, the most conspicuous of which is the middle. The inferior is largely hidden by the soft palate, as is also the lower end of the septum. By inclining the mirror to one side, the depression leading to the Eustachian orifice is seen, bounded above and behind by a prominent ridge. By bringing the mirror to a nearly horizontal position, the vault of the naso-pharynx and the region of Luschka's tonsil are brought into view.

James B. Ball.

RHONCHAL FREMITUS.—A physical sign, appreciated by palpation of the chest, elicited by the act of breathing when certain secretions or other materials are present in the larger air-tubes or in a cavity. *See* Physical Examination.

RHONCHUS (ῥέγχω, I snore).—Rhonchi are sounds heard on auscultation when the air-channels are partially obstructed. The term is restricted by some authors to the so-called *dry* and more or less musical sounds produced in the bronchial tubes, for instance, *sonorous* and *sibilant* rhonchus; the bubbling and crepitating sounds in chest-disease being spoken of as *râles*. By other authorities, again, all such sounds, whether sibilant or crackling, are described either as *rhonchi* or as *râles*, the terms being interchangeable. *See* Physical Examination.

R. Douglas Powell.

RHYTHM (ῥυθμός, a measured movement).—The relative proportion between the several parts of certain actions. In medical science it is generally applied to the movements of respiration, and to the action of the heart. *See* Physical Examination.

RIBS, Diseases of.—*See* Chest-walls, Diseases of; and Deformities of the Chest.

RICKETS (O. E. *wrikken*, to twist).—Synon.: *Rachitis*; Fr. *Rhachitisme*; Ger. *Rhachitis*; *Englische Krankheit.*

Definition.—A general disease, affecting the nutrition of the whole body; arresting natural growth and development; perverting and delaying ossification; retarding dentition; causing the bones to become soft, and to yield to pressure, and the muscles and ligaments to waste; and in many cases producing alteration of the brain, liver, spleen, and lymphatic glands.

Ætiology.—Rickets is the consequence of slow impairment of nutrition, and the causes which produce it are principally—bad feeding, foul air, damp cold rooms, want of sunlight, want of exercise, and want of cleanliness. Of these, perhaps the first two have the greatest influence in causing the disease; for if the quantity of nutritive material introduced into the system be restricted by an improper selection of food, and if the oxidation of waste matters be hindered by an insufficient supply of fresh air, interference with nutrition is necessarily carried to a high degree. A pure bracing air will by itself do much in counteracting the effects of an improper dietary, for it has been noticed that injudicious feeding is less hurtful in country places where the air is dry than in large towns. This however, may be partly explained by the greater vigour of the digestive organs in the former case, enabling the child to derive nourishment from food which, under other conditions, would be innutritious. Some children are affected more readily and more severely by these causes than others, for the more the strength of the child is reduced before the actual exciting causes of the disease come into play, the more quickly does the patient fall a victim to their effects. Therefore, all influences which impair the general strength, such as weakness in the parents, or, in the case of the child himself, an attack of acute disease, or even unusually troublesome dentition, must be looked upon as predisposing causes of the disorder. There is no proof that rickets is hereditary. A tuber cular family predisposition renders the occurrence of rickets unlikely. Some years ago a distinguished foreign physician attempted, by arguments drawn chiefly from morbid anatomy, to prove rickets to be invariably a consequence of inherited syphilis. But the reasons for rejecting this hypothesis are overwhelming.

Anatomical Characters.—The bones are affected in three ways: growth is retarded; the spread of ossification into parts still cartilaginous is interfered with; and bone already ossified is softened. The growth of bone is not completely arrested; it rather becomes irregular. There is considerable development of the cartilaginous epiphyses, and also of the fibrous periosteum; but these parts ossify incompletely and slowly; and as the normal increase in size of the medullary cavity continues in the usual way, the bone comes gradually to consist less and less of osseous substance, and more and more of, as yet, unossified matter proliferated at the circumference. It is in this way that the bones become soft, and not from any abnormal absorption of earthy salts from bone already ossified. The process of calcification itself, besides being retarded, is abnormal: it has indeed been described as rather a process of petrifaction than of true ossification. On account of the softness of the long bones, serious deformities ensue, as will be afterwards described. The flat bones become greatly thickened from proliferation of the periosteum. This is especially noticeable at the edges of the cranial bones; and when ossification is completed, the sutures of the skull can be felt to be prominent. In parts, however, and especially in the occipital bone, the osseous substance becomes thinned in places from absorption under the pressure of the growing brain. This condition, which is called 'craniotabes,' can be detected by palpation. Calcification is very slow in the cranial bones, and the fontanelle often remains open long after the end of the second year.

The liver, spleen, lymphatic glands, and kidneys are sometimes enlarged. The increase in size is due, not to the presence of any foreign growth or deposit in these organs, but to irregular hypertrophy of their fibroid and epithelial elements, conjoined with a deficiency in earthy salts—an alteration analogous to the changes in the bones. The brain is enlarged from an increase of the neuroglia, not of the nerve-elements. The voluntary muscles are small, pale, flabby, and soft. Under the microscope their striæ are seen to be indistinct. The urine contains less urea and uric acid than natural, but more phosphates, especially phosphate of lime.

Symptoms.—In most cases the symptoms proper to rickets are preceded by others which indicate a certain amount of interference with the digestive functions. There is occasional vomiting; the bowels are often relaxed; and the motions are habitually loose, pasty-looking, and offensive.

The beginning of the disease is marked by profuse sweating of the head, face, and neck; this is especially seen if the child fall asleep either at night or in the day. Almost at the same time he begins to throw off the bedclothes at night. He will do this even in winter, and may be seen lying almost naked in the coldest weather. Characteristic changes soon occur in the bones. The ends of the long bones enlarge; the flat bones become thickened; and all the bones lose their firmness and grow softer. These changes affect the osseous system as a whole, and lead to serious deformities. If the child had been able to walk, he becomes unsteady on his legs, or even loses the power of walking altogether. He sits or lies about; is drowsy in the daytime; and at night moves his head restlessly from side to side, so as in many cases to wear the hair off the occiput. The flesh is soft and flabby; the motions remain loose and offensive; and the child appears to be occasionally troubled with abdominal discomfort, for he may be found asleep in his cot, resting upon his hands and knees, with his head buried in the pillow. When the bone affection is pronounced the child shows strong dislike to being touched or played with. This wish for quiet is usually ascribed to tenderness, but is more probably occasioned by the knowledge that movement hurries the breathing and raises a demand for air which the chest-wall with its softened ribs is unable to satisfy. If evident tenderness be present, this symptom usually indicates that the case is becoming complicated with scurvy.

A prominent symptom in rickets is the deformity produced by alterations in the shape of the skeleton. The softened ribs yield readily to pressure, and it is to pressure, and not to the force of muscular action, as was at one time supposed, that the distortions are chiefly due. The long bones become bent and twisted. The direction of the bending depends upon the direction in which the force of pressure is applied, and in the lower limbs will therefore manifestly vary according as the child can or cannot walk. Sometimes, however, if the disease begins before the child is able to support himself upon his feet, the lower limbs may escape deformity altogether. They are usually in such cases particularly small and thin, with weak, flabby muscles, but the bones themselves are straight. Force of gravity is another cause of deformity of bone. Thus, in the humerus there is often a curve where the deltoid is inserted; this is produced in great measure by the weight of the hand and forearm when the limb is raised by the deltoid muscle.

The skull is elongated from before backwards; the fontanelle is wide; the sutures are thickened; the forehead is high, square, and sometimes prominent; and the head generally looks large. By palpation of the occiput the condition named 'craniotabes' can sometimes be detected. It is an early symptom. The face appears unduly small when compared with the head, for the growth of the facial bones is arrested. On account of this pause in the development of the jawbones dentition is delayed; but the teeth are not only slow to appear, they are also deficient in dental enamel, so that they are no sooner cut than they begin to decay.

The spine is curved on account of muscular and ligamentous weakness; and if this weakness be great, the natural posterior curve of the spine is so much exaggerated as almost to simulate angular curvature. It disappears, however, at once when the child is lifted up by the shoulders. Sometimes the spine is curved laterally.

The deformity of the chest has the following characters: The softened ribs sink in so as to present a groove passing downwards and outwards on each side of the sternum. The bottom of the groove is formed more by the ribs than the cartilages, so that the enlarged ends of the ribs, looking like a row of beads under the skin, can be seen lying along the outer side of the groove. The sternum is forced forwards by this bending of the ribs, and the antero-posterior diameter of the chest is increased. The deformity is due to the pressure of the external air. In healthy breathing this pressure is overcome by the resistance of the thoracic walls, aided by the force of the inspired air. In the rickety child the resistance offered by the softened ribs is greatly reduced, and they therefore sink in at the parts where they are least supported. On account of the softened state of his ribs, the breathing of a rickety child is quick and laborious.

The pelvis is pressed upon from above by the spine and the abdominal contents, from below by the heads of the thigh-bones; and the direction of these forces varies according to the position of the child. The general shape thus produced is triangular, and the pelvic cavity is often greatly narrowed.

A rickety child is short for his age; for his limbs, besides being bent, are stunted, growth in them being more or less arrested. His joints are large, and loose from relaxation of the ligaments. If the disease be severe, the child gets anæmic and wastes, and the muscles become very flabby and small. His belly is big, even when there is no splenic enlargement, from shallowness of pelvis and flatulent accumulation. Such children give little trouble. They are quiet, and seldom cry if left alone. They are late in walking, late in talking, cut their teeth late, and in nursery phraseology are 'backward children.'

COMPLICATIONS.—One of the chief characteristics of rickets is the *intense sensitiveness to cold* with which it is always accompanied; and it is to chills in different forms that a large proportion of deaths occurring in this disease must be attributed. A catarrh may affect the chest or the belly, and in either case the complication is a very dangerous one.

A pulmonary catarrh in a young child should never be made light of, on account of its tendency to cause collapse of the lung; and if the child be the subject of rickets, the danger is really imminent on account of the softness of the ribs.

If the chill affect the abdomen, as it is very apt to do, an intestinal catarrh is set up; and unless the diarrhœa be quickly arrested, the strength of the child becomes seriously reduced.

Besides its influence in increasing the susceptibility of the body to cold, rickets also heightens the *nervous impressibility* of the child. This effect is not a common result of mere weakness, for in an ordinary case of malnutrition with wasting, the natural sensitiveness of the nervous system to external impressions is impaired. It must be therefore looked upon as a peculiarity of the rickety state. Its effects are seen in the attacks of laryngismus stridulus, tetany, and convulsions to which these children are so liable. Few cases of laryngismus occur in children who are not the subjects of rickets. Such patients usually have carpo-pedal contractions, and are liable to be convulsed upon the very slightest provocation. On account of the backwardness of the teeth in this disease, all nervous derangements are commonly attributed to dentition; but in rickets dentition, although delayed, is not necessarily troublesome; in fact, the teeth, when they appear, are often cut with singular ease.

Another important complication is infantile *scurvy*; indeed, in the child scurvy is rarely seen apart from rickets. It is not that the complaint is due directly to the general impairment of nutrition upon which the rickety state depends, but that owing to the impoverishment of the blood the patient has become peculiarly susceptible to a scurvy diet, and if fed largely upon tinned foods rapidly develops the disease.

The first symptom noticed is a tenderness of the legs. The child, if able to stand, refuses all at once to put his feet to the ground, and cries if required to do so. He shows a great dislike to movement, and as the tenderness increases begins to keep his lower limbs flexed upon his body. He lies quietly in his cot, sometimes moans as if in pain, and screams at the slightest touch. At this time the lower parts of the thighs, the knees, or the legs may be noticed to be swollen, but the colour of the skin is unaltered. The swelling is due to extravasation of blood beneath the periosteum, and, as a rule, is limited to the parts named, but in exceptional cases it may affect the arm, especially about the elbow and wrist. Sometimes there is slight œdema. While these local symptoms continue there is often moderate fever (101°–102° at night); the complexion is pallid, with a faint sallow tint; and the child is very feeble and sweats profusely. There are usually petechiæ and bruise-like patches on the skin, and in some cases the gums are spongy and sore; but this symptom is often absent in the rickety child—indeed, if rickets be marked and dental development arrested, the gums are usually quite healthy. In the worst cases there may be separation of the epiphysis of the affected part of the bone. The child then ceases to flex the limb, and lies with it stretched out as if paralysed.

Under appropriate treatment improvement is rapid. In an ordinary case the more urgent symptoms subside in a few days, and even in bad cases recovery is rarely long delayed. A separated epiphysis under favourable conditions becomes again united with the bone, and the patient quickly regains colour and strength.

Sometimes rickets is accompanied by *chronic hydrocephalus*; the excess of fluid is, however, small. This complication is often suspected where it does not really exist.

Diagnosis.—When the symptoms of rickets are well marked, the bony distortions themselves are sufficiently characteristic to make the nature of the disease unmistakable. It is, however, of great importance to recognise the early symptoms of the disorder, so that by prompt treatment we may prevent the osseous and other changes taking place. It must be remembered that loss of flesh is a late symptom, and that a rickety child is not necessarily a thin one. If an infant pass the ninth month without any appearance of a tooth; if his wrists enlarge; and if on inquiry we find that he is subject to head-sweats at night, and likes to lie naked in his cot, the diagnosis of rickets may be made without hesitation. Weakness of the legs in a young child is often a source of anxiety to parents, and a medical practitioner is consulted because the child is twelve months old and cannot stand. In these cases the early signs of rickets will almost certainly be discovered. Looseness in the joints is common in cases of rickets, where the symptoms of the disease manifest themselves at the end of the second year. The relaxation of the ligaments is not as a rule combined with much bone deformity, although it may be so. Weakness of the legs from rickets is distinguished from essential paralysis by the fact that, although there may be no power of standing, the child is yet able to move his limbs; and that the muscles, although weak, are not powerless.

When scurvy occurs it is important not to misapprehend the nature or gravity of the complication. Early treatment is essential to quick recovery, and delay adds greatly to the child's suffering, if it do not put his life in danger. Marked tenderness in a rickety baby should suggest scurvy at once; and if the child scream loudly, while holding both legs flexed and motionless, our suspicions are amply confirmed. Even if swelling be trifling or absent, gentle manipulation will detect thickening round the shaft of the bone at the seat of tenderness. This is especially likely to be found round the femur for some distance above the knee. In addition, the gums may be spongy, although this symptom is often absent; and there may be petechiæ or bruise-like patches, or even unhealthy sores, on the skin.

Prognosis.—The duration of rickets is dependent upon the duration of the causes which produce it. So long as the unhealthy influences under which the disease originated are in operation, the morbid processes continue; but when a better hygiene is adopted, and failing nutrition is restored, recovery begins.

When recovery takes place, the symptoms gradually become less intense and finally disappear. The enlargement of the joints greatly diminishes, and even the bony distortions become notably reduced, while the bones themselves become thick and strong. Growth, however, is not rapid, and, if the disease have been severe, the child seldom reaches the average height.

When the disease terminates fatally, it is usually through one of the complications which have been mentioned. Sometimes the child sinks and dies, apparently worn out by the intensity of the general disease; but even in these cases the immediate cause of death is usually asphyxia, through the softened state of the ribs. One cause of the great mortality from bronchitis in children is the frequency with which that complaint attacks rickety subjects, even a mild catarrh being seriously dangerous when the ribs are much softened.

In estimating the prospects of recovery in any particular case, we must pay attention to the amount of chest-distortion; and to the presence or absence of disease of the glandular system. If the ribs be much softened, there is always cause for anxiety; and if in a case of pulmonary catarrh there be great recession of the lower ribs in inspiration, the condition is a serious one. The presence of any complication, except perhaps chronic hydrocephalus, necessarily increases the gravity of the case.

Treatment.—As rickets is the direct result of malnutrition produced by the unwholesome conditions in which the child has been living, our first care must be to alter these conditions. We must see that the living rooms are thoroughly ventilated; that the child is taken out regularly into the open air; that he is warmly dressed; and that in his daily bath the washing process is conducted rapidly so as to avoid a chill. We must next select for the patient a diet which is at once sufficiently digestible and nutritious. The term 'digestible' as applied to diet is a relative term. Food digestible to one infant is indigestible to another, and food readily digested by a child in his natural state of health becomes indigestible to him when his stomach is temporarily weakened by teething or any febrile attack. It is not, however, sufficient that the diet should be digestible; it must also be nutritious. Children kept too long at the breast frequently become rickety, even although fed at the same time upon other and suitable food; for the watery breast milk, which forms the principal part of their diet, is sufficient by its bulk to satisfy their desire for food, without supplying the required nourishment to the tissues. Rickety children at the breast should at once be weaned, and, if under twelve months old, should be fed principally upon milk guarded with saccharated solution of lime, in the proportion of fifteen drops to the bottleful. They may take, besides, broths, bread and butter, and occasionally the yolk of an egg lightly boiled or beaten up with milk. Instead of bread and butter, the milk may be thickened for some meals with Chapman's wheat-flour baked in an oven; but farinaceous food should be given with very great caution to these children, on account of their tendency to acid indigestion, which renders a starchy diet particularly likely to disagree. Under twelve months of age the child can seldom bear more than one teaspoonful of a farinaceous powder twice in the day. After the first year, strong beef-gravy, and flower of broccoli stewed, may be added to the diet. At sixteen or eighteen months old, a little mutton may be given, carefully pounded in a warm mortar. A mealy potato, well boiled and mashed, may be allowed, but the effect of all farinaceous food is to be carefully watched. The presence of flatulent pains is a sure sign that the proper quantity has been exceeded. Often in rickets digestive power is very feeble, so that even with the most carefully regulated diet improvement is halting and progress slow. When this is the case, great advantage may be derived from the use of papain as a digestive adjuvant, giving one grain in a spoonful of water with a grain of bicarbonate of sodium immediately before each meal.

The diet and general hygienic arrangements having been regulated, the secondary question of drug-giving has to be considered. Before adopting tonic treatment, it is important to improve the condition of the bowels. A dose of castor-oil or of rhubarb and bicarbonate of sodium should be given to clear away undigested food, and afterwards a few grains of bicarbonate of sodium with a drop of tincture of opium in a little aromatic water will soon remove the offensiveness of the motions. Citrate of iron may then be ordered, and the child should begin at once to take cod-liver oil. The dose of the oil should be small at first (♏ xv–xx), and while it is being taken, the motions should be watched for any appearance of oil in the stools; if this occur, the dose is too large, and must be diminished. As convalescence advances, other medicines may be given; and iron wine, quinine, and reduced iron are all useful. So long as the previous directions have been attended to, the exact tonic used is of comparatively little moment; but cod-liver oil should never be omitted from the treatment. Lime has been strongly recommended by some authors, but according to the writer's experience is of little value unless combined with iron. It may once more be repeated that in rickets the success of treatment is in direct proportion to the conscientiousness with which the rules relative to diet and general management have been carried out; and the mother should be made to understand that the child's recovery depends upon her own watchfulness and care.

The osseous deformities can be prevented to a certain extent, by hindering the child from walking while the bones are still soft. The bowing of the legs is often owing to the child's getting upon his feet before the bones have become sufficiently consolidated to bear the weight of the body. In these cases light well-padded splints which project below the feet will be the best safeguard. When the ligaments of the joints are loose and weak, the joints may be much strengthened by a well-fitting silk elastic support.

After the tenderness of the body has subsided, the child should be well shampooed, especially along the spine, both morning and evening.

With regard to the complications—Diarrhœa and pulmonary catarrh must be treated upon ordinary principles. A good flannel bandage very much diminishes the tendency to relaxation of the bowels, and is of further value in retarding the too rapid descent of the diaphragm, and so in diminishing to a certain extent the recession of the chest-walls during inspiration. The nervous complications are best treated with bromide of potassium. Laryngismus stridulus is often cured at once by bathing the whole body three times a day with water of the temperature of 60° F.

The moment scurvy is detected, the child's diet should be revised. He should be given plenty of fresh cow's milk, and this may be thickened once or twice a day with a well-boiled potato. For medicine, half a grain of quinine dissolved in a teaspoonful of fresh lemon-juice can be given three times a day. If the gums are spongy, Dr. Cheadle's recommendation of the glycerines of tannic acid and carbolic acid (fifteen drops of acid in an ounce of water) is useful, applied with a soft brush. Local attention to the limbs is rarely necessary, but if the epiphyses have separated light splints must be applied.

EUSTACE SMITH.

RIGIDITY (*rigidus*, cold, frozen, stiff). SYNON.: Fr. *Rigidité*; Ger. *Starrheit*.—This term implies the existence of a more or less fixed condition in parts that ought to be freely movable. It is a state met with principally in the limbs, where it is dependent upon certain unnatural conditions of the joints or of the muscles, either separately or in combination. It may, however, occur in the trunk as a whole, or in the neck, owing to the existence of tetanic or tonic spasms in muscles, due to one or other of various causes. The valves of the heart, and the arteries, when stiffened by fibrosis, are said to be rigid. Again, it is a term commonly applied to a condition of the 'os uteri' during parturition, in certain women, in whom the orifice of the womb does not dilate coördinately with the increase in force of the uterine contractions. The term is also sometimes used in connexion with the features. Marked rigidity of a limb at this or that articulation often results from joint-disease. Perhaps more frequently, however, rigidity in a limb is primarily dependent upon altered functional or nutritive conditions of its muscles, which may or may not be associated with actual paralysis implicating the same parts.

Numerous cases exist in which, without the existence of paralysis, or with a comparatively small amount of it, tonic spasms occur in the muscles of a limb, so as to entail rigidity (*see* SPASM). This may be met with, for instance, in hysteria, and in the early stages of some spinal diseases, more especially in primary lateral sclerosis, or in the form of paralysis that goes with Pott's disease.

More frequently still, however, rigidity is found in association with distinct paralysis. For many years a distinction has been made between two kinds of rigidity associated with paralysis; the one of which, known as 'early rigidity,' is apt to supervene soon after the onset of a cerebral or spinal paralytic affection; whilst the other, known as 'late rigidity,' comes on rather in old cases in which mere paralysis with flaccidity of muscles may have been previously present. The former is now believed in many cases to have a tendency to pass into the latter form; and where this becomes well-developed, it is commonly associated with a secondary or with a primary sclerosis of the corresponding lateral column of the spinal cord, even though the initial paralysing lesion may be in some portion of the motor tract of the opposite cerebral hemisphere (*see* SPINAL CORD, Diseases of). In 'early rigidity' we have to do with mere functional changes in the muscles, and the condition itself of rigidity is not constant; it intermits from time to time during the day, and commonly disappears during sleep. But in 'late rigidity,' associated with extensive secondary degenerations in the spinal cord, the nutrition of the nerves, as well as of the muscles and their tendons, appears to suffer, and that, for the most part, in an irretrievable manner. This more severe condition of rigidity is associated with actual shortening of muscles or tendons, and in this stage but little, if any, difference exists between the degree of rigidity of the limbs by night and by day. *See* MOTILITY, Disorders of.

H. CHARLTON BASTIAN.

RIGOR.—SYNON.: Shivering-fit; Fr. *Frisson*; Ger. *Frostanfall.*

SYMPTOMS.—This state is characterised by the following phenomena: There is general shivering, the tremulous movements not infrequently being so great as to cause chattering of the teeth. The face wears an expression of great discomfort, or even of distress. The complexion, especially on the lips and beneath the nails, is blue and livid. The tongue is moist, although thirst is felt. The fingers are shrivelled and 'dead'; the skin is dry and corrugated (*cutis anserina*); and the cutaneous sensibility is diminished. The respiration is quickened and shallow. The pulse is frequent, small, and firm. The temperature of the general surface is raised, although a sensation of cold—sometimes of severe cold—often referred to the back or the abdomen, is present. The extremities, however, as the fingers, ears, and nose, may be colder than natural. With these may be combined other symptoms, such as headache, nausea, vomiting, and the special pains in the back or the limbs which are proper to the different species of fever; but delirium is rarely present.

PATHOLOGY AND ÆTIOLOGY.—Rigors are the result of the disturbance of some, as yet undetermined, nervous tract, which, however, is clearly connected with, if not indeed the same as, the great coördinating centre in the medulla for the respiratory, cardiac, and vascular movements, and which must, further, be in intimate relation with the thermotaxic centre, if such exist. One of the exciting causes of this disturbance may be the existence of some abnormal differences between the temperature of the surface and that of the interior of the body. This suggestion of Liebermeister, at any rate, supplies an answer to one or two perplexing questions. It enables us to understand how it is that a man already in the grasp of a serious disorder, the temperature of whose body is raised, and is rapidly rising, has yet the same sensation of cold as a healthy man whose external temperature is below the normal, and whose nervous and vascular systems are merely reacting in a perfectly natural manner under one of the commonest conditions of animal life, for in each case the surface is colder than the deeper parts, and thus gives rise to a sensation of cold. It gives a plausible solution of the paradox that the greater the absolute heat of the body as a whole, the more acute is the sensation of cold; and it establishes on a scientific basis the empirical belief in the value of rigors as marking the access of disease, when it is seen that their presence is a proof that increased tissue-change, as shown by the increased production of heat—the very essence of fever—has already begun.

The early diagnosis of fevers, whether idiopathic or symptomatic, is often greatly facilitated by the careful study of the phenomena of the initial rigors. Putting on one side the cases in which a local cause may be found to exist, very violent rigors occur chiefly in connexion with the following diseases: Malarial fevers, relapsing fever, variola, scarlet fever, erysipelas, pyæmia, and croupous pneumonia. They are less marked in typhus and enteric fever, pleurisy, catarrhal pneumonia, and bronchitis. It must, however, be remembered that, in appraising the value of any nervous symptom, such as rigors, the personal factor is of extreme importance, and that general rules derived from averages are here more than ever misleading, if applied indiscriminately to individuals.

An additional argument for their central origin is found in the well-known fact, that in children and in persons of unstable nervous equilibrium—for example, epileptics—convulsions are a frequent result of the same causes which produce rigors in other cases.

Rigors occur under the following conditions: (1) In health, when a more or less extensive part of the surface of the body is chilled by external cold. Indeed the chilling of even a very small extent of skin is sufficient to produce them. (2) From irritation of a sensory nerve, and especially in connexion with some mucous surface. Thus rigors are an everyday result of the presence of irritating matters in the stomach or bowels, of catheterism, and of the passage of biliary or renal calculi. (3) With the access or the exacerbation of some local disease, especially if it be one which is to end in the formation of pus. Rigors occur, not only at the beginning, but also during the progress, and with great violence just before the bursting of an abscess. Septic thrombosis in veins is also attended by rigors. The writer himself once experienced very violent rigors in connexion with extensive thrombosis of the veins of the left arm, due to a prick received at a *post-mortem* examination, although no suppuration whatever took place during the whole course of his illness. (4) At the beginning of idiopathic and symptomatic fevers, that is, when the fever has already begun, and the increased heat-production in the viscera has destroyed the natural balance between the temperature of the interior and of the surface of the body.

Although for practical purposes it is convenient to distinguish these different modes of origin of rigors, they are essentially identical; that is, in each we have the effect of irritation of a certain kind conveyed by afferent nerves to some central tract or organ.

Treatment.—Warm, mildly stimulating drinks, and external warmth are always grateful to the patient, and perhaps shorten the duration of the attack. Tincture of aconite, in five-minim doses, has the reputation of preventing the occurrence of rigors from local sources of irritation, and may perhaps be useful when they arise from more general or from constitutional causes. Nitrite of amyl also has been employed, apparently with some measure of success. But the only effectual treatment is that of the diseased condition with which they are associated, and this can rarely be begun with advantage before the termination of the rigors or 'cold stage.' Until that period has arrived, it is at best useless to attempt any internal medication; even sulphate of quinine is of little or no avail in this stage of malarial fever, and often seems merely to aggravate the sickness, headache, and general discomfort, which are the usual concomitants of rigors.

J. Andrew.

RIGOR MORTIS (Lat. The stiffness of death).—Synon.: Fr. *Rigidité Cadavérique*; Ger. *Todtenstarre.*—The stiffening of the muscles after death, due to coagulation of their plasma. *See* Death, Signs of.

RINGWORM.—*See* Tinea Tricophytina; and Epiphytic Skin-Diseases.

RIOLO, in Italy, near Bologna.—Chalybeate, sulphurous saline waters. *See* Mineral Waters.

RIPPOLDSAU, in the Black Forest, Germany.—Mixed iron waters. *See* Mineral Waters.

RISUS SARDONICUS or SARDONIUS (*risus*, a laugh; and *sardonius*, connected with, or caused by, the herb *sardonia* or *sardoa*, that is, belonging to Sardinia).—A peculiar expression of the face, in which the features are distorted by spasm of the muscles, so as to present the appearance of a painful grin or laugh. It is usually observed in tetanus. *See* TETANUS.

RODENT ULCER.—SYNON.: Fr. *Cancroïde*; Ger. *Epithelialkrebs.* Rodent ulcer must be recognised as a kind of tumour; but its exact position amongst other forms of new-growth is still not absolutely decided. Hence, in this work a special article is devoted to its consideration. Most authors agree in classing it amongst the epitheliomas; a conclusion which the accumulated evidence of recent years tends to make practically certain.

CLINICAL CHARACTERS. — *Naked-eye appearances.*—A distinguishing feature of most rodent ulcers is the fact that ulceration follows *pari passu* with new-growth, the result being that, as in the case of lupus, instead of the formation of a swelling or tumour, an actual diminution of the size of the part occurs. Another characteristic of the disease is, that while it often makes its appearance at a period of life which might be considered early for an epithelioma, it runs a course of extreme chronicity, and rarely, if ever, affects the lymphatic glands. Many cases last for twenty or thirty years, interfering but little with the general health, and at times in part undergoing a process of feeble cicatrisation. In a case recently observed the cicatrix was rather extensive, and had stood the test of a considerable period of time.

Rodent ulcer begins as a pimple, usually on some part of the face, and most frequently on the side of the nose or about the eye. After this has remained quiescent for a long time, perhaps years, ulceration occurs, and continues to spread with great slowness, involving in its course every structure that it meets. Thus in time huge caverns are excavated in the face; the eyeball may be destroyed; the nose and upper jaw may disappear; and not infrequently, if the disease reach the forehead, the dura mater is exposed, and the brain is seen pulsating at the bottom of the cavity. The appearance of the ulcer is characteristic: the surface is glistening, and is covered with very imperfect granulations; it has an uneven level, and is mottled with yellow and red; the margin is very slightly raised, and somewhat indurated, has a purplish pink colour, and is often considerably undermined. The discharge is thin and purulent. Capillary hæmorrhage not infrequently occurs, but more severe bleeding is rare. A section through the edge shows the narrow margin of new-growth, in which alone the characteristic structure is to be made out. Death may occur from old age or other causes independent of the disease; from an attack of erysipelas or meningitis, or from marasmus induced by the constant worry and discharge.

MICROSCOPICAL APPEARANCES, AND PATHOLOGY. — Many tumours which approach somewhat nearly the condition above described will be found on examination to possess the structure of a lobular epithelioma (*see* CANCER); but the most typical ones will usually exhibit something like the appearance represented in fig. 9, vol. i. Beneath the epidermis, and embedded in a varying amount of stroma consisting of more or less well-developed fibrous tissue, are large, roundish, and irregular masses of densely packed epithelial cells of small size, the circumferential ones taking an oval shape, while the deeper ones are circular. There is, as a rule, no tendency to the formation of globes; but, in some cases which have run a typical course, imperfect nests have been found. The so-called *prickle-cells* are, as far as the writer has observed, never seen. The cells are smaller than those usually met with in an epithelioma, and suggest the origin of the growth from the sweat-glands, a view which is favoured by the fact that the epithelial masses occasionally assume a more or less distinctly tubular arrangement. Strenuous advocates are found in support of, and in opposition to, this theory of the primary source of rodent ulcer, and the same may be said of other hypotheses, such as that it starts from the hair-follicles or the sebaceous glands; but, in default of stronger evidence than is at present forthcoming, it would be unwise to dogmatise upon the question.[1]

PROGNOSIS.—The prognosis in a case of rodent ulcer may be implied from what has been said of its clinical features, course, and terminations.

TREATMENT.—The obvious treatment is free removal by the knife in the early stages. The method of scraping with a sharp spoon, which is not infrequently adopted, is not so likely to reach the limits of the disease, and does not seem to have sufficient theoretical or practical evidence to support it. Mr. Moore was a strong supporter of the plan of removing even very large ulcers; he was in the habit of proceeding with the knife as far as prudence would allow, and applying chloride of zinc paste to any parts it was considered unsafe to cut away. This treatment in his hands and in the hands of other surgeons has been followed by very marked success.

R. J. GODLEE.

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[1] The reader will find some of the literature of the subject in the late Mr. Charles H. Moore's book on Rodent Cancer, in Dr. J. Collins Warren's monograph on Rodent Ulcer, and in the various communications to the *Transactions of the Pathological Society of London*; but in German writings he must search under the head of Epithelial Cancer, to which class rodent ulcer has always been consigned by these authorities.

ROHITSCH, in Styria (Austria).—Acidulated, sulphated waters. *See* MINERAL WATERS.

ROISDORF, in Germany.—Mixed alkaline table waters. *See* MINERAL WATERS.

ROME, Central Italy.—Moderately warm, moist, fairly calm winter climate. Mean winter temperature, 45° to 50° F. The air is damper than that of the Riviera. *See* CLIMATE, Treatment of Disease by.

ROMEGNO, in the Val Sugana, in the Austrian Tyrol.—Arsenical sulphate of iron waters. *See* MINERAL WATERS.

ROMERBAD, in Styria.—Thermal waters. *See* MINERAL WATERS.

RONDEBOSCH, in Cape Colony.—*See* AFRICA, SOUTH.

ROSALIA (*rosa*, a rose).—A rose-coloured rash; a term formerly applied to scarlatina and rubeola, before these rashes were clearly differentiated.

ROSEOLA.—Fr. *Roséole*; Ger. *Roseola.* This is a term more used in the past than the present for patchy erythema, in which the tint is less bright than usual, a trivial distinction which scarcely justifies its continued existence. If retained at all, it would be best restricted to the symptomatic eruptions seen in various serious constitutional conditions, such as the early stage of syphilis, in leprosy, and less constantly in variola before the more characteristic rash, and in vaccinia, cholera, diphtheria, malaria, spinal meningitis, and enteric fever.

A so-called idiopathic roseola is sometimes seen in young children, chiefly in the spring and autumn—a disordered alimentary canal, especially during dentition, being the most common ætiological factor.

In such cases there may be an elevation of temperature of several degrees, with other febrile symptoms, but without catarrh, and lasting for a few hours only as a rule. The eruption, which is rosy red, varies much in shape. There may be patches the size of the end of the finger, faint papules, circles, or gyrate outlines. These come out in any part of the body or nearly all over, fading perhaps at one part and appearing at another, the whole process lasting a few days.

TREATMENT.—But little treatment is required for so transitory an affection, which is chiefly interesting from a diagnostic point of view. Any disorder of the alimentary canal should be corrected by a mild mercurial purge; and every likely cause of irritation, either in the gums or elsewhere, should be searched for and removed if possible.

The roseola symptomatic of the grave disorders enumerated requires no special treatment, the serious constitutional condition claiming the whole attention.

H. RADCLIFFE CROCKER.

ROSE-RASH.—A popular name for roseola. *See* ROSEOLA.

ROTHELN.—The German synonym for rubella; frequently employed by English practitioners. *See* RUBELLA.

ROUND-WORMS.—*See* ENTOZOA.

ROYAT, in France.—Muriated alkaline waters. *See* MINERAL WATERS.

RUBBING SOUND.—A synonym for friction-sound. *See* PHYSICAL EXAMINATION.

RUBEFACIENTS (*ruber*, red; and *facio*, I make).—A class of counter-irritants which produce simple redness of the skin. *See* COUNTER-IRRITANTS.

RUBELLA (dim. of *Rubeola*).—SYNON.: *Rubeola sine Catarrho*; False Measles; German Measles; Epidemic Roseola; Fr. *Rubéole*; Ger. *Rötheln.*

DEFINITION.—A specific eruptive fever. The rash appears on or after the first day of the illness, beginning on the face in rose-red spots, extending next day to the body and limbs; it subsides with the fever on the third day; and is not preceded by catarrh nor followed by desquamation.

ÆTIOLOGY. Propagated by contagion, rubella occurs in epidemics, often of limited extent, but with sporadic offshoots. The period of incubation is long, mostly over a fortnight, the extremes being from ten to twenty-one days. Hence a difficulty in tracing the source of personal infection; this is increased by the slight and transient nature of the illness allowing patients to mix freely with others. One attack is preventive of a recurrence, but is not protective against either measles or scarlet fever. nor do attacks of either of these diseases in any way modify the liability to this one; it is as distinct from them as is chicken-pox from small-pox. During epidemics of measles or of scarlet fever, mild and irregular cases of both are not infrequently mistaken for this exanthem; well-marked outbreaks of it are often attributed to measles; while slight attacks of scarlet fever are miscalled Rötheln; and a hybrid disease is imagined which has no existence. Very young infants seem less susceptible than older children; a child at the breast has been known to escape when the mother and other children in the family have been attacked. Adults not infrequently suffer, as many persons escape attacks in childhood; sex makes no difference. The disease is contagious, even before the rash is thrown out; and it continues to be so for some days, or it may be weeks afterwards. Second attacks are rarer than in scarlet fever, but the rule against them may be less absolute than for measles. A recrudescence of the rash from the third to the sixth day is sometimes seen. Rötheln is seldom fatal; when a mortality is reported as high as 3 per cent. of the attacks, measles is present, or scarlet fever.

SYMPTOMS.—Slight fulness of head, heaviness, pain, or giddiness is felt, with aching of the back or limbs, chills, and a little sore-throat, for twelve hours or a day before the rash appears. Very often the rash is first seen with surprise, in dressing, as the feeling of illness has passed or may have escaped notice. Enlargement of the superficial cervical glands is an early sign, most marked in children. There is redness of the fauces and uvula, less mottled than in measles, not so intense as in scarlet fever; the tonsils are full and smooth; there is no ulceration. Sometimes an odour, as in measles, attends the rash. The eyes are suffused, but there is little or no coryza; the lids are somewhat swollen and irritable; the face is flushed, and the cheeks are red or full before the appearance of the spots. These are bright red, raised, rounded, with clear skin between them, but they soon coalesce; not grouped as in measles, the spots are more prominent than in scarlet fever, and there is not the finely diffused redness of the neck and chest observed in that disease. Moreover, the rash is already fading from the face and upper part of the body while extending to the limbs, so that it is less intense on the third day. It leaves some itching, or a very fleeting yellowish tinge, but no discoloured mottling of the skin, and no desquamation. However little illness is felt at the beginning, a rise of temperature commences with, or just before, the rash. It may reach 102°–103°, or be only 2° F. above the normal. With rest in bed this may fall one degree by the end of the second day, but is evenly maintained as the eruption proceeds, and subsides with it on the third day. During the following week it is readily disturbed, either raised by exertion or depressed by fatigue or chill. At this time, eighth to eighteenth day, a relapse has been observed. Here a further caution is required, as convalescents readily take scarlet fever when exposed to that infection; such exposure six days after the rash produced scarlet fever in five days (see p. 161 of Dr. Moore's book on *Fevers*. Dublin, 1892).

Slight catarrhal signs not infrequently come on after the rash has faded. The eyelids are sticky, the nostrils stuffed, the throat sore, or some cough begins. Exposure, or want of care, at this time may determine serious disturbance of health, generally with pulmonary complication.

The urine is often high-coloured in the early part of the illness; the chlorides are increased; but there is no albuminuria, nor has this ever been known to follow. In some few cases transient complaint of the throat or of fatigue has been made a week before the rash; or epistaxis has occurred. Fulness of the small cervical glands is often felt, but no constant intermediate symptoms are found, and any precedent feeling of sickness is without fever.

DIAGNOSIS.—The sudden onset of Rotheln without previous sneezing or cough sufficiently distinguishes it from measles, to which it is much more nearly allied, as well by general characters as by the kind of rash, than to scarlet fever. But the spots are more evenly distributed at wider intervals, each with an areola of its own before coalescence, and not in groups with a common areola. There is no gradual rise of temperature before the rash, nor the sudden fall afterwards, both characteristic of measles. The small lymphatic glands are palpably enlarged in this ailment down the sides of the neck, and perhaps behind the ears, but not specially at the angle of the jaw, as in scarlet fever. The rash appears first in spots on the face. On the second day it may look like that of scarlet fever, or, on the other hand, the red flush of scarlet fever, at first sparsely distributed, or with prominent red papillæ, may lead to mistake; but the sudden onset is much more marked in scarlet fever, when the rash, should it appear as early, is more intense on the third day, especially on the neck and chest, yet without raised papules. Moreover, the fever persists till the fifth day, even when not greatly elevated; there is also the state of the pulse and tongue in scarlet fever, and the prominence of throat-symptoms. Sometimes it is not till the second or third week that desquamation, and possibly signs of renal irritation, or the occurrence of other cases, complete the diagnosis. The length of interval between successive cases is also a distinction. Roseola is not contagious; it occurs in red points or spots, not raised above the healthy skin between; there are no throat-symptoms, no enlarged lymphatic glands, no fever. Erythema affects parts of the skin only: attention restricted to the character of the eruption often leads to error.

PATHOLOGY.—As in most infectious diseases, particles given off from the sick, chiefly by the breath, attach themselves to the mucous surface of the throat or air-passages, and either multiply themselves, or produce a morbid change in the material around them. This morbid matter, entering the lymphatics, is at first arrested in their glands, and thence enters the blood. For a time some of this may be deposited again at the point from which it started, or the amount be too small to produce that arrest of nerve-tone which permits the dilated vessels and increased combustion of general fever. A special effect on the vaso-motor nerves of the skin is necessary to produce the turgidity of the rash, and this not of the momentary character of a passing irritation. Local irritation of the sympathetic in the neck, starting from the mucous membrane, may determine the early appearance of the rash on the face. The skin generally has not the intense vascular injection, with the exudation that results in detached epidermis, as seen in scarlet fever; nor do the congested vessels of the papillæ leave such dilated meshes as after measles. Whether any special microzyme is associated with rubella there is no histological research to show.

Prognosis.—Recovery is so much the rule, that were it not for the mischief any febrile disturbance may excite in weakly children, and the risk of pulmonary disease from premature exposure, all cases of rubella might be expected to do well. In severe cases the throat must be looked to, and in all cases the chest examined. We must bear in mind that infection persists for a month, and that two months may elapse before health is quite restored.

Treatment.—Rest in bed for three days, and confinement to the house for a week, is almost all that is required in rubella. The fever demands no secretion to be increased for its mitigation, nor any special means for its control. Dilute acids may be given for relaxed throat; and tonics, such as bark or iron, during convalescence.

William Squire.

RUBEOLA.—A synonym for measles. *See* Measles.

RUMINATION (*rumino*, I chew again). Synon.: Fr. *Rumination*; Ger. *Wiederkauen*. Rumination, which is the normal method of digestion in a large class of animals, occurs occasionally in the human subject. In the cases recorded, the return of the food usually took place about a quarter of an hour after the meal had been finished. The regurgitation seems to have been produced by the contractions of the muscular coat of the stomach, assisted by those of the diaphragm and abdominal muscles. The food is usually stated to have had no acid taste, and therefore could not have undergone any digestion. Dr. Copland recommends that the meals should be deliberately and carefully masticated. As to medicinal treatment, he had found benefit from ipecacuanha and aloes twice a day, and a tonic draught one hour before dinner.

Samuel Fenwick.

RUPIA (ῥύπος, dirt or filth).—Synon.: Fr. and Ger. *Rupia.*—A term applied to the crusts formed by the desiccation of purulent and ichorous discharge, over the foul sores or ulcers of syphilis.

Description.—The crusts of rupia vary in thickness and extent. Sometimes they are flat and rugged, and sometimes prominent; and they are generally marked on the surface by concentric lines, which indicate the peripheral growth of the ulcers which they conceal. Their colour is grey, sometimes brown, and more or less mottled with black, from admixture of blood with the purulent secretion. When of large size and flat they suggest the idea of an oyster-shell embedded in the skin; at other times they are conical in shape, like the shell of the limpet. This latter variety results from the desiccation of the discharges poured out by a pustule in course of centrifugal growth, and the consequent superaddition of fresh layers to the under-surface of the original crust.

Treatment.—Rupia is chronic syphilis in a state of ulceration, and calls for the treatment applicable to that disease. Iodide of potassium will heal the ulcerations, and then the crusts of rupia will fall off of themselves. If the crusts adhere firmly, it is better to avoid removing them artificially, as they constitute a natural covering to the ulcers whilst the latter remain in existence.

Erasmus Wilson.

RUPTURES (*rumpo*, I break).—Synon.: Fr. *Ruptures*; Ger. *Risse.*—The subject of rupture of organs generally has been discussed in the article on Perforations and Ruptures, to which the reader is referred; and this lesion is dealt with in relation to particular organs where required, as in the heart, stomach, and other important viscera. The general meaning of the word is so evident that it needs no definition. In addition to its obvious meaning, it is used in a popular sense as a synonym for hernia, which is spoken of as a *rupture*. *See* Hernia.

Frederick T. Roberts.

S

SACCHORRHŒA (σάκχαρον, sugar; and ῥέω, I flow).—A term applied to the escape of sugar from the body in any of the excretions, or in discharges, such as the urine, sweat, or expectoration. *See* Diabetes Mellitus.

SAIDSCHÜTZ, in Bohemia.—Sulphated bitter waters. *See* Mineral Waters.

ST. ANTHONY'S FIRE.—A popular synonym for erysipelas. *See* Erysipelas.

ST. CATHERINE'S WELLS, in Ontario, Canada.—Iodo-bromated muriated saline waters. *See* MINERAL WATERS.

ST. GALMIER, in Loire, France.—A simple acidulated table-water. *See* MINERAL WATERS.

ST. GERVAIS, in Savoy.—Saline sulphurous waters, thermal and cold. *See* MINERAL WATERS.

ST. HONORÉ, in Nièvre, France. Slightly thermal sulphurous and arsenical waters. *See* MINERAL WATERS.

ST. MORITZ, Upper Engadine, Switzerland. — A bracing mountain winter and summer climate. Baths; whey and milk cure. Altitude, 5,620 feet. *See* CLIMATE, Treatment of Disease by; MINERAL WATERS; and PHTHISIS.

ST. PAUL'S.—A city in Minnesota, on the banks of the Mississippi, 1,200 feet above sea-level. Well protected from winds. Climate cold, clear, dry, and calm; winters rather extreme. Mean annual temperature 44° F.; the mean daily range 19°; rainfall 30 inches. A health-resort for phthisical patients. *See* CLIMATE, Treatment of Disease by.

ST. SAUVEUR, in the French Pyrenees.—Sulphur waters, slightly thermal. *See* MINERAL WATERS.

ST. VITUS'S DANCE.—A popular synonym for chorea. *See* CHOREA.

SALINS, near Dôle, in France.—*See* MINERAL WATERS.

SALINS-MONTIER, in Savoy.—Muriated saline waters, with some iron, iodine, and arsenic. *See* MINERAL WATERS.

SALIVARY CALCULUS. — *See* MOUTH, Diseases of.

SALIVARY FISTULA.—*See* MOUTH, Diseases of.

SALIVARY GLANDS, Diseases of. SYNON.: Fr. *Maladies des Glandes Salivaires*; Ger. *Krankheiten der Speicheldrüsen.*

SUMMARY.—These glands, as well as their ducts, are liable to be attacked by inflammation; the latter may also become mechanically occluded. The parotid gland is the seat of the disorder known by the name of *Cynanche parotidea*, or mumps (*see* MUMPS). *Salivary calculus* and *salivary fistula*, as well as *ranula*, are described in the article MOUTH, Diseases of. Occasionally the parotid is sympathetically invaded by inflammation during the height of, or at the termination of, other acute diseases, and this affection requires special consideration here.

Metastatic or Symptomatic Parotitis.—This affection is met with during the course of, or convalescence from, several of the acute eruptive fevers, such as typhus and typhoid fevers, scarlet fever, small-pox, and measles. It commences, according to the researches of Virchow, with congestion of the gland, followed by the usual result. Soon thereafter the duct becomes affected; and there is found in it a tough, filamentous, whitish substance, which speedily is transformed into pus. This invades the lobules of the gland; these then soften and break down, until the whole of the gland-tissue is more or less destroyed, as well as the interstitial tissue, by phlegmonous inflammation. Sometimes, however, only the gland-tissue proper is destroyed, and the gland, when examined *post mortem*, appears as if studded with numerous suppurating islands. This phlegmonous inflammation spreads from its seat of origin in various directions, most frequently to the neighbouring connective tissue enveloping the muscles found in this situation, descending to the clavicle, not sparing the periosteum and bones; and it has even been known to pass to the brain and its coverings.

SYMPTOMS.—If this affection develop itself during the height of an acute disease, then, by reason of the stupefying effect of the primary disease, the more manifest subjective symptoms are wanting, and the complaint is consequently said, somewhat improperly, to come on insidiously. But careful observation will reveal, by the unusual rise in temperature, the increased restlessness, and the somewhat distressed look of the patient, that some new complication is about to discover itself, and will warn the intelligent practitioner to make a close physical examination of the various organs. Probably the first indication of this metastatic parotitis will be a little swelling about the lobe of the ear, and closer investigation will show loss of the usual depression between the lower jaw and the mastoid process, and in its place a more or less hard tumour Pressure will usually elicit an expression of pain from even an apathetic patient. The inflammation may end either in resolution or in suppuration. The former termination may be looked for if the enlargement have formed slowly, and during the convalescence of the individual from the original disease. Suppuration is, in all cases, to be dreaded; and this is indicated by the irregularly reddened appearance of the swelling, and ultimately the sense of fluctuation. Occasionally the pus finds its way outwards, or discharges through the external auditory meatus, this latter being by no means an uncommon method of exit; or the pus burrows about in the cellular tissue investing the various muscles in this region.

PROGNOSIS.—This depends greatly on the

severity of, and the stage of, the primary disease during which this complication declares itself. If it make its appearance at the height of the fever, and particularly if that be a grave form of fever, then the prognosis must be very guarded. Trousseau remarks that it is an affection from which he has almost never seen enteric or other fever patients recover. This is certainly not in accord with the experience of this country. If it occur during convalescence from a fever or other disease, the prognosis is then much more favourable.

Treatment.—Warm poultices must be applied from the first; supporting measures used; and the patient's powers sustained by plentiful nourishment, and the exhibition of stimulants and tonics. If there be any tendency to suppuration, the poulticing must be diligently maintained, and an opening made into the abscess the moment that fluctuation is certainly made out. Caution must be exercised in this case, for, if no pus be evacuated, the incision not only is useless, but rather increases the œdema of the tissues, besides putting the already weakened patient to unnecessary pain.

Enlargement of the Parotid Gland. This may be either benign or malignant. In the former case it is usually the result of a previous parotitis, or it may be due to the development of some tumour in the body of the gland. Such cases are distinguished from the malignant variety by the fact that the skin always remains freely movable over the tumour, and over the lower jaw; while in the malignant affection the lower jaw is with difficulty defined, and is not readily moved. The tumour is always limited to one side; and the malignant growth rarely has its starting-point in this gland, similar disease being found in other organs. The simple tumour may be modified, if not altogether removed, by the external and internal use of iodine long continued; failing this, operation is called for. The malignant variety calls for surgical treatment.

Claud Muirhead.

SALIVATION. — Synon.: Ptyalism; Fr. *Salivation*; Ger. *Speichelfluss.* — Increased flow of saliva can only be styled a disease when the amount secreted exceeds that which in health passes into the stomach. Strictly speaking, ptyalism is not a distinct disease, any more than dropsy can be so accounted, but it obtains a position as an independent disorder in the nomenclature of diseases, and must therefore be shortly noticed.

Ætiology.—The causes which give rise to salivation are numerous, as are also the diseases of which it is a symptom. Thus any irritation of the mucous membrane of the mouth and fauces at once induces an increased flow of saliva. Hence this is one of the leading symptoms of aphthæ, thrush, cancrum oris, ulcers, and excoriations of the mouth and tongue, scorbutic and syphilitic affections of the mouth, glossitis, mumps, and various affections of the fauces and pharynx. This salivation may also be a reflex effect, as when it occurs in cases of tic, facial neuralgia, pregnancy, or gastric affections. Ptyalism is also the result of the ingestion of certain drugs, mineral and vegetable, as in the case of the prolonged use of mercury, iodine, and jaborandi. These seem to produce an alteration in the character of the saliva, as well as in the quantity. An increased or diminished flow of saliva is also induced by direct nervous agency, as when mental emotions, such as fear, suddenly render the mouth parched and dry; and the opposite effect is induced by the thought of palatable articles of food, and then the mouth is said to 'water.' In various conditions the saliva dribbles away, as in the insane, in paralytic persons, in those stupefied by disease, such as typhus, and in teething children.

Symptoms.—The symptoms of salivation are evident enough. The individual complains of no pain, but of the exceeding discomfort in the constant spitting and gathering of saliva in the mouth, which interrupts speech, deglutition, and sleep. If it continue unchecked for some time the patient emaciates. When the affection is due to mercury, the first evidence of the constitutional action of the drug, which precedes the salivation, is a peculiar taste in the mouth, of a 'coppery' nature, with tenderness of the gums of the upper jaw, and fœtid odour of the breath; then there are observed salivation, large flabby tongue, and, if it goes still farther, ulceration of the gums and mouth.

Treatment.—When salivation is due to some nervous cause, or if the cause be not very apparent, ten-drop doses of tincture of belladonna thrice daily are often sufficient to put an end to it in one or two days. Minute doses of nitrate of pilocarpine, gr. $\frac{1}{36}$, have also proved useful. If it be induced by mercury or other drug, the use of this must be entirely suspended. Mild astringent mouth-washes should be ordered, such as chlorate of potassium, alum, or acetate of lead in solution, to be used frequently.

Claud Muirhead.

SALZBRUNN, in German Silesia. Alkaline waters. *See* Mineral Waters.

SALZKAMMERGUT, in Austria. An inland bracing summer climate. *See* Climate, Treatment of Disease by; and Ischl.

SALZUNGEN, in Saxe-Meiningen. Cold muriated saline waters. *See* Mineral Waters.

SAN DIEGO.—A health-resort in South California, on the Pacific Coast. A dry bracing climate, resembling that of Santa Barbara, free from fog, and equable. Mean temperature 60° F.; the records seldom rise to 80° or sink to the freezing-point. Mean daily range only 15°. Average rainfall 10 inches. Winds principally from the north-west. Well suited for pulmonary complaints. *See* CLIMATE, Treatment of Disease by.

SANDOWN, in the Isle of Wight. Exposure S.E. Mean temperature 51·4°. An open, bright, bracing health-resort, with good sea-bathing. *See* CLIMATE, Treatment of Disease by; and SEA-AIR and SEA-BATHS.

SAND-WORM. — A term sometimes employed to designate the sand-flea or jigger. *See* CHIGOE.

SANGUINEOUS (*sanguis*, blood).—This word is used in relation to the presence of blood in discharges, effusions, or extravasations, when they consist more or less of this fluid, as in hæmoptysis, hæmorrhagic pleurisy, and cerebral hæmorrhage.

SANITARY LAW.—The first laws which were passed in England relating to sanitary matters were directed successively against the scourges plague, small-pox, and cholera, and these were placed under control by various statutes which were passed between 1603 and the commencement of the reign of Victoria.

The statute of 1 Jac. I. c. 31 made it a capital offence for any person having an infectious sore upon him uncured to go abroad and converse in company, after being commanded by the proper authority to keep his house. That Act was repealed in the first year of the present reign, but some statutes relating to quarantine, which were passed in the first instance for the purpose of dealing with plague, remain in force to the present day. Small-pox was not the subject of legislation until a generation after the discovery of vaccination, and the first Act dealing with it was passed in 1840 (*see* VACCINATION). Cholera became the subject of legislation in 1832, after the serious visitation with which the country had then been afflicted. By the law that was then passed the Privy Council were empowered to issue such orders as appeared expedient for the purpose of preventing the spread of the epidemic, for securing the proper burial of the dead, and for relieving the necessities of persons suffering from the malady. Apart from epidemic disease, the Legislature was slow to deal with sanitary precautions, and it was left to private persons to vindicate the public right to have nuisances abated by the enforcement of the common law. This procedure was tedious, costly, and uncertain, and hence, in boroughs and populous towns, special local statutory powers were frequently obtained.

Boards of commissioners for the paving, improvement, lighting, and watching of towns were formed for many places under the sanction of Parliament, and these bodies, together with the reformed municipalities created by the Municipal Corporations Act of 1835, formed the nucleus around which developed the local governing bodies as we know them to-day. The first conception of a local authority was that of a body whose existence, except in the case of a corporation created by charter, could only be brought about by the direct sanction of Parliament given by way of a local Act. This procedure, though at first cumbersome, was, under the Ministry of Sir Robert Peel, greatly simplified by the passing of what have been long known as the Model Clauses Acts. The effect of this improvement was to enable comparatively short local Acts to be passed, and to incorporate by mere reference a large number of useful provisions relating to various matters of sanitary and other local administration. Owing, however, to the costliness of obtaining parliamentary sanction to local bills, there was a growing demand for some simpler method of creating a local governing body in a town of sufficient importance to require one; and the sanitary commissioners who had been examining the condition of the country having reported as to the great need for the establishment of a general scheme of local government for towns and populous districts, the attention of Parliament was at length seriously directed to the matter. After two unsuccessful attempts the Public Health Act of 1848 was passed. By this epoch-marking statute a general board of health was established, and power was given to it to cause the Act to be applied to any place having a known and defined boundary. These provisions were taken advantage of freely, and the regulation of such matters as the laying out and sewerage of streets, the construction and drainage of houses, the provision of a water-supply to towns, and the removal of nuisances, were put within the easy reach of towns that had previously been subject to no control whatever. Ten years later this Act was repealed and replaced by the Local Government Act, 1858. This Act remained in force till 1875, and under it about eight hundred local boards were formed up to 1872. As a result of the report of the Sanitary Commission of 1869, the scheme of local government was carried still further by the passing of the Public Health Act, 1872, under which the whole country was divided into urban and rural sanitary districts, and the Sanitary Acts applied to the entire country. And when the Public Health Act, 1875, which repealed and consolidated all the previous statutes outside the metropolis that related to sanitary law, was passed, this arrangement was not disturbed, and it now forms the basis of local government as settled by the Local Government Act, 1894. On January 1, 1894, there were in existence 1,030 urban sanitary authorities and 574 rural sanitary authorities, and under the Act mentioned these bodies are continued in force, under the description of urban district councils and rural district councils, for urban districts and rural districts respectively. Of the urban districts, 64 were county boroughs, 238 were non-county boroughs, 31 were Improvement Act districts, and 697 were Local Government districts formed under the Public Health Acts.

In addition to these bodies, every rural parish having a population of three hundred or upwards will have a parish council; and such rural parishes as have a population of one hundred or upwards will be enabled to have a parish council if they so resolve. Some parishes may by order of the county council be grouped under a common parish council. In addition to these bodies, there is in rural districts the parish meeting for every 'rural parish' in such district. This consists of the persons known as the parochial electors—that is, the persons who are registered on the parliamentary and local government register of electors—for the parish. Taking them in order of importance, there are the following local governing bodies: (1) Councils for counties; (2) Councils for municipal boroughs; (3) Councils for urban districts which are not boroughs; and (4) Councils for rural districts. For the purposes of sanitary administration the urban and rural district councils are the most important bodies, and the jurisdiction of the county councils over them is very limited. In some cases, such as the provision of sewerage and water-supply, a parish council has the right to complain to the county council that the rural district council is in default, and the county council can thereupon supersede that body. In the case of urban district councils in default an appeal lies to the Local Government Board.

It is unnecessary here to set forth the mode of election and qualifications of councillors or the details of the constitution of the councils; but it may be stated in general terms that the councils consist of members who are called councillors, and who are elected by the registered electors, and, in the case of municipal corporations and county councils, with the addition of aldermen who are elected by the councillors. The constitution of county councils is determined by the Local Government Act, 1888, of municipal corporations by the Municipal Corporations Act, 1882, and of urban and rural district councils by the Local Government Act, 1894.

It will now be necessary to describe in detail the powers of the local authorities, and the rights and liabilities of individuals in England and Wales, with special reference to sanitary matters only.

Powers of Local Authorities.—A. *County Councils.*—By the Local Government Act, 1888 (section 17), it is provided that a county council may appoint one or more medical officers of health, and may make arrangements for rendering the services of any such officer regularly available in the district of any district council; and section 19 further provides that if it appears to a county council from the report of the medical officer of health of any district that the Public Health Act, 1875, has not been properly put in force within the district to which the report relates, or that any other matter affecting the public health of the district requires to be remedied, the council may cause a representation to be made to the Local Government Board on the matter. Such a representation would enable that Board to put in force the powers conferred upon them by section 299 of the Public Health Act, 1875. Under that section they may issue an order limiting the time for the local authority to perform its duty; and if such duty is not performed by the time so limited, the order may be enforced by writ of *mandamus*, or the Board may appoint some person to perform such duty.

B. *Urban and Rural District Councils.*—It is declared by section 7 of the Housing of the Working Classes Act, 1885, to be the duty of every local authority entrusted with the execution of laws relating to public health and local government to put in force from time to time, as occasion may arise, the powers with which they are invested, so as to secure the proper sanitary condition of all premises. These and other powers possessed by urban authorities under the sanitary laws will now be explained. They may be roughly divided into powers (1) which relate to the improvement of the general sanitary condition of the district viewed in its physical aspects; (2) which relate to the maintenance of dwellings and their surroundings, as well as factories and workshops, in a proper sanitary condition. It must be borne in mind that the powers here described are those exercisable by urban authorities, and that the powers of rural authorities, though capable of being extended, as occasion arises, by means of orders issued by the Local Government Board, are under the Public Health Acts limited to certain matters only.

1. *Powers which relate to the improvement of the general sanitary condition of the district.*

Sewerage.—Foremost under this heading comes the provision of sewers, and these the local authority is required to make so far as may be necessary for effectually draining their district. Thus the surface-water and the sewage will be carried off, but it must not be discharged into any stream until it has been purified. Sewage may be disposed of or dealt with by any suitable method, and sewage works can be provided for the purpose, either in or out of the district of the local authority. One local authority may agree for the communication of their sewers with those of another in an adjoining district.

Water-Supply.—A local authority may provide their district or any part of it with a supply of water proper and sufficient for public and private purposes, and may (1) construct and maintain waterworks, dig wells, and do any other necessary acts; (2) take on lease or hire any waterworks, and (with the sanction of the Local Government Board) purchase any waterworks, or any water or right to take or convey water, either within or without their district, and any rights, powers, and privileges of any water company; and (3) contract with any person for a supply of water.

Before commencing to construct waterworks within the limits of supply of any water company empowered by Act of Parliament or any order confirmed by Parliament to supply water, the local authority must give written notice to every water company within whose limits of supply the local authority are desirous of supplying water, stating the purposes for which and (as far as may be practicable) the extent to which water is required by the local authority.

It is not lawful for the local authority to construct any waterworks within such limits if and so long as any such company is able and willing to supply water proper and sufficient for all reasonable purposes for which it is required by the local authority; and any difference as to whether the water which any such company are able and willing to lay on is proper and sufficient for the purposes for which it is required, or whether the purposes for which it is required are reasonable, or as to the charges, must be settled by arbitration.

The provisions of the Waterworks Clauses Acts with regard to communication pipes, the waste or misuse of water, the fouling of water, and the payment and recovery of water-rates, are incorporated with the Public Health Act, 1875, and in this way local authorities are enabled to take advantage of the powers which are generally conferred on water companies for carrying out the supply of water to any district.

Pollution of Rivers.—Any local authority, with the sanction of the Attorney-General, may, either in their own name or in the name of any other person, with the consent of such person, take proceedings under the Public Health Act for the purpose of protecting any watercourse within their jurisdiction from pollutions arising from sewage, either within or without their district. Besides these powers, the Rivers Pollution Prevention Acts require local authorities to enforce a number of penal provisions which are designed to prevent the fouling of streams by solid matters, by sewage, or by manufacturing or mining refuse.

Polluted Wells.—Under the Public Health Act, 1875, it is provided that, on the representation of any person to any local authority that within their district the water in any well, tank, or cistern, public or private, or supplied from any public pump, and used or likely to be used by man for drinking or domestic purposes, or for manufacturing drinks for the use of man, is so polluted as to be injurious to health, such authority may apply to a court of summary jurisdiction for an order to remedy the same; and thereupon such court shall summon the owner or occupier of the premises to which the well, tank, or cistern belongs if it be private, and in the case of a public well, tank, cistern, or pump, any person alleged in the application to be interested in the same, and may either dismiss the application, or may make an order directing the well, tank, cistern, or pump to be permanently or temporarily closed, or the water to be used for certain purposes only, or such other order as may appear to them to be requisite to prevent injury to the health of persons drinking the water. The court may, if they see fit, cause the water complained of to be analysed at the cost of the local authority applying to them under this section.

Streets.—All streets which are highways repairable at the expense of the inhabitants, and the pavements, stones, and other materials provided for the purposes of the highways by any surveyor of highways, belong to the local authority, and are under their management and control. They must level, pave, flag, channel, alter, and repair the streets as occasion may require, and may raise, lower, or alter the soil, and may place and keep in repair fences and posts for the safety of foot passengers. They may regulate the line of buildings in streets by reference to existing buildings, but they cannot prescribe a building-line. They may make by-laws as to the width and construction of new streets. The local authority can undertake or contract for the proper cleansing of streets, the removal of house refuse from premises, and the cleansing of earth-closets, privies, ashpits, and cesspools, and may by public notice require the periodical removal of manure or other refuse matter from stables or other premises.

Cemeteries.—Under the Public Health (Interments) Act, 1879, a local authority may provide a cemetery, and the provisions of the Cemeteries Clauses Act, 1847, are made applicable. Where the Burial Acts are in force, burial grounds may be provided by the local authorities who exercise the functions of a burial board, or by a specially appointed burial board itself.

Pleasure - Grounds. — An important power, the exercise of which must have a very important bearing on the general well-being of our towns, is that which enables a local authority to provide pleasure-grounds for its district. A local authority can provide and maintain public walks and pleasure-grounds and other open spaces by the exercise of the powers conferred by the Public Health Acts and the Open Spaces Acts.

2. *Powers which relate to the maintenance of dwellings and their surroundings, as well as factories and workshops, in a proper sanitary condition.*

Construction of Buildings. — The Public Health Acts contain many important provisions relating to the sanitary condition of dwelling-houses, but the most important are those which authorise the making of by-laws for regulating the erection of new buildings, as defects may be prevented at the outset that could not be remedied at a later stage. This by-law-making power extends to enable the local authority to require plans of every new building, to regulate the thickness of walls, and the provision of damp-proof courses, to require the site under the floors to be covered with concrete, to regulate the height of rooms, to prescribe definite areas of open space in front and rear so as to secure a free circulation of air, to require that drains shall be properly laid and ventilated, to regulate the mode of construction of water-closets, privies, ashpits, and cesspools, and their distance from dwellings and sources of water-supply, as well as many other matters. The powers are contained in section 157 of the Act of 1875, as amended by section 23 of the Act of 1890, which latter Act is only in force in the districts which adopt it. These sections are as follows: The Public Health Act, 1875, section 157, provides, as regards buildings, that every urban authority may make by-laws with respect to the following matters—that is to say: With respect to the structure of walls, foundations, roofs, and chimneys of new buildings, for securing stability and the prevention of fires, and for purposes of health; With respect to the sufficiency of the space about buildings, to secure a free circulation of air, and with respect to the ventilation of buildings; With respect to the drainage of buildings, to water-closets, earth-closets, privies, ashpits, and cesspools in connexion with buildings, and to the closing of buildings or parts of buildings unfit for human habitation, and to prohibition of their use for such habitation.

And the Public Health Acts (Amendment) Act, 1890, section 23, provides that the above-cited section shall be extended so as to empower every urban authority to make by-laws with respect to the following matters—that is to say: The keeping water-closets supplied with sufficient water for flushing; the structure of floors, hearths, and staircases, and the height of rooms intended to be used for human habitation; and the paving of yards and open spaces in connexion with dwelling-houses.

By section 23 of the Act of 1890, it is further provided as follows: 'Every local authority may make by-laws to prevent buildings which have been erected in accordance with by-laws made under the Public Health Acts from being altered in such a way that if at first so constructed they would have contravened the by-laws.' All by-laws made under these enactments require to be confirmed by the Local Government Board, but before such confirmation can be obtained notice of intention to apply for confirmation must be given, in one or more of the local newspapers circulated within the district to which the by-laws relate, one month at least before the making of the application; and for one month at least before the application, a copy of the proposed by-laws must be kept at the office of the sanitary authority, and must be open during office hours thereat for the inspection of the ratepayers of the district to which the by-laws relate, without fee or reward. When such by-laws have been made, it is the duty of the local authority to enforce them against everyone with impartiality.

Drainage.—It is not lawful in any urban district newly to erect any house or to rebuild any house which has been pulled down to or below the ground floor, or to occupy any house so newly erected or rebuilt, unless and until a covered drain or drains be constructed, of such size and materials, and at such level, and with such fall as, on the report of the surveyor, may appear to the urban authority to be necessary for the effectual drainage of such house; and the drain or drains so to be constructed must empty into a sewer which the urban authority are entitled to use, and which is within one hundred feet of some part of the site of the house to be built or rebuilt; but if no such means of drainage are within that distance, then into such covered cesspool or other place, not being under any house, as the urban authority direct.

Cleansing.—Where, on the certificate of the medical officer of health or of any two medical practitioners, it appears to any local authority that any house or part thereof is in such a filthy or unwholesome condition that the health of any person is affected or endangered thereby, or that the whitewashing, cleansing, or purifying of any house or part thereof would tend to prevent or check infectious disease, the local authority are required to give notice in writing to the owner or occupier of such house or part thereof to whitewash, cleanse, or purify the same, as the case may require.

Water-Supply.—Where on the report

of the surveyor of a local authority it appears to such authority that any house within their district is without a proper supply of water, and that such a supply of water can be furnished thereto at a cost not exceeding the water-rate authorised by any local Act in force within the district, or where there is not any local Act so in force, at a cost not exceeding twopence a week, or at such other cost as the Local Government Board may, on the application of the local authority, determine under all the circumstances of the case to be reasonable, the local authority may give notice in writing to the owner, requiring him, within a time therein specified, to obtain such supply, and to do all such works as may be necessary for that purpose. If such notice is not complied with within the time specified, the local authority may, if they think fit, do such works and obtain such supply, and for that purpose may enter into any contract with any water company supplying water within their district; and water-rates may be made and levied on the premises by the authority or company which furnishes the supply, and may be recovered as if the owner or occupier of the premises had demanded a supply of water and were willing to pay water-rates for the same.

Particular Classes of Dwellings.—In regard to particular classes of dwellings, there are special provisions in the Public Health Acts. Such provisions relate to cellar dwellings, common lodging-houses, and houses let in lodgings or occupied by members of more than one family. As to the first, it is provided that it shall not be lawful to let or occupy or suffer to be occupied separately as a dwelling any cellar (including for the purposes of the Act in that expression any vault or underground room) built or rebuilt after the passing of the Act (viz. August 11, 1875), or which was not lawfully so let or occupied at the time of the passing of the Act. But cellar dwellings which were then in actual occupation are allowed to be used subject to certain limitations as to height and situation.

A person may not keep a common lodging-house or receive a lodger therein unless the house is registered in accordance with the provisions of the Act, nor unless his name as the keeper thereof is entered in the register kept under the Act; but when the person so registered dies, his widow or any member of his family may keep the house as a common lodging-house for not more than four weeks after his death without being registered as the keeper thereof.

A house may not be registered as a common lodging-house until it has been inspected and approved for the purpose by some officer of the local authority; and the local authority may refuse to register as the keeper of a common lodging-house a person who does not produce to the local authority a certificate of character, in such form as the local authority direct, signed by three inhabitant householders of the parish, respectively rated to the relief of the poor of the parish within which the lodging-house is situate for property of the yearly rateable value of six pounds or upwards.

The most effective control that can be exercised over common lodging-houses is that obtained by means of by-laws which every local authority is required to make: (1) for fixing and from time to time varying the number of lodgers who may be received into a common lodging-house, and for the separation of the sexes therein; and (2) for promoting cleanliness and ventilation in such houses; and (3) for the giving of notices and the taking precautions in the case of any infectious disease; and (4) generally for the well ordering of such houses.

As regards houses let in lodgings which are not common lodging-houses, but are commonly known as lodging-houses or tenement houses, the only special control that can be exercised is by means of by-laws under section 90 of the Public Health Act, 1875. This section is put in force in the district of every local authority by section 8 of the Housing of the Working Classes Act, 1885, and its provisions are very much the same as those of the section relating to by-laws for common lodging-houses.

Conditions to be Implied on Letting Houses for the Working Classes.—It is provided by section 12 of the Housing of the Working Classes Act, 1885, that in any contract for letting for habitation by persons of the working classes a house or part of a house, there shall be implied a condition that the house is at the commencement of the holding in all respects reasonably fit for human habitation. The expression 'letting for habitation by persons of the working classes' means the letting for habitation of a house or part of a house at a rent not exceeding in England the sum named as the limit for the composition of rates by section 3 of the Poor Rate Assessment and Collection Act, 1869.

Nuisances.—Coming now to general nuisances, we find that section 91 of the Public Health Act, 1875, as amended by section 9 of the Housing of the Working Classes Act, 1885, and by the Factory and Workshops Acts, 1878 to 1891, sets out a comprehensive list of nuisances which are capable of being abated, and for the abatement of which the local authority is empowered to serve notices, and on the non-compliance with the terms thereof to apply to a court of summary jurisdiction for an order requiring the abatement of the nuisance, or prohibiting its recurrence, and directing the execution of any works necessary to secure that end. The nuisances which are liable to be dealt with in this way are set out as follows:—

(1) Any premises (including a tent, van,

shed, or similar structure used for human habitation) in such a state as to be a nuisance or injurious to health.

(2) Any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain, or ashpit, so foul or in such a state as to be a nuisance or injurious to health.

(3) Any animal so kept as to be a nuisance or injurious to health.

(4) Any accumulation or deposit which is a nuisance or injurious to health.

(5) Any house or part of a house or a tent, van, shed, or similar structure used for human habitation, so overcrowded as to be dangerous or injurious to the health of the inmates, whether or not members of the same family.

(6) Any factory, workshop, or workplace not kept in a cleanly state, or not ventilated in such a manner as to render harmless as far as practicable any gases, vapours, dust, or other impurities generated in the course of the work carried on therein that are a nuisance or injurious to health, or so overcrowded while work is carried on as to be dangerous or injurious to the health of those employed therein.

(7) Any fireplace or furnace which does not as far as practicable consume the smoke arising from the combustible used therein, and which is used for working engines by steam, or in any mill, factory, dyehouse, brewery, bakehouse, or gaswork, or in any manufacturing or trade process whatsoever; and

Any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance.

Since the Factory and Workshop Act, 1891, the duty of enforcing the sanitary provisions of the law in the case of all factories and workshops is vested in local authorities.

The local authority, or any of their officers, must be admitted into any premises for the purpose of examining as to the existence of any nuisance thereon, or of enforcing the provisions of any Act in force within the district requiring fireplaces and furnaces to consume their own smoke, at any time between the hours of nine in the forenoon and six in the afternoon; or in the case of a nuisance arising in respect of any business, then at any hour when such business is in progress or is usually carried on. In the case of tents, vans, sheds, and similar structures, entry can only be demanded between six o'clock in the morning and the succeeding nine o'clock in the evening.

Where under the Act a nuisance has been ascertained to exist, or an order of abatement or prohibition has been made, the local authority or any of their officers must be admitted from time to time into the premises between the hours aforesaid until the nuisance is abated, or the works ordered to be done are completed, as the case may be.

If admission to premises for any of these purposes is refused, any justice on complaint thereof on oath by any officer of the local authority may, by order under his hand, require the person having custody of the premises to admit the local authority, or their officer, into the premises during the hours aforesaid, and if no person having custody of the premises can be found, the justice shall, on oath made before him of that fact, by order under his hand, authorise the local authority, or any of their officers, to enter such premises during the hours aforesaid.

Any order made by a justice for admission of the local authority, or any of their officers, on premises will continue in force until the nuisance has been abated, or the work for which the entry was necessary has been done.

Where an order of abatement or prohibition has not been complied with, or has been infringed, the local authority, or any of their officers, are entitled to be admitted from time to time at all reasonable hours, or at all hours during which business is in progress or is usually carried on, into the premises where the nuisance exists, in order to abate the same.

It is the duty of every local authority to cause to be made from time to time an inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of the Public Health Act, and to enforce the provisions of the Act in order to abate the same; also to enforce the provisions of any Act in force within their district requiring fireplaces and furnaces to consume their own smoke.

In addition to the above offences, which are described in the Public Health Act, 1875, as nuisances in every district, whether urban or rural, there is a section (s. 47) which is specially applicable to urban districts. It provides that every person who in an urban district (1) keeps any swine or pigsty in any dwelling-house, or so as to be a nuisance to any person; or (2) suffers any waste or stagnant water to remain in any cellar or place within any dwelling-house for twenty-four hours after written notice to him from the urban authority to remove the same; or (3) allows the contents of any water-closet, privy, or cesspool to overflow or soak therefrom, shall for every such offence be liable to a penalty; and the local authority must abate the nuisance in the manner indicated above.

Every urban authority has power to make by-laws for the prevention of nuisances arising from snow, filth, dust, ashes, and rubbish, and the prevention of the keeping of animals on any premises so as to be injurious to health. Under these powers the deposit and removal of accumulations of filth may be controlled, and the keeping of swine and other animals placed under restrictions. These powers are further extended where the Public Health Acts (Amendment) Act, 1890, is in force, for that enactment confers on local authorities power to make by-laws for prescribing the times for the removal or carriage through the streets of any fæcal or offensive or noxious matter or liquid, whether it is in course of removal, or carriage from within or without, or through the district; and requiring that the vessel, receptacle, cart, or carriage used for this purpose is properly constructed and covered so as to prevent the escape of any of the contents, and for compelling the cleansing of any place on which any such matter or liquid has been dropped or spilt in the removal or carriage.

Offensive Trades.—Offensive trades are at times a source of great nuisance, and this was recognised by the framers of the Public Health Act, 1848, the provisions of which Act have been substantially incorporated in the Act of 1875. It is there enacted that any person who establishes any of the offensive trades specified (which are the trades of blood-, bone-, soap-, and tripe-boiler, fellmonger, and tallow-melter), or 'any other noxious or offensive trade, business, or manufacture,' without the consent in writing of the urban authority, shall be liable to penalties. The defect of the earlier Act was that proceedings with respect to offensive trades could only be taken within the limits of a city, town, or populous district; and it was necessary to show that the person complained of was not using the best practicable means to abate the nuisance. Under the Act of 1875 the proceedings in question may be taken by the authority in any urban district, and the burden of proof that the best practicable means are used to abate the nuisance is thrown upon the defendant. Any urban authority may from time to time make by-laws with respect to any offensive trades established with their consent, in order to prevent or diminish the noxious or injurious effects thereof. It may be well to point out that any 'other' trade besides those specified in the Act to be within the powers of the Act must be *ejusdem generis.* Hence it has been held that brick-burning and the keeping of a fried-fish shop are not 'offensive trades,' but that the business of a rag-and-bone merchant is an offensive trade within the terms of the Act.

Slaughter-houses.—Closely allied to offensive trades are slaughter-houses, and as to these the powers of the Public Health Acts are very extensive. In the first place, every slaughter-house in existence before the Local Government Acts were in force in the place where it is situated has to be registered, and all new ones have to be licensed. Under the Public Health Acts (Amendment) Act, 1890, the license may be made an annual one. The local authority may make by-laws dealing amongst other things with the maintenance of the slaughter-houses in a cleanly and proper state, and requiring a sufficient supply of water to be provided.

Hospitals.—Of late years great progress has been made in dealing with infectious disease by the provision, under the powers of the Public Health Act, 1875, of hospitals to which patients can be removed. Any local authority may provide for the use of the inhabitants of their district hospitals or temporary places for the reception of the sick, and for that purpose may themselves build such hospitals or places of reception; or contract for the use of any such hospital or part of a hospital or place of reception; or enter into any agreement with any person having the management of any hospital, for the reception of the sick inhabitants of their district, on payment of such annual or other sum as may be agreed on; and two or more local authorities may combine in providing a common hospital.

Where any suitable hospital or place for the reception of the sick is provided within the district of a local authority, or within a convenient distance of such district, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, or is on board any ship or vessel, may, on a certificate signed by a legally qualified medical practitioner, and with the consent of the superintending body of such hospital or place, be removed, by order of any justice, to such hospital or place at the cost of the local authority; and any person so suffering, who is lodged in any common lodging-house, may, with the like consent and on a like certificate, be so removed by order of the local authority; and any person who wilfully disobeys or obstructs the execution of such order will be liable to a penalty not exceeding ten pounds. It is further provided by the Infectious Disease (Prevention) Act, 1890, that any justice of the peace, upon proper cause shown to him, may, where the Act (which is adoptive) is put in operation, make an order directing the detention in hospital, at the cost of the local authority, of any person suffering from an infectious disease, who is then in a hospital for infectious disease, and would not, on leaving the hospital, be provided with lodging or accommodation in which proper precautions could be taken to prevent his spreading the disorder. The order may be limited to some specific time, but any justice has power to enlarge the time as often as may appear to him to be necessary.

Notification of Infectious Disease.—The Infectious Disease (Notification) Act, 1889, and the Infectious Disease (Prevention) Act, 1890, both of which may be put in force in any district by being adopted in the prescribed manner, but are not in force otherwise, contain some very important provisions which it is proposed now to describe.

The Infectious Disease (Notification) Act, 1889, may be adopted by resolution passed at a meeting of the local authority, of which previous notice must be given to every member. When the Act has been duly adopted it is provided that where an inmate of any building used for human habitation is suffering from an infectious disease to which the Act applies, then, unless such building is a hospital in which persons suffering from an infectious disease are received,

(*a*) The *head of the family* to which such inmate (referred to as the patient) belongs, and in his default the nearest relatives of the patient present in the building or being in attendance on the patient, and in default of such relatives every person in charge of or in attendance on the patient, and in default of any such person the occupier of the building, shall, as soon as he becomes aware that the patient is suffering from an infectious disease to which the Act applies, send notice thereof to the medical officer of health of the district.

(*b*) Every *medical practitioner* attending on or called in to visit the patient shall forthwith, on becoming aware that the patient is suffering from an infectious disease to which the Act applies, send to the medical officer of health for the district a certificate stating the name of the patient, the situation of the building, and the infectious disease from which, in the opinion of such medical practitioner, the patient is suffering.

The certificate must be in the form prescribed by the Local Government Board, and must be given in respect of a case of infectious disease to which the Act applies occurring in any building, not belonging to Her Majesty, used for human habitation, unless such building is a hospital in which persons suffering from an infectious disease are received; and also in a case occurring in any ship, vessel, or boat not belonging to Her Majesty or to a foreign Government, or in any tent, van, shed, or similar structure used for human habitation and not belonging to Her Majesty, in like manner as nearly as may be as if it were a building. The penalty for default in sending the certificate is a fine not exceeding 40*s.* The forms of certificates are to be supplied gratuitously by the local authority, who will also pay for every certificate sent by a medical practitioner in accordance with the requirements of the Act a fee of 2*s.* 6*d.* if the case occurs in the course of his private practice, or a fee of 1*s.* if the certificate is given in respect of a case occurring in his practice as medical officer of any public body or institution. Where a medical practitioner attending on a patient is himself the medical officer of health of the district, he will be entitled to the fees to which he would be entitled if he were not such medical officer. It seems that if a medical practitioner in the proper exercise of his discretion certifies that a patient is suffering from any disease, his opinion cannot be subjected to review by the local authorities, and the fee to which he is entitled under the Act must be paid.

The infectious diseases to which the Act applies in all cases include the following: small-pox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names: typhus, typhoid, enteric, relapsing, continued, or puerperal. If the authority of any district to which the Act extends desire that the Act shall in their district apply to any infectious disease other than the above, they may from time to time, by a resolution, order that the Act shall in their district apply to such disease.

It is of importance to note that the provisions of the Act apply to every ship, vessel, boat, tent, van, shed, or similar structure used for human habitation, in like manner as nearly as may be as if it were a building, and that a ship, vessel, or boat lying in any river, harbour, or other water not within the district of any local authority within the meaning of the Act, will be deemed for the purposes of the Act to be within the district of such local authority as may be fixed by the Local Government Board, and where no local authority has been fixed, then of the local authority of the district which nearest adjoins the place where such ship, vessel, or boat is lying.

Prevention of Infectious Disease.—The Infectious Disease (Prevention) Act, 1890, is also an adoptive Act, and is not in force until the prescribed forms for adopting it have been gone through; but it may be adopted in part only. The diseases to which it applies are the same as in the case of the Act of 1889, and the subjects to which it relates are—

(*a*) The inspection of dairies, and the prohibition of the supply of milk therefrom in cases where it appears that infectious disease is attributable to, or likely to be caused by, the consumption of milk so supplied;

(*b*) The cleansing and disinfection of premises, bedding, clothing, &c., for the purpose of preventing or checking infectious disease;

(*c*) The retention, removal, and burial of the bodies of persons who have died from infectious disease;

(*d*) The detention in hospital of persons suffering from infectious disease, who would, on leaving the hospital, be without proper lodging; and

(*e*) The provision of temporary shelter and attendance for members of families who have been compelled to leave their dwellings for the purpose of the dwellings being disinfected.

As during recent years attention has been very prominently directed to milk as a source of infection, it is not surprising to find that this Act confers powers which are considerably in advance of any which the Legislature has previously given to local authorities. On this subject the Act provides that in case the medical officer of health of any district in which the section is adopted is in possession of evidence that any person in the district is suffering from infectious disease attributable to milk supplied within the district from any dairy situate within or without the district, or that the consumption of milk from the dairy is likely to cause infectious disease to any person residing in the district, he shall, if authorised in that behalf by an order of a justice having jurisdiction in the place where the dairy is situate, have power to inspect such dairy, and, if accompanied by a veterinary inspector or some other properly qualified veterinary surgeon, to inspect the animals in the dairy. If, on such inspection, the medical officer of health is of opinion that infectious disease is caused from consumption of the milk supplied from the dairy. he is to make a report to the authority whose officer he is. This report must be accompanied by any report that may be furnished to him by the veterinary inspector or veterinary surgeon above mentioned. The authority may thereupon require the dairyman to appear before them to show cause why an order should not be made requiring him not to supply any milk from the dairy within the district, until the order has been withdrawn. If he fails to show such cause, they may make the order.

The Act also contains some important provisions in regard to the use of public conveyances for the conveyance of the bodies of persons dying of infectious disease, the disposal of infectious rubbish, and the cleansing and disinfection of houses and articles therein likely to retain infection. On the last subject the Act provides that where the medical officer of health of any local authority, or any other registered medical practitioner, certifies that the cleansing and disinfecting of any house, or part of it, and of any articles in it likely to retain infection, would tend to prevent or check infectious disease, the clerk to the authority is to give notice in writing to the owner or occupier that the house or part, and any articles in it likely to retain infection, will be cleansed and disinfected by the authority at the cost of the owner or occupier, unless he informs the authority, within twenty-four hours from the receipt of the notice, that he will do the cleansing and disinfection, to the satisfaction of the medical officer of health, within a time fixed in the notice. If, within twenty-four hours from the receipt of the notice, the person to whom it is given does not inform the authority that he will so do the cleansing and disinfection, or if, having so informed the authority, he fails to have the work done within the time fixed in the notice, the house or part of a house and articles are to be cleansed and disinfected by the officers of the authority under the superintendence of the medical officer of health, and the expenses incurred may be recovered from the owner or occupier in a summary manner. But where the owner or occupier of the house or part of a house is unable effectually to cleanse and disinfect it, and any article therein likely to retain infection, the officers of the authority, with the consent of the owner or occupier, may undertake the cleansing and disinfection at the cost of the authority.

No person may retain unburied, elsewhere than in a public mortuary, or in a room not used at the time as a dwelling-place, sleeping-place, or workroom, for more than forty-eight hours, the body of any person who has died of an infectious disease, unless he shall have obtained the sanction in writing of the medical officer of health, or of a registered medical practitioner.

In connexion with this Act it is of the greatest importance to bear in mind that it is an adoptive Act not only as a whole, but as to sections, so that before any particular enactment is acted on, steps should be taken to ascertain that it has been properly put in force in the particular district.

Dwellings of the Working Classes. Some very important alterations of the law were made by the Housing of the Working Classes Act, 1890, the principal of which related to (1) unhealthy areas, and (2) unhealthy dwellings.

As to unhealthy areas, it is provided that where an official representation is made to the local authority by the medical officer of health, that within a certain area in their district either (*a*) any houses, courts, or alleys are unfit for habitation; or (*b*) the narrowness, closeness, and bad arrangement or the bad condition of the streets and houses or groups of houses within such area, or the want of light, air, ventilation, or proper conveniences, or any other sanitary defects, or one or more of such causes, are dangerous or injurious to the health of the inhabitants either of the buildings in the said area or of the neighbouring buildings, and that the evils cannot be remedied otherwise than by an improvement scheme for the re-arrangement and reconstruction of the streets and houses within such area, the local authority, if satisfied of the truth of the representation, shall pass a resolution to the effect that such area is an unhealthy area, and proceed to make a scheme for the improvement of the area. Before the scheme can come into operation it has to be confirmed by provisional order, which requires the sanction of Parliament.

The law relating to the assessment of compensation payable under an improvement scheme in respect of any house or premises situate in an unhealthy area, provides that in such cases evidence shall be receivable by the arbitrator to prove—(1) That the rental of the house or premises was enhanced by reason of the same being used for illegal purposes, or being so overcrowded as to be dangerous or injurious to the health of the inmates; or (2) that they are in such a condition as to be a nuisance within the meaning of the Acts relating to nuisances (which are defined by section 2 as meaning as respects any urban sanitary district in England the Public Health Acts, and as including any local Act which contains any provisions with respect to nuisances), or are in a state of defective sanitation, or are not in reasonably good repair; or (3) that they are unfit, and not reasonably capable of being made fit, for human habitation; and that if the arbitrator is satisfied by such evidence, then the compensation—(*a*) shall in the first case, so far as it is based on rental, be based on the rental which would have been obtainable if the house or premises were occupied for legal purposes, and only by the number of persons whom they were under all the circumstances of the case fitted to accommodate without such overcrowding as is dangerous or injurious to the health of the inmates; and (*b*) shall in the second case be the amount estimated as the value of the house and premises if the nuisance had been abated, or if they had been put into a sanitary condition, or into reasonably good repair, after deducting the estimated expense of abating the nuisance or putting them into such condition or repair, as the case may be; and (*c*) shall in the third case be the value of the land, and of the materials of the buildings thereon.

As to unhealthy dwellings, the Act gives some powers that are far in advance of any previous law. It is declared to be the duty of every local authority to cause to be made from time to time inspection of their district with a view to ascertain whether any dwelling-house therein is in a state so dangerous or injurious to health as to be unfit for human habitation, and if, on the representation of their medical officer of health or any of their officers, or information given to them, it appears that any dwelling-house is in such state, to forthwith take the proceedings against the owner or occupier for closing it under the Public Health Act, 1875.

Under the Public Health Act it had hitherto been necessary that the proceedings should be taken with a view to the abatement of a nuisance, and that the works requisite to abate the nuisance complained of should be specified. This, however, is no longer the case, as summary proceedings may be taken for the express purpose of causing the dwelling-house to be closed, and appropriate forms are prescribed for this purpose.

The effect of the closing order will be to prohibit the using of the premises for the purpose of human habitation until, in the judgment of the court, they are rendered fit for that purpose. In making it the court may impose a penalty not exceeding 20*l*.

Where a closing order has been made in respect of any dwelling-house, and has not been determined by a subsequent order, the sanitary authority, if of opinion that the house has not been rendered fit for human habitation, and that the necessary steps are not being taken with all diligence to render it so fit, and that the continuance of any building being or being part of the dwelling-house is dangerous or injurious to the health of the public, or of the inhabitants of the neighbouring dwelling-houses, are required to pass a resolution that it is expedient to order the demolition of the building. Unless the building is promptly made fit for human habitation it must be demolished.

County of London.—It is necessary to explain that the law as set forth above relates to the whole of England and Wales, but does not apply to the county of London, for which there are several special Acts of Parliament. The Local Government Acts, 1888 and 1894, the Metropolis Local Management Acts, the Metropolitan Building Acts, the Public Health (London) Act, 1891, and some other Acts, prescribe the law relating to the constitution, powers, and duties of the London County Council and the Local Authorities in the Metropolis, and also the general provisions as to the laying out of streets, the construction of buildings, and the regulation of all matters of sanitation and public health. It would be impossible to go into these provisions here, but in many respects they are the same as those above described for the provinces.

W. A. Casson.

SANITATION; SANITARY SCIENCE (*sanus*, sound).—Sanitary science treats of the principles on which health is maintained and disease prevented. The principal agencies which contribute to this result will be found treated of in this work under the following headings: Baths; Contagion; Disinfection; Exercise; Food; Hospitals, Construction of; Hydrotherapeutics; Immunity; Personal Health; Physical Education; Poisonous Food; Public Health; Quarantine; Sanitary Law; Sea-air and Sea-baths; and Vaccination.

SAN REMO, on the Riviera, Italy, near the French Frontier.—A well-sheltered, dry, mild, equable winter climate. Mean winter temperature, 54° F. Early vegetation. *See* Climate, Treatment of Disease by.

SANTA AQUEDA, in Spain.—Cold sulphated and chalybeate waters. *See* Mineral Waters.

SANTA BARBARA, in Southern California. A very mild, equable climate, on the Pacific coast. Temperature mean annual, 61° F.; winter mean, 54°. Rainfall, 16 inches. Used for phthisis and other pulmonary affections. *See* Climate, Treatment of Disease by.

SANTA FÈ. — The capital of New Mexico, at an altitude of 7,013 feet, in a dry and arid region. Lacks equability of temperature. Mean annual temperature 48° F.; relative humidity percentage, 45. More suitable for a winter than a summer residence for invalids. It is principally recommended as a winter residence for pulmonary affections on account of its combining a certain degree of warmth with altitude. *See* Climate, Treatment of Disease by.

SARATOGA, in Saratoga County, New York, U.S.A.—Alkaline chalybeate and muriated alkaline waters, containing traces of iodine and bromine. The springs of Ballston, a few miles from Saratoga, are of a like character. *See* Mineral Waters.

SARCINA (*sarcina*, a pack or bundle).—This is a morphological term applied to various species of micro-organisms belonging to the group of Schizomycetes, which, developing by fission in three planes at right angles to one another, form more or less cubical aggregates of 4, 8, 16, 32, or 64 cocci, having the appearance of corded 'bales' or 'packets.' *See* Micro-organisms.

So far as is known at present, these bodies are not pathogenic, but merely find a suitable habitat in the diseased conditions with which they are associated, but of which they are not the cause.

The most important species of sarcina in human pathology are the following:—

1. **Sarcina ventriculi.**—This species, first discovered by Goodsir in 1842, is of frequent occurrence in the stomach, and in the vomit of gastric dilatation from pyloric obstruction; in some cases of gastric ulcer and carcinoma without dilatation; and in rare cases of gastric catarrh. Sarcinæ are not sufficiently constant to be of much diagnostic value, and are certainly not pathognomonic of a dilated stomach, as has been supposed. Their appearance is usually associated with a state of fermentation of the gastric contents, which appear like yeast, and are of an acid reaction and smell; but it would seem that the organism is developed in the progress of the fermentation, and is not the actual cause of the condition, for, when placed in suitable surroundings, living sarcinæ have not been observed to set up fermentative changes, and cases are recorded of their occurrence in vomit that showed no signs of fermentation.

Sarcinæ are easily detected under the microscope. A drop of liquor potassæ added to a fragment of vomit on the glass slide, and covered with thin glass, is sufficient to display their characteristic appearances. The constituent cells are of a diameter of about $\frac{1}{12000}$ of an inch (*see* fig. 137).

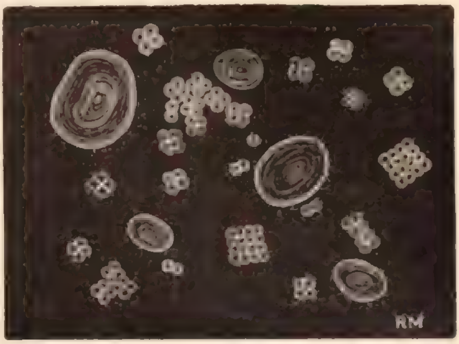


Fig. 137.—Sarcina ventriculi. Showing sarcinæ and starch-granules in vomited matter. × 400 diam.

2. **Sarcina pulmonum.**—This species has been described as occurring in certain lung-states associated with suppuration. It is said to readily induce ammoniacal decomposition of the urine when introduced into this fluid; and in one case appeared to contain starch or cellulose in its composition.

3. **Sarcina urinæ.**—This species of sarcina is of much rarer occurrence, and has been occasionally found in the bladder. It is much smaller than the gastric species, and the 'bales' usually consist of a greater number of cocci.

Sarcinæ are also stated to have been found in the fæces, in the ventricles of the brain, in hydrocele fluid, in gangrenous intestines, in cholera stools, and even in the blood.

W. H. Allchin.

SARCOCELE (σάρξ, flesh; and κήλη, a tumour).—A name for any solid enlargement of the testes. *See* Testes, Diseases of.

SARCOMA (σάρξ, flesh).—A tumour composed of some modification of embryonic connective tissue. *See* Tumours.

SARCOPTES SCABIEI. — A synonym for acarus scabiei. *See* Acarus.

SATURNISM (*saturnus*, lead). — A synonym for lead-poisoning. *See* Lead, Poisoning by.

SCABIES (*scabies*, scab, mange). — Synon.: Itch; Fr. *Gale*; Ger. *Krätze*.

Definition.—A simple inflammation of the skin, produced by the irritation of the *acarus scabiei* and the scratching of the sufferer. The disease is contagious, as the parasite is easily transferred from one person to another.

Description.—The parts of the body most likely to be attacked are the soft skin between the fingers, and on the flexor side of the wrists and elbows; the lower part of the abdomen, buttocks, and penis; and in women the mammæ; in children the feet and legs, in addition to the other parts of the body already mentioned, are very liable to be attacked. The acarus generally attacks both sides of the body symmetrically, and in adults is never met with in the skin of the face or scalp; but any other part of the body may be affected.

The eruption produced by the acari and by scratching is attended with itching, especially at night, and resembles a scattered eczema; and the extent and severity of the disease will depend chiefly on its duration. The most characteristic feature for the purposes of diagnosis is the scabies burrow, which resembles roughly an old pin-scratch. Examined closely, it has a dotted and beaded appearance with ragged dirty edges at its entrance, where the roof of the cuniculus has been worn away by rubbing. At the distant end of the burrow may be sometimes seen the parent acarus, which is easily extracted by inserting the point of a pin along the burrow and touching the acarus, which immediately adheres to the pin, and may thus be removed for the purpose of examination.

Diagnosis.—The following points serve to distinguish scabies: (1) the particular parts attacked above indicated; (2) the eruption, which consists of scattered and isolated papules and vesicles, and more rarely pustules, with their tops more or less torn by scratching; (3) the history of the case, and especially of contagion; (4) the presence of the scabies burrow; and (5) the demonstration of the acarus by means of the microscope.

Treatment.—The usual plan of treating scabies is by the use of either (1) sulphur ointment; or (2) sulphur baths or lotions. The former is the more effectual method, although the latter may be occasionally preferred. In order to cure an ordinary case of scabies, it is simply necessary that the patient, before going to bed, should thoroughly apply and gently rub in the sulphur ointment to every part of the body, excepting the skin of the face and scalp; and in order to keep the ointment in contact with the skin, he should sleep in his under-clothes, such as drawers, jersey, socks, and gloves, and in the morning take a warm bath and put on clean clothes. This process should be repeated for three or four nights, after which the ointment should be used every night for a week or ten days to those parts of the body only which are especially attacked by the disease.

The ointment should contain a drachm of sulphur to an ounce of benzoated lard, but for young children an ointment of about half this strength is most suitable. A common mistake is to continue the use of the strong sulphur ointment of the Pharmacopœia for several weeks, thus producing an irritable state of skin, which is mistaken for a continuation of the scabies.

If a sulphur bath be preferred, it may be made by dissolving half a pound of sulphurated potash in thirty gallons of water. It is necessary to repeat the bath several times at intervals of a few days.

If it be desired to treat scabies by a lotion, Vlemingkx's solution may be used. It is made by boiling five gallons of water with a quarter of a pound of quicklime and half a pound of sulphur until three gallons are left. This lotion is effective, but it is apt to irritate the skin, and is not so generally useful as the sulphur ointment. *See* Acarus.

R. Liveing.

SCALD.—An injury to any part of the body caused by the action of moist heat, either in the form of steam or of a hot fluid. *See* Heat, Effects of Severe or Extreme.

SCALD-HEAD (*scall*, scurf; scabbiness). A popular term, commonly used as the negation of ringworm; all diseases of the scalp, in the belief of the people, being either ringworm or scald-head. The term finds a more suitable application to that form of folliculitis of the scalp which is denominated *kerion.* Kerion begins with circumscribed tumefaction of the scalp and profuse exudation from the hair-follicles, and terminates by elimination of the hair and baldness; the latter being generally temporary, but sometimes permanent.

Erasmus Wilson.

SCARIFICATION (*scarifico*, I make an incision).—This is an operation in which small superficial incisions are made, through either the skin or mucous membrane, to allow the escape of blood, as in wet-cupping, or of serous fluid, in relieving dropsical effusions; or to liberate the teeth, as in difficult dentition.

SCARLATINA.—A synonym for scarlet fever. *See* Scarlet Fever.

SCARLET FEVER.—Synon.: Scarlatina; *Febris Scarlatina*; Fr. *Scarlatine*; Ger. *Scharlach.*

Definition.—An infectious specific fever; with sudden ingress, soreness and redness of the throat, and a finely diffused scarlet rash on the second day, most intense on the third day, beginning to fade on the fifth or sixth with some subsidence of fever, and followed by desquamation of the cuticle, in both small and large flakes; and inducing a liability to rheumatic and renal symptoms and a tendency to serous effusions.

Ætiology.—Some product of the sick, however conveyed to those hitherto unaffected and susceptible, always reproduces this disease, which again gives off infecting material with identical properties. No other origin for scarlet fever can now be admitted; its extension to any new locality is traceable to an imported infection. The periodical recurrence of epidemics in large communities is mainly attributable to an increase in the number of the susceptible. Wherever scarlatina spreads, children are the chief victims. Even among people not protected by a previous attack, a less liability is noticed with advancing years.

In adults, unless specially predisposed, the attack is less severe than during adolescence and childhood. The disease is most frequent from the second to the sixth year, and most fatal to children of two and three years old, when the mortality is 20 per cent.; this seldom exceeds 5 per cent. after the age of five years. In England, where scarlet fever prevails more than in any other country except, perhaps, the United States, and causes the highest mortality of any epidemic disease, two-thirds of all the deaths from it occur in the first five years of childhood. Five per cent. of the whole mortality falls in the first year, 15 per cent. in the second, 20 per cent. in each of the next two years, thence progressively decreasing—that for all ages over fifteen being less than 5 per cent., and more than half of these deaths being in the next decade. The following decade shows a slightly increased incidence on women, partly because they are more with the sick, and partly from a greater susceptibility after childbirth. Sex has no directly predisposing influence. The proportional mortality from scarlet fever is about 8 to 10,000 of population in England and Wales, the range being from 0·5 to 1·5 per 1,000; in Liverpool this has reached to 3·7, and in London to 2 per 1,000. From 2 to 5 per cent. of all the yearly deaths are from this disease; in London this proportion varied from 8 per cent. in 1870, to 1 per cent. two years afterwards. Epidemics of scarlet fever are not evenly distributed—they subside in one place while they extend in another; in epidemic years (as 1863, 1870, 1887, and 1892) the increase becomes very general. From our large towns scarlet fever is seldom or never absent; among sparse populations the disease may not reappear for years.

The influence of season on scarlet fever is marked with us by an autumnal increase of the disease: the number of deaths from it in London is always at its highest at the end of October. Cold has very little effect on the intensity of the disease; but indirectly may check its spread. Heat favours its diffusion, but lessens the severity of the attack and of its after-consequences. Epidemics tend to recur every five or six years, as a fresh series of the susceptible arises. They often extend with us in dry seasons, and subside after wet ones. Whatever the relation of moist air and subsoil water to other infections, in this one rain may free the air of floating particles, and carry them off by the sewers.

A defective hygiene from imperfectly drained dwellings greatly increases the dangers of this disease. Defective ventilation will aggravate the type, or intensify the infection which a free ventilation would dissipate. The best conditions of personal hygiene are often powerless in modifying the dangers of individual liability. The healthy and well-to-do enjoy no exemption. No mildness of type in the infecting source is any safeguard against the dangers to follow, even to members of the same family. Individual susceptibility is most variable: sometimes persons in not very good health escape while with the sick, but on returning in improved health to them as convalescents, or to the house they have left, are at once seized. After surgical operations the predisposition to receive infection is increased; any shock or injury may determine a seizure after an exposure otherwise harmless. How long after quitting an infected place such injury may excite disease is uncertain. An idiosyncrasy to suffer seriously from this kind of disease marks even the robust in certain families; in others there is a liability to more than one attack. The rule against a recurrence prevails so largely as to be the great element of personal safety to anyone again exposed to infection. Any person, however safe, may be the carrier of infection; not only the hands that have touched the sick and things in actual contact with them, but clothes or even papers that have been in the sick-room, may convey it.

Infection attaches to the whole period of illness. Greatest at the height of the disease, it is given off for six weeks—it may be for nine and ten weeks, after. Second attacks have occurred six or eight weeks from the first seizure; in some of these cases recrudescence of an originally mild attack seems likely, with further sore-throat and followed by freer desquamation. A relapse is possible as late as the fourth week; this, if not a re-infection, prolongs the duration of the infectious period; so also may any serious complication delaying convalescence. During all this time infection may be received by clothes or near surfaces, and retained by them for months, unless driven off by cleansing and disinfectants. A dry heat of 220° will disinfect woollen clothing; a curtain from the bed of a child only sickening for scarlet fever, folded and put away without such care, has set up the disease after a long interval. Clothes removed to a distance and unpacked months afterwards will give off infection. Persons protected by a previous attack from again undergoing scarlet fever, may, when much exposed to it, have sore-throat or other signs of partial sickening, sufficient to carry the disease elsewhere. Every case of sore-throat occurring in an infected house is capable of conveying scarlet fever, whether the subject of it be protected or not. Sore-throat in children is always a sufficient reason for keeping them at home. It is the slight cases of infectious sore-throat, not bad enough to prevent children from going out of doors or being sent to schools and parties, that elude our efforts to arrest epidemics of this kind in their usual course. Infection begins at the very commencement of sickening, but at that time is more readily controlled. Scarlet fever having gained entrance into a healthy house need not spread; timely isolation of the first case, or separation of the susceptible, is mostly successful, for the rash is an early symptom at once attracting attention. If others have received infection the sickness will appear in less than a week, when a second separation is sure to be effective. Till the week is over, those who may have escaped are not to be sent among other families.

The period of incubation is a short one. Not more than from three to five days, it is said to be as short as three hours; it may possibly extend to seven or ten days. The longest interval known to the writer from a single definite exposure to sickening has been four and a-half days. In most of the instances where four to five days have intervened, one or two of these days have not been without sore-throat or other signs of invasion. Such cases are infectious before the seizure is definite. In separating children from an infected house, anyone who has received infection is sure to show evidence of it before the week end. The only exceptions to this rule are, where some communication has been kept up with the infected house, where clothes have retained infection, or some source of it has existed in the second house. All accurate investigation of the cause of infection in scarlet fever tends to reduce the estimate of the average incubation-period to less than three days. In the longer periods adduced it is probable that infection attaches to something without, instead of immediately acting on or within, the sufferer. A week or more may intervene between successive cases in any family, when precautions sufficient only to delay the spread of infection have been maintained.

Inoculation will reproduce scarlatina, all the symptoms appearing with the usual rapidity and not less than the usual severity. Some modification has resulted from inoculating a serous exudation from the skin during eruption: redness began at the point of insertion in thirty hours; this extended during three days, faded after five days, and proved protective. Attempts at implanting the disease by desquamated epidermic scales have mostly failed; as with diphtheritic exfoliations, the active contagion is not long or intimately associated with dead material. The particulate contagion, carried in the blood, can permeate everywhere, for mothers ill from scarlet fever have given birth to infants affected with sore-throat; yet the mother may suffer, and the child escape. Animals are inoculable with the blood of persons with scarlet fever. A dog has contracted fever and bad throat from being in bed with a scarlet-fever patient; such illness is not necessarily identical with that originating it, nor need it be directly transmissible as a specific disease either to dogs or men, but we see how pet animals may carry infection from one person to another.

Infection has many times been traced to milk. The facility with which this fluid will absorb and convey infection is very remarkable: for it to stand in the room with sick people is enough to cause it to be tainted; the cream is specially prone to impregnation. In some cases convalescents from scarlet fever, in others healthy persons coming from an infected house, have milked the cows, and handled or distributed the milk. In this way sore teats in the cow may convey infection.

Pathology and Anatomical Characters. Scarlet fever results from the entrance of an infecting particle into the blood; but how minute or of what nature is uncertain. Micrococci are found in the blood during this fever, even within the corpuscles; and in the serum rapidly oscillating bodies appear as dark specks among the globules; also small rod-like bodies, single or joined, have been described. Such serum injected under the skin caused sudden fever in the rabbit, with similar bodies in the blood, again inoculable. Not only the blood and serum of the subject of scarlet fever, but most secretions of the body, carry infection. Minute spores, similar to those in the blood, traverse membranous septa, and have been found in the renal epithelium. Most abundant in the breath, infection attaches also to the nasal or pharyngeal secretion. The first serous exudation from the skin has been used for inoculation; desquamated cuticle is less effective. Infection is generally received by the throat and lungs, seldom by a wound or abrasion of the skin, and never by the unabraded skin. At first it multiplies at the point of reception, hence probably the day or two of sore-throat; it is delayed but little in the lymphatics before entering the blood. Infection is most rapid when carried direct to the lungs, as when inhaled through a tracheotomy tube, no particles being detained on the pharynx. Many of the first effects of the disease, such as the quick pulse and nerve-disturbance, are directly attributable to the raised body-heat. The state of the skin adds to the fever, secretion is checked, there is a general hyperæmia (not specially of the papillæ as in measles), with serous exudation in its upper layers. A bad throat gives rise to irritating and injurious secretions, keeps up the fever, and interferes with the supply of necessary diluents. The products of increased tissue-change are imperfectly eliminated by the kidneys. Further stress on the kidneys is caused, partly by the high fever, and partly by a special irritant in the blood acting upon its vascular and secreting structures. This renders the renal tissues prone to suffer, and to continue irritable. Any febrile albuminuria mostly passes off in the first week. The specific scarlatinal nephritis occurs from the end of the second to the third or fourth week of illness; but the vascular changes begin early, chiefly in the cortical part of the kidney; the glomeruli are obstructed by a proliferation of epithelial nuclei, distending them to twice their size, and so compressing the vascular tuft; there is hyaline degeneration of their capillaries, and in the elastic intima of the afferent vessels, which has been found after two days' illness (Klein); also thickening of the small arteries in other parts, with germinating nuclei in the muscular coat. The brunt of the disease falls first on the glomeruli; thence arise stasis and hyperæmia of intertubular capillaries; then signs of parenchymatous nephritis, with cloudy swelling of epithelium-cells, increase of their nuclei, and granular change in some of the convoluted tubes, may be found. Sometimes there is granular matter or blood in them, and in the cavity of Bowman's capsule. Hyaline spherules from these appear in the urine; and epithelium in some cases begins to be detached from the larger ducts of the pyramids. After the first week changes due to interstitial as well as to parenchymatous nephritis commence. The connective tissue round the larger vessels is infiltrated with lymphoid cells, thence spreading to the base of the pyramids and to the cortex, some parts of which become pale and firm, and the tubules obliterated. After this process has reached a certain degree, the evidence of parenchymatous change increases—crowding of the urinary tubes with lymphoid cells, granular and fatty degeneration of epithelium, with casts or cylinders of various kinds in the tubes, and abundant products of inflammation. These changes may commence round an artery plugged with fibrin; they lead to enlargement of the kidney, with obliteration of tubules and Malpighian corpuscles, the latter undergoing fibrous degeneration. Klein also describes early interstitial hepatitis. He found the same hyaline degeneration and thickening of arteries in the spleen and intestines as in enteric fever, but most marked in the spleen, with degeneration of surrounding adenoid tissue. Veins obstructed with fibrin were found in the cervical glands, with degenerative changes; in the centre of the lymphatic follicles here, and in the pharynx and tonsils, the lymph-cells were replaced by large granular cells.

Thickening of the walls of the smaller arteries, and some change in the capillaries of the pia mater, have been noticed in this as in other acute fevers, otherwise the early cerebral symptoms are not marked by anatomical change. In uræmia leucocytes are found in the perivascular spaces of the brain and cord. Later cerebral mischief, except from caries of the temporal bone, is more rare than after measles; but disseminated sclerosis may result. Hemiplegia from embolism has occurred in the second week of scarlet fever. Besides the results of endo- and peri-carditis, blood-clots and fibrinous coagula are found in the heart. Cardiac dilatation, or pneumonia, may follow upon uræmia. The blood in scarlet fever has been said to be deficient in fibrin; fibrin is less readily formed in this, as in other specific fevers, until some secondary inflammation arises; in the after-dyscrasia it more readily separates. Tubercular peritonitis has followed.

Ulcerative endocarditis, or suppurative synovitis, almost as certainly fatal, may occur. After death septicæmic micrococci are found in obstructed capillaries; but septicæmia itself has a rash like that of scarlet fever. The streptococci of secondary suppuration may be associated with scarlatinal infection. Among the secondary lesions of scarlet fever are the ulceration and suppuration of inflamed glands, with sloughing of the cellular tissue around them or in other parts. Fatal hæmorrhage from the throat has resulted from an injured artery. Good recovery has been made after sloughing in the neck had extended to the sheath of the carotid, exposing all the deep muscles, and leaving the salivary glands bare.

Symptoms.—The invasion of scarlet fever is abrupt. The ingress of fever is seldom marked by rigors, not always by chilliness. Slight pallor, languor, vertigo, drowsiness by day, restlessness, starting, or delirium at night, aching of the limbs and forehead, sore-throat, and vomiting, are common. In children convulsions or coma may occur. Sudden illness comes on within an hour of apparent health, or after a day or two's warning sensations in the throat. The temperature begins to rise at once, the pulse becomes very rapid—and this is sometimes more marked than the rise in temperature; but soon suffusion of the eyes, flushing of the face, and great heat succeed, with thirst and pain in deglutition, or stiffness of neck. The deep lymphatic glands at the angles of the jaw can be felt enlarged and tender; already the arch of the palate and both tonsils are red; the redness extends a little on to the palate; the tongue is furred; its fungiform papillæ prominent, bright red, and bare; its edges and tip red. Coma, convulsions, or vomiting may persist, with considerable depression, and yet the temperature be near 105°; it may even reach 106° F. at this early stage. More frequently the greatest disturbance of pulse and temperature is from the third to the fifth day of the fever. Very often a fine flush of redness suffuses the neck and chest soon after the sore-throat is complained of, perhaps within a few hours of the first suspicion of illness.

The *eruption* may thus be among the earliest obvious signs of the disease. It generally appears by the second day, and is well established on the third; but it may be delayed, or suppressed, or recede, and then the severity of the prodromata serve as a guide.

The rash begins in fine red points, with diffused redness around, so as to leave no clear skin between; or red patches are formed in some places, as in the flexures of the joints. The finger-nail drawn firmly across this redness on the abdomen or thigh leaves a white streak where the vessels contract for a time; after steady pressure the skin is of a yellowish tint; or petechiæ may be seen. The sides of the neck, the face, and the chest first show the rash, which soon spreads to the trunk and limbs; or it may come out on them at once. The skin is exceedingly hot, not always dry, sometimes with free perspiration. Miliaria often appear where the rash is most intense; these minute exudations are not the result of perspiration, though sudamina may occur. The eruption reaches its fullest extension and intensity by the fourth day, fading on the fifth and sixth. The heat and swelling then subside, and the skin feels dry and inelastic, or a partial subcutaneous œdema of the eyelids, feet, or hands is noticeable; in other parts the cuticle is easily thrown into fine wrinkles, and is ready to desquamate. Desquamation begins from the sixth to the ninth day, when the specific morbid process is subsiding.

Sore-throat is always present; some traces of this are observable the day before the seizure, or from the time of receiving the infection, often with diarrhœa. During the attack the redness spreads from the tonsils to the palate, uvula, pharynx, and epiglottis; it becomes more intense, and there is swelling with some œdema. The mucous membrane is either dry and shining, or coated with thick mucus clogging the fauces. The tonsils project and are smeared with sticky secretion, while sometimes there is abrasion of their surface or ulceration, rarely abscess. These conditions and the symptoms they produce are worst during the first three days of the illness, and subside as the rash is thrown out. After the first week, in severe cases, ulceration, not confined to the tonsils, may occur. The connective tissue around the lymphatic glands in the neck becomes brawny and may slough, that under the lower eyelid may suppurate. Persistent coryza stuffs the nostrils with acrid discharge, or, extending along the Eustachian tube, fills the middle ear with pus, bursting the tympanum, deafness not being the only or worst result. Otorrhœa from the meatus is less serious; this is not at first purulent. The tongue is red and bare after the eruption, with a 'strawberry' appearance as the fur clears away. The mucous surfaces are left tender, and care as to ingesta is required. There may be also much and serious trouble with deglutition. Vomiting, the most constant of the ingressional nervous signs, rarely persists as a gastric symptom. The tendency to diarrhœa may continue, but constipation is rare, except as an after-consequence.

The *pyrexia* of scarlet fever is characteristic. High at the first, it keeps high, or rises higher for three or four days; there is then a marked, though incomplete, subsidence after the rash is thrown out, mostly on the fifth or sixth days, sometimes earlier; but the temperature rarely becomes normal till the second week, some fever lingering after the eruption is over. When the greatest tension of skin is passed, the surface temperature has been found on the fifth and sixth days at 97°, with 101° *in axillâ* and 105° *in recto*; the latter keeping at 103° for two or three days longer. A crisis is to be looked for on the fourth or fifth day; defervescence not till the eighth or ninth; and this is often further delayed by complications or relapse. There are no other constant remissions during the febrile period, but some nocturnal exacerbations occur during the first part of it, often associated with harmless delirium. The persistence of more serious delirium then and later in persons of all ages points to meningeal irritation. Coma in children may depend not only on the high temperature, but on the state of the arachnoid cavities; even hemiplegic signs have occurred independently of the embolism so often consequent on endocarditis. Uræmic coma is rare. Intracranial inflammation and abscess not infrequently result from caries of the temporal bone after otitis.

The chief *respiratory disturbances* are, at first, irritative cough, and symptoms resulting from œdema of the glottis; the breathing is always quickened when the pulse is rapid and the fever high. Pleurisy with effusion has occurred at all periods of scarlatina, more frequently in the later stages, with a limited pneumonia, pulmonary congestion, or broncho-pneumonia.

On the side of the *circulation*, besides the quick pulse, often slow or irregular about the third week, there is the liability to endocarditis during the eruptive period or later, and to pericarditis; these complications often prolong the duration of the fever, seriously affect the nutrition of the heart, and give rise to dilatation with special symptoms and dangers. Vascular tension is not much raised in scarlatinal albuminuria.

The *urine* is altered as in other fevers; the increase of nitrogenous waste, in proportion to the degree of fever, is eliminated most largely at the crisis. At first the quantity of urine is less; the chlorides, much diminished, reappear as the fever declines; the urea, relatively increased, is less absolutely so than it is afterwards with a freer excretion; urate of sodium is deposited; uric acid, diminished on the second and third days, increases at the febrile crisis, often appearing in abundance on the fifth and sixth days, then again normal, but increasing after rheumatism or other febrile disturbance; phosphoric acid, normal during the first four days, is much diminished on the fifth, then remains below the standard till the eighth or ninth day, when there is often a deposit of earthy phosphates, with a pale, barely acid urine. Oxaluria may follow.

The kidneys, almost as constantly as the throat and skin, are the seat of important changes, to which the state of the urine is a trustworthy guide; this consequently must be the subject of repeated examination. At first there may be partial suppression of urine for a day or more; this yielding, tube-casts, blood, and albumin are found, clearing off as the secretion becomes freer. Such transient albuminuria may occur in other fevers, but here the first congestion of the glomeruli increases—it may be while the skin-affection is at its height, more frequently in its decline—and a distinctive form of nephritis is set up, generally about the ninth and tenth day, when the skin is desquamating. This has a marked febrile disturbance of its own, often leads to chronic kidney-disease, and is attended throughout with albuminuria. Dr. Ashby says about 6 per cent. of the Manchester hospital cases suffer from post-scarlatinal nephritis; he notes a greater fatality in such cases following upon severe throat-lesion without any apyretic interval. Later in the disease albuminuria and hæmaturia set in without rise of temperature. Both these conditions are often followed by dropsy. Albuminuria commonly begins during the desquamation-period in the second week; possibly as early as the fourth day; rarely as late as the thirty-first day. Three stages of this condition are noticed. The quantity of urine in the first stage is much diminished, the urea even more in proportion than the water; the specific gravity is increased; the turbidity from deposited urates is cleared by heat or the addition of hot water, showing no smoky tint from blood. If this stage be prolonged, albumin is found, with finely granular or clear casts; seldom with blood discs or renal epithelium; but they, together with epithelial tube-casts, are freely washed out as this stage is passing away. The second stage is marked by diuresis; the pale urine of low specific gravity acquires a smoky tint from blood-discoloration; this may deepen to brown or give a brighter red deposit. Albumin to a large amount may pass, with pale urine, when there is but little blood; the whole quantity of albumin may be greater, though proportionally less than in the earlier stage; it diminishes towards the close of this period, as the urine gradually clears. Some blood-corpuscles, renal epithelium, and tube-casts are found in the deposit. Clear urine still in excess and slightly flocculent marks the third stage, in which the albumin gradually, but not always entirely, disappears.

The urine may not be much lessened at first, in mild cases, and yet afterwards become albuminous; or a well-marked first stage in a severe case is not always followed by albuminuria. This is often a specific effect of the disease and independent of chill. Anuria, here as in measles, has been met with on the decline of the rash. There may be hæmoglobinuria in the later stages, with deep bloody colour, and no great increase of albumin.

Hæmaturia, if partly dependent on a blood-state, is one of the more obvious indications of kidney-mischief. Another is afforded by the occurrence of scarlatinal *dropsy*. Allowing for an error from mere surface-œdema being mistaken for it in the first week, and later for the effects of anæmia, anasarca is fairly indicative of albuminuria past or present.

Albuminuria may be absent, or only have existed for a day or two before the anasarca or ascites began. Anæmia is a very marked late feature of the disease, so that pallor and chronic dropsical cachexia often go together. Apart from renal dropsy, there is a form of scarlatinal dropsy which occurs suddenly in the second or third week, as the result of a special inflammation of serous membranes, often associated with rheumatism, or with some degree of albuminuria. *Serous effusions* into the pericardium or pleuræ, indicated by dyspnœa, are ascertained by their distinctive physical signs. They are part of a general tendency to inflammation of the serous membranes. Pleurisy is more commonly associated with albuminuria; it may tend either to hydrothorax or to empyema. Pericarditis is more commonly associated with rheumatism.

Rheumatism is frequently induced by scarlet fever; before the end of the first week, just after the rash is fullest, pains begin in several joints—wrists, ankles, or knees; the fever, instead of subsiding, rises; and the pulse again becomes quick, tense, and hard. At this time pericardial friction is to be looked for, or an endocardial murmur may be heard either at base or apex; an apex murmur is sometimes heard when there is neither rheumatism nor albuminuria, and may not necessarily mean endocarditis. Pains in the limbs, or arthritic symptoms, may come on as late as the third week, with renewed fever of the rheumatic type, sometimes with profuse perspirations. The articular swellings mostly subside, but there is also, unlike what is seen in rheumatism, the possibility of suppuration.

Sloughing of the cellular tissue around inflamed glands, or of the skin over them, is a more frequent and less fatal evidence of the same tendency. Sometimes diphtheritic necrosis of mucous membrane, or of blistered and ulcerated surfaces, after scarlet fever, evinces a specific dyscrasia.

Desquamation begins earliest where the rash has been most intense. It may be seen as early as the fourth day, more frequently on the sixth and seventh; rarely it is delayed beyond the tenth day, it may be to three weeks; and it is seldom completely over in less than six weeks. The desquamation period, really the whole time of cure, is also spoken of as occupying the second week, and as marked by a subsidence of fever even to below the normal. There is generally a remission of fever at this time, but without any great depression of temperature; the pulse also is weak, and may be irregular; considerable depression and a sense of debility about the tenth day are frequently to be noticed. All this, if coincident, can hardly be consequent upon desquamation. As soon as the vessels of the skin are less tense, the wrinkled epidermis becomes scurfy and separates. This is first seen on the chin and sides of the neck, the less delicate cuticle being raised and removed on small patches, which increase as the edges are detached, leaving a large new surface of skin; the thick epidermis of fingers and feet peels off in larger flakes, or in casts. A shreddy look of hands or toes may betray a mild attack of scarlet fever, overlooked, from three to six or eight weeks before. After well-marked scarlet fever the desquamation may be slight.

New cuticle is rapidly formed during convalescence, and is more than once cast off and renewed. Sometimes there is a pause in this process, and desquamation is thought to be over, when, with change of air or improved nutrition, a further peeling of what seems healthy cuticle occurs, not without risk of a further dissemination of infection, up to the ninth week of convalescence. Any form of desquamation beginning later than this can seldom or never be the bearer of infecting particles; even the flakes of a second desquamation carry infection so loosely as to be readily deprived of it by the ordinary means of washing and exposure. In fact, desquamation, though a very good sign that infection still attaches to its subject, because recovery is barely complete, is not the only, nor even the chief, means of its diffusion. The first fine desquamation is more infective than the later shreds.

But infection is given off before this is formed, as well as after it is all over. The secondary lesions of the throat, nose, and lips are infectious; abscesses, formed more than three weeks after the disease began, yield an infecting pus contaminating specifically the lancet used for their evacuation; nor can any definite time less than six weeks be fixed when the specific morbid process may be supposed to have ceased. A kind of recrudescence, but without the reappearance of the rash, would seem possible up to the eighth week; and the casting off in the tenth week of *débris* of tissue formed perhaps a fortnight before, as in menstruation, may not be without the elements of infection. Children are very liable to weak throat or a return of coryza for some months after convalescence from scarlet fever.

VARIETIES.—1. *Scarlatina mitior*, called also *scarlatina simplex* or *benigna*. The rash appears only on parts of the skin, and soon fades; the throat, hardly sore, is of a pinky red, with tonsils just rounded, the back of the pharynx, perhaps, streaked with mucus from the small glands; the fever is so slight that it is said to be absent; the early fine desquamation escapes notice; and it may be three, four, or five weeks before peeling on the hands and feet proves the true nature of the illness. Some mild cases begin with well-marked rash, and rapid pulse, but no high fever; the temperature, rising to about 100°, falls on the third or fourth day. These cases are not over in the third week; but there is no great illness; the rash is forgotten, and precautions are relaxed till some anasarca is noticed, or other subjects are ill with more marked symptoms. Desquamation is not later after a mild attack, nor more prolonged than after a severe one, but it may be the only distinctive sign left of a marked impairment of health and of its cause.

2. *Scarlatina gravior.*—This includes all the more serious cases, some called *scarlatina anginosa*, when endangered by the severity of the throat-symptoms; others *scarlatina maligna*, when marked from the first by high fever or its consequences. This latter form is known also as the *adynamic*, when exhaustion or collapse rapidly ensues, in some cases even before the rash has had time to appear. If cardiac failure be less sudden, such cases are shown by septic pneumonia after a sloughing throat, or pyæmia with multiple abscesses and small hæmorrhages in the kidneys or elsewhere. There are all grades of severity between these and the slighter forms of the disease. We sometimes see the mildest kind of attack in

one child set up the worst form in another; or the disease may begin moderately, and bad symptoms appear on the third or fifth day, such as restlessness, depression, weak and rapid pulse, dusky rash, lividity or pallor, dysphagia, sore mouth, dry tongue, tympanites, and cold perspirations. Again, these signs of exhaustion may follow upon some complication in the second week, while the temperature is still high; or appear as late as the fourth or fifth, after great emaciation, when the fever is over. Diphtheria, either of mucous surfaces or of the skin, appears in some of these cases, not as a new infection, but as one result of the disease. So among several children with scarlet fever, one may have only a faint rash, slow to appear, soon fading, or perhaps again returning, called *scarlatina anginosa maligna*; but the appearances in the throat and other signs are those of diphtheria; or one child with such a throat and no noticeable rash has started scarlatina among others. Some malignant cases, mostly fatal, show extreme prostration from the first, with rapid pulse and grave nervous disturbance; the temperature is always high—105° or more, even when the skin feels cool. Several of these fatal cases follow one another in a household, either from a developed intensity in the infection, from a family predisposition to suffer from it, or from some such tendency to excessive temperature-disturbance.

The infection of scarlet fever is readily received, by those who have not previously suffered from it, in the course of most diseases; and in many of them it proves a serious complication. *Surgical scarlet fever* differs in no respect from ordinary scarlet fever; it will spread to the susceptible who have no wound or open sore, not to those who are protected by a previous attack, though in the same ward and recently operated on. One attack of scarlet fever is so generally protective against a recurrence that the not infrequent instances of exceptions to this rule in no way invalidate the more important practical deductions from it; those who have already had it may attend on the sick or mix with convalescents. Some persons have two or three attacks, or are liable to sore-throat whenever they come in contact with it; still the rule is constant enough to be depended on for practical purposes.

Mortality.—The fatality of 16,606 cases treated in special hospitals in London from 1886 to 1889 was 1,507, or below 10 per cent.; nor is this rate of fatality less in non-epidemic years, or in seasons when the disease is less prevalent. It varies greatly in different epidemics and in different communities, seldom reaching the high proportion measles sometimes does. Sometimes it passes as lightly as measles often does, but it is mostly much higher. Since many more children have measles and fewer die, while many families escape scarlet fever altogether, and the deaths from it are double those from measles, the proportional fatality of scarlet fever is much greater than for measles. In both diseases many of the milder cases escape notice, and so the rate given may be too high.

Diagnosis.—The sudden illness, with high temperature, quick pulse, and severe nervous symptoms, without previous cough or sneezing, but with sore-throat and tender swelling of the glands at the angles of the jaw, at once point to scarlet fever in a child who has not had it; this is made certain by the early rash.

Diphtheria may come on in the same way, with slight suffusion of face, or more insidiously, but the throat-signs are distinctive. Herpetic sore-throat has a shorter febrile stage, and no rash. The rash of rubella is in raised spots, and less diffused at first; in doubtful cases, perhaps called febrile roseola, albumin is to be looked for in the first fortnight, and desquamation afterwards, before an absolute diagnosis from rubella is formed. Erythema may result from septicæmia, and from mercury, arsenic, sulphur, iodine, bromides, phenazone, santonin, chloral hydrate, salicin, quinine, copaiba, ipecacuanha, belladonna, opium, and oil of turpentine. Rash from the last two drugs may be followed by desquamation.

Prognosis.—Caution is needed in the prognosis of the mildest cases of scarlet fever, as these are not exempt from all the complications of the illness, or the accidents of convalescence.

High initial fever, severe angina, fever rising on the fifth day or persisting beyond the tenth, and great depression, all betoken danger. There is danger from sloughs and secondary suppuration; from cardiac inflammation and its consequences; and from kidney-disease, either at first, or from albuminuria slowly increasing for two or three months; the effects of renal dropsy, under timely care, are of more hopeful prognosis. Family predisposition is to be considered, as well as the age of the patient; and individual susceptibility more than the character of the prevailing epidemic. The temperature has reached 111° F. with recovery, and 115° in a fatal case.

Treatment.—This must have regard to the care of the patient, and the safety of others. All cases must be treated in bed for two or three weeks. A hair mattress, not too thick, is better than a feather bed; and no extra covering is required. Isolated rooms and separate attendance are needed. Carpets and woollen curtains should be removed from the sick room. This must be kept cool and well ventilated by a partly open window and an open fire, but without draughts that come directly on to the patient.

A linen sheet, dipped in carbolic solution, is suspended before the door; a moderately strong solution of permanganate of potassium should stand ready, in which to dip the fingers, or anything used by the patient; a stronger disinfectant is required for the immersion of body-linen when removed, or for the excretions. No medicines will cut short scarlet fever; simple salines, as solution of acetate of ammonium or citrate of potassium, which act slightly on the skin and kidneys, tend to its mitigation if plenty of liquid be given. The best relief is obtained from tepid sponging over the whole body, part at a time, twice in the twenty-four hours, or a tepid bath, and oil or cold-cream used to the skin afterwards. Where the fever is not very high nor the rash intense, a warm bath is comfortable. The hot pack is injurious, most so when the rash is imperfect and the nervous disturbance indicates excessive body-heat. In such cases cold affusion or the cautious use of the wet pack would moderate fever; but these means must be so used as to soothe and not to tire the patient. It is not until after the fever is over that washing with carbolic soap, and detergent baths, with carbolic inunctions, should be practised. During the fever a little solution of permanganate of potassium, or aromatic vinegar, added to the water for sponging the body, or the solution of peroxide of hydrogen, is agreeable and refreshing, neutralising some of the morbid exhalations, if not quite disinfecting them. For this latter purpose strong acetic acid (1 to 5), or carbolic acid (1 to 20 of oil), would be required. Carbolated oil (1 to 40) can be used with advantage from the first, so that the earliest skin-dust may be intercepted. Resorcin mixed with seven to ten parts of vaseline is useful for this purpose.

The throat-symptoms often claim early attention. Swallowing soon becomes easier and the external swelling less after small lumps of ice have been repeatedly held to melt at the back of the mouth; young children can have a teaspoonful of iced water with a morsel of ice in it given frequently; older persons find relief from inhaling steam. A warm compress with cotton-wool over it should be applied round the neck. Puffy swelling over the glands is often removed by fomentation, or by warm linseed poultices constantly renewed. A warm poultice held close up to the ear relieves pain from the tonsil. Mischief within the throat is lessened by taking chlorate of potassium into the mouth, or by the solution of it in spray; a sloughy throat requires chlorinated soda solution, one part to ten of water. Here also the acid chlorine mixture is useful; it is made by dropping strong hydrochloric acid on to chlorate of potassium in a bottle (♏ 3 of the acid and gr. j of the salt to each ounce of capacity), and then adding water to dissolve the liberated chlorine. Large doses of chlorate of potassium are objectionable, as tending to renal irritation. The throat, ear, or nostril may need gentle cleansing and use of the diluted glycerine of borax or of carbolic acid; resorcin, ten grains to the ounce of water, as a spray, or with oil, can be applied. For the control of fever eliminants and depressants are to be avoided; aconite is not needed in the mild cases of fever and sore-throat; it is prejudicial in the more severe forms. The mineral acids moderately control heat-production, and may be given diluted from the first. A tendency on the fifth day to increase of an already high temperature has been checked by the substitution of acids for salines. In all cases with high temperature stronger apyretic remedies are required. Of these, the two most effective and most suitable in scarlet fever are quinine and digitalis. Of the former, two or three doses, on the third or fifth day, at the rate of one grain for every two years of age, reduce fever, and so prevent the worse forms of throat and kidney mischief. If the urine be scanty, or already contain albumin, digitalis is to be preferred; it is of marked benefit where the pulse has been much accelerated in the early stages; and it is specially suited to combine with iron in the later stages of the disease, or with iron and a saline when diuretics are required. The combination of digitalis and quinine in all the graver forms of scarlet fever seems to be specially indicated. Mercuric and other germicides internally are unsafe. The sulpho-carbolate of sodium has been recommended. Salicylate of sodium is not well suited for administration in scarlet fever, as the acid is secreted by the kidneys and may irritate them. When given, it has caused perspiration and reduced the pulse and temperature, but the worst symptoms of bad cases were not lessened by it, while the tendency to rheumatism and to albuminuria is not diminished. It is effective against the rheumatism that follows scarlet fever when there is no kidney-lesion. In most of these cases perchloride of iron in full doses is the best remedy. Acute kidney-congestion should be treated by dry-cupping to the loins, hot epithems round the body, or a warmly packed poultice across the back; a brisk aperient is often most useful at the beginning of this as of other secondary complications. Here free secretion from the bowels is to be favoured by salines, and their diuretic action should be aided by plenty of liquid. Large enemata of hot water tend to relieve the kidneys. Free action of the skin can be obtained by the hot-air bath, or by a hypodermic injection of nitrate of pilocarpine. Two drops of a 5 per cent. solution of the hydrochlorate will answer; the sixth of a grain will produce perspiration in an adult; or one-twentieth of a grain may be given every hour till perspiration ensues. Children require full doses of pilocarpine, up to one-tenth of a grain twice a day in azoturia; in pale urine there is more urea and less water after some days' use of it. Diarrhœa at the febrile crisis seldom need be checked; care as to ingesta, and warm applications or poultices, perhaps with a little opium externally, suffice for its relief. Great caution is required at all times in the use of any opiates; there are many soothing means which promote sleep without resorting to direct sedatives. Chloral hydrate is not very suitable.

The diet, at first limited to milk and other liquids, may consist also of eggs and beef-tea as soon as more food can be taken, with fish or fowl, and soup with vegetables. Lemon-juice, oranges, or grapes may supplement the vegetable-supply in rheumatic or renal complications. Caution is required as to meat, and even the supply of beef-tea should be limited, while milk can be given *ad libitum*, and eggs may be largely depended on. Alcoholic stimulants are only to be used with great caution. They are apt to excite a return of fever if given early, and may embarrass the restoration of the kidney-function. Still there are many bad cases where a little brandy has to be added to the egg and milk, or where wine must be allowed. Moreover, after high fever a condition like that of heat-exhaustion comes on, with shallow breathing, weak, slow, or irregular pulse, cool surface, restlessness and threatened collapse, where brandy, ammonia, cinchona bark, and even opium may be needed. During convalescence, chill and fatigue must be guarded against. Careful diet is required, and some preparation of iron with meals, or bitters and bark as tonics. We must not advise change of air too soon: three weeks indoors for the disease to cease, and three weeks at home after that, for restoration of health, is the safest rule for all. Warm baths on three or four successive days, with plenty of soap to remove all roughness of skin, and fresh woollen clothing, are required before leaving the sick-room. The hair should be dressed with carbolic oil after washing, or with a mixture of acetic acid, glycerine, and spirit. Infection can be removed from clothes and bedding by stoving all that does not undergo a heat of 212° in washing. The best means of disinfecting the room and what is not easy to remove from it, is by burning sulphur or bisulphide of carbon in it. An ounce and a half of sulphur should be burnt for every 100 cubic feet of clear space. *See* Disinfection.

No convalescent should mix with susceptible children until six weeks from the seizure, however slight the attack; if convalescence have been interrupted, or some after-effects of the disease remain, this interval has to be two or three weeks longer. Those much with the sick should wash their hands after assisting the patient, and change their outer dress on leaving the room. A solution of salicylic acid with borax and glycerine promises to be of some use in clearing infectious particles from the throat, and so may act as a preventive against one mode of infection. No true prophylactic is known.

William Squire.

SCHANDAU, in Saxony.—Chalybeate waters. *See* Mineral Waters.

SCHINZNACH, in Switzerland.—Sulphur waters. *See* Mineral Waters.

SCHLANGENBAD, in Germany.—Simple thermal waters. *See* Mineral Waters.

SCHMECKS (Tatra-Füred, Tatrabad), in Hungary (Alt-Schmecks and Neu-Schmecks, and Unter-Schmecks).—Acidulated alkaline waters, and climatic health-resort. *See* Mineral Waters.

SCHÜLS.—*See* Tarasp-Schüls.

SCHWALBACH. — *See* Langen-Schwalbach; and Mineral Waters.

SCIATICA. — Synon.: **Fr.** *Névralgie, Sciatique*; Ger. *Hüftweh.*

Definition.—Neuralgia in the district of the sciatic nerve.

Sciatica is signalised by paroxysmal pain in any or all of the following localities: the buttock; the back of the thigh; the knee; the front, back, and outside of the leg; and the whole foot except its inner border. The condition is frequently of peripheral origin, and is then dependent on inflammation of the nerve-trunk. Or it may arise independently, to all appearance, of any local cause in the nerve itself, and is then probably caused by some impairment of nutrition of a nerve-centre. As the diagnosis of interstitial neuritis from neuralgia is as yet not certainly differentiated, the two conditions will be considered together.

Ætiology.—*Predisposing causes.*—The predisposing causes of sciatica are arterial degeneration; anæmia; the rheumatic and gouty diatheses; the toxic influences of malaria, chronic alcoholism, syphilis, and lead; inherited neurotic disposition; fatigue; and a damp and cold climate.

Exciting causes.—These include exposure of the limb to a draught of cold air for some long time, which is a common source of the affection; sitting on a cold or damp seat; over-walking; strains; concussion of the spine; the encroachment of morbid growths; blows upon or wounds of the nerve-trunk; malignant and other tumours of the pelvis; disease of the vertebræ or pelvic bones; the pressure of the gravid uterus; rheumatic or gouty inflammation of the sciatic nerve, or of one or other of its branches; syphilitic periostitis, causing a swelling which presses upon the trunk or some branch of the sciatic nerve; and a gumma in the sheath of the nerve.

In chronic rheumatic arthritis of the hip-joint the sciatic nerve may sometimes be felt to have hard, knotty swellings upon it, apparently arising from a chronic perineuritis. This is associated with very obstinate sciatica.

Sciatica affects especially the middle age of life—from forty to fifty years, is rare in youth, and but seldom commences in elderly persons. Venereal excesses have a closer connexion with sciatica than with any other form of neuralgia.

The violent manipulation of a professional rubber, employed to treat a dull aching in the sciatic region, may bring about acute sciatica.

Anatomical Characters.—Nothing certain is as yet known of the seat of the lesion in cases of neuralgia proper manifested in the district of the sciatic nerves.

The few changes which have been observed *post mortem* in cases of sciatica have been in the direction of thickening of the sheath of the nerve, the result of inflammation. It has happened, however, that in cases which during life have been supposed to be examples of neuritis, no trace of the inflammatory process has been found in the nerve itself.

Symptoms.—After more or less of vague discomfort in the affected limb, deadness, tingling, stiffness, or some such abnormal sensation, pain occurs in some part of the district already indicated. This is variously spoken of as shooting, darting, screwing, tingling, or burning; and the sufferer will often map out with precision the course of various branches of the nerve as the seat of his distress. Sometimes the leg is described as being numbed, or as if it were going to burst. Occasionally the feeling resembles a very faint shock of a battery. As is characteristic of neuralgia generally, the pain may be apparently spontaneous in origin, whilst in certain cases it is also liable to be aggravated by movement, but in no case is it *only* excited when muscular contraction takes place. It may either occur in paroxysms, with intervals of complete immunity varying from minutes to hours; or there may be more or less continuous suffering, with frequent and violent exacerbations. Throbbings or pulsations of the pain are often described. It is not, as a rule, accompanied by pyrexia. When the pain is at its height, a powerlessness of the muscles of the limbs is apt to be experienced, and this not simply on account of the distress of moving, but from an actual paresis, dependent possibly upon a depressing influence communicated to the motor centres; or, should the condition be one of neuritis, due to obstruction of nervous impulses by inflammatory products. From a like cause affecting the vaso-motor fibres the limb will feel cold, not only subjectively, but to the touch.

Tender points may be met with in all, but more often in some few only, of the following situations: The posterior inferior spine of the ilium; about the middle of the dorsum of the ilium; about midway between the tuber ischii and trochanter major; the fold of the buttock; head of the fibula; behind each malleolus; in the popliteal space. There is commonly some cutaneous anæsthesia in some part of the limb, and sometimes replacing this there will be found patches of skin which are hyperalgesic. The tactile sense proper is lowered at these points, whilst the sense of temperature, especially for heat, is often heightened. At the same place a weak voltaic current is felt as extremely and quite abnormally painful. Cramp of the calf muscles is common. It is often impossible for the patient to sit, owing to the tenderness of the nerve-trunk near the tuber ischii. The act of putting on a stocking, stooping, or sneezing gives rise to great pain.

There are great differences in the course and character of the affection. In some persons the disease from the first presents the characters of a chronic affection. There is never pain sufficient, for example, to prevent sleep, and it may not arrive at a degree of severity to interfere much with locomotion. Indeed the sufferer may experience a certain amount of relief from moving about. But the patient is worn by a more or less constant aching in the district of the sciatic nerve, which becomes especially marked after long sitting, as on a railway journey, and most of all if the seat be somewhat hard. Fatigue of body and mental worry have great effect, in such cases, in intensifying the symptoms, which, on the other hand, may almost entirely disappear in circumstances favourable to improved health and mental exhilaration. Sciatica of this type is prone to attack the middle-aged, to be permanent, and to acquire additional intensity with advancing years. In contrast with such cases are those which from the first exhibit the characteristics of an acute affection. The pain is so agonising that no posture affords relief, sleep is impossible, the general health greatly suffers. and the patient is placed completely *hors de combat*. The disease may last for weeks or months without material intermission, the patient being confined helplessly to his bed; and when at length the symptoms subside, the period of convalescence may be very prolonged. Or after some weeks of acute suffering, improvement may take place, to be followed only by a relapse, which is even more violent than the original attack.

Although the recumbent position is commonly that which is least irksome to the patient, yet it will happen that after a night passed in sleep attempts to move the affected limb cause it to be more painful than after walking, and there is a distressing stiffness about it.

In some persons the disease attacks once, in a very severe form, it may be at a comparatively early period of life, and never recurs. In many, however, it tends to recurrence, and with such persistence that the patient will speak of 'his sciatica' as a companion which is always present, though occasionally for a term out of sight. Or it may alternate with attacks of typical neuralgia in other parts of the body; or be replaced by various functional disorders of the nervous system, accompanying an excess of uric acid in the urine.

The disease may be accompanied by considerable muscular atrophy of the limb, and a quasi-paralytic condition, which, though capable of improvement, may, exceptionally, leave the patient more or less lame for the rest of his life. Much more often the wasting which has accompanied the acute symptoms of the disease gradually ceases as these subside, and during the somewhat prolonged convalescence the limb is restored to its original size, and the lameness is no longer observed. Sciatica often follows lumbago. In some cases years may elapse between the attacks, but much more frequently it is a question of a few days or weeks.

DIAGNOSIS.—There are three conditions of the muscular system which are apt to be confounded with sciatica: (1) Myalgia from over-exertion of the flexor muscles at the back of the thigh. Here the pain will be found at the points of insertion of the muscles, and is only felt during their action. (2) Rheumatism in the muscles from exposure to cold. Here, again, the pain is not spontaneous, as in sciatic neuralgia, but is always dependent on muscular action. (3) A low inflammation of the loose bursal tissue which separates the large muscles of the thigh, brought about, it is probable, by the presence of some morbid material conveyed by the lymphatic vessels with which the spaces are in direct communication. Uric acid and pus are especially liable to cause this affection. Sacroiliac disease may be distinguished by its always occurring in youth; by the pain being confined to the sacral neighbourhood; and by the limb being lengthened at an early period. From hip-joint disease, especially in the slow insidious form which it sometimes takes, sciatica is not always distinguished with facility. The paroxysmal character of the pain, presence of tender points, absence of result from forcible movement of the joint, and absence of characteristic position or shortening of the limb, will best serve for diagnosis. The lameness in sciatica may lead to the idea of paraplegia, from which the disease may be distinguished by the perfect integrity of the other limb, as well as by the paroxysmal pains, tender points, and the history showing that the powerlessness was secondary to the pain. From the darting pains in the thigh consequent on renal calculus, sciatica may be easily distinguished by careful examination.

The affection may be limited to a single branch, and when this is the terminal portion of the anterior tibial nerve supplying the big toe, there is a *primâ facie* resemblance to gout. It may be distinguished from this, however, by noting the absence of heat, swelling, redness, or pain on moving the joint; and the presence of a small spot, at which alone pressure is extremely painful.

Syphilitic periostitis, with inflammation of the sheath of the sciatic, may be distinguished from malignant disease by the effect of large doses of iodide of potassium. Sciatica may be distinguished from the lightning-like pains of tabes dorsalis by the presence of the patellar tendon-reflex. Should the anterior crural nerve be affected with neuritis coincidently with the great sciatic, the knee-jerk may be temporarily lost. It is well to remember that sciatica, properly so called, is an unilateral affection. Should it be described as affecting *both* lower extremities coincidentally, examination will show that the supposed sciatica is either tabes dorsalis, or neuritis of the cauda equina, of diathetic origin, or secondary to the presence of a morbid growth. Or it may be due to diabetes mellitus, alcohol, or syphilis.

TREATMENT.—This should be constitutional as well as local. Gout, rheumatism, syphilis, malaria—if inquiry show that either of these conditions lies at the base of the disease—will need the treatment appropriate to each. Against a gouty or rheumatic basis the diet should be spare in meat, with milk—all stimulants being as a rule avoided. Bicarbonate of potassium in effervescence, citrate of lithium, iodide of potassium, and colchicum will be the drugs most likely to afford relief. If the gouty character be very pronounced, it will be well to give salicylate of sodium in twenty- or thirty-grain doses, dissolved in half a tumbler of water, every three or four hours. The bowels should be freely acted upon with mercurial alteratives and Carlsbad salt. If syphilis be suspected, iodide of potassium or of sodium should be given, in doses of from ten to thirty grains three times a day or oftener.

Quinine, in doses of five grains, or arsenic may be employed if there be reason to believe that there is a malarious taint.

The recumbent position is very necessary in all cases of any severity; and, should the distress be very great indeed, it is a good plan to put the patient on a water mattress.

Or the affected limb may be preserved from movement by the application of a long splint, kept in position by a flannel bandage, changed daily. Sometimes the rapidly repeated application of very hot linseed-meal poultices will give much relief. Occasionally, if the pain and tenderness be very exquisite, and the patient's age and condition do not contra-indicate it, the application of a few leeches to the upper and back part of the thigh is useful. The hypodermic injection of morphine gives, of all remedies, the most speedy relief; but it is a hazardous remedy for the patient, who is very apt to acquire the morphine habit. It is best to employ a solution of one grain in thirty minims, and to inject at first three minims twice in the twenty-four hours, if necessary. The dose may be increased by one minim at a time if it be found desirable; but it is rarely necessary, except in cases of malignant disease, to exceed eight minims of such a solution. The dose and frequency should be diminished as relief is obtained. The hypodermic injection of hydrochlorate of cocaine is sometimes very useful. It should be performed at the seat of pain, and endeavour made to thrust the point of the syringe into the spot of greatest tenderness. The application may be repeated, if necessary, two or three times a day, in doses of gr. ¼. The bowels should be kept thoroughly relieved. Flying blisters, not larger than a five-shilling piece, one following another as it heals, not on the same but on a closely adjoining part of the skin, may usually be applied with much advantage. Even in cases dependent upon malignant disease they will often give relief for a time. Spongiopiline wrung out of boiling water, and sprinkled with the compound mustard liniment, makes a good counter-irritant, and will sometimes take the place of blistering.

The continuous galvanic current is occasionally palliative. From twenty to forty cells may be employed; and whilst one rheophore is applied to the sacro-iliac synchondrosis, the other is dropped into a tub of salt water, in which the patient places his foot. The strength should be arrived at gradually, and the application continued for ten minutes at a time. Then, without removing the rheophores, the strength of the current must be gradually reduced to zero. Without this precaution a shock will be given, which is undesirable. The electrical application should not be employed during the very acute stage, but rather in cases of moderate severity, or where the most formidable suffering has subsided. The current may be conveyed into a bath if preferred. One rheophore is allowed to fall into the bath, the other is held by the patient above the level of the water, which should be of a temperature of 95° F., and should contain some salt. In some cases, after acute symptoms have subsided, good has appeared to be done by enveloping the limb in a flannel bandage, over the folds of which sulphur is sprinkled. In other cases it is said that oil of turpentine taken internally has cured where other remedies have failed. In obstinate cases the sheath of the nerve may be punctured in a few places with a sharp needle. *See* Acupuncture.

The baths of Buxton, Wiesbaden, Wildbad, Royat, and Gastein have been found useful in treating sciatica; and artificial hot air or vapour baths may be beneficial in some instances.

The sciatic nerve has been cut down upon and stretched with advantage in several cases of confirmed sciatica. *See* Nerves, Diseases of.

T. Buzzard.

SCIRRHUS (σκιρρός, hard).—A hard glandular, cancerous tumour. *See* Cancer; and Tumours.

SCLEREMA NEONATORUM (σκληρός, hard; and *neonatorum*, of the newly born).—Synon.: Skin-bound Disease.

Definition.—A congenital affection, or one appearing in early infancy, characterised by a stretched and tense condition of the skin.

Description.—The disease usually commences on the lower extremities, and gradually involves the entire surface. The skin becomes glossy-looking and of a yellowish or reddish colour, but it may be mottled. To the touch it is firm and rigid, like bacon-rind, and cannot be pinched up between the fingers. The surface is cold, feeling like that of a half-frozen corpse. The infant is, in fact, skin-bound; all movement becomes impossible; and the features remain fixed and staring. Death within a short period is the ordinary termination, recovery rarely occurring spontaneously.

The disease is usually associated with affections of the respiratory and circulatory systems, and has been observed in connexion apparently with congenital syphilis.

Microscopical observation has thrown but little light on the nature of sclerema neonatorum. There is a general dry and thinned condition of the skin, but the disease seems to differ from the scleroderma of adults in the absence of increased fibrous tissue, a histological character which is peculiar to the latter affection.

Treatment.—No treatment appears to avail in this disease, but that usually employed for syphilitic taint has been suggested.

Alfred Sangster.

SCLERODERMA (σκληρός, hard; and δέρμα, the skin).—Synon.: Addison's Keloid; Morphœa.

Definition.—A chronic disease of the skin, circumscribed or diffuse, in which an excess of fibrous tissue leads to hardness, change of colour, and by contraction to stiffness and immobility.

Ætiology.—Scleroderma is a rare disease of the skin, which occurs at all periods of life, but more frequently in young adults and in middle-age. It is more frequent in women than in men. Little is known as to its causation; but rheumatism, especially of the joints, has been known to precede the attacks, and it has sometimes followed exposure to wet and cold. It attacks persons otherwise in good health. The circumscribed form sometimes follows the course of cutaneous nerves, and for this and other reasons it is regarded by some authors as essentially a tropho-neurosis. So far, however, the correctness of this view cannot be considered as having been definitely established. In some cases the circumscribed form has been referred to irritation caused by blows, blisters, pressure, and other causes.

Anatomical Characters.—The essential structural changes consist in an increased formation of connective tissue, and a perivascular exudation of the cellular and plastic substances, which is always associated with new growth of this element. The number of elastic fibres appears increased in certain parts of the skin. The formation of new fibrous tissue takes place not only in the corium, but in the panniculus adiposus, and extends to the deep fascia and periosteum. In its overgrowth the fat disappears, and the smooth muscular fibres appear to be hypertrophied. The papillary body is rendered more dense than usual by bands of connective tissue, and there is an increase of pigment both in it and in the rete. Otherwise the epidermis is unaltered. In the early stage the effusion leads to hypertrophy of the cutis, but later the contraction of the fibrous tissue causes atrophy of the integument and narrowing of the blood-vessels. At first the sebaceous and sweat glands are unchanged, but they are afterwards atrophied. Sometimes there appears to be a dilatation of the sweat-glands in the early stage. In the extreme atrophic stage of diffuse scleroderma the compression leads to more or less disorganisation of ligamentous tissues.

Description.—Scleroderma is found in two well-marked forms *diffuse* and *circumscribed*, which in their typical development differ so much from each other in appearance that they were formerly considered to be distinct diseases, the circumscribed form being known and usually described as *morphœa.* Transition forms are, however, sufficiently common to establish the nosological identity of the two varieties of the affection.

Circumscribed scleroderma.—A developed patch of circumscribed scleroderma is usually characterised by a rounded area of white or yellowish-white skin, which in some cases looks like smooth ivory. Around this patch there is a yellowish or brownish pigmentation. The white surface is usually firm to the touch, brawny, and difficult to pinch between the fingers. The sensibility is unimpaired. The earliest stage in the development of such an area is characterised by hyperæmia, which is manifested by congestion and small dilated blood-vessels shining through the surface. The disease may begin in one or more such isolated patches, which, as they become circumscribed, are surrounded by a well-marked lilac border of minute blood-vessels. Such a patch may remain for months or years without much change, or it may undergo involution, which sometimes takes place quickly, leaving the skin healthy; or, on the other hand, it may become atrophic, the skin becoming thin, parchment-like, and cicatricial.

These patches occur in various parts of the body, but most frequently on the neck, face, chest, trunk, arms, and thighs. They are unsymmetrical. There is a sufficient number of cases on record in which the changes in the cutis have followed the track of certain nerves so as to indicate a certain relation to nerve-distribution. The affected skin does not sweat. There are usually no subjective symptoms, but there may be itching, or tingling, occasionally even pain. Circumscribed scleroderma sometimes occurs in the form of bands, which are usually depressed below the surface and more or less adherent, and sometimes extend for a considerable length.

Diffuse scleroderma.—This occurs on different parts of the body, but more usually in its upper half. It may be limited to certain parts, the skin between them remaining normal, or it may be spread over large parts of the integument, such as the back, abdomen, limbs, and face. It may develop after a short period of malaise, but as a rule the process is at the beginning not observed by the patient, his attention being first called to it by stiffness of the skin; or pigmentation may be early observed. Stiffness is usually first felt about the neck, chest, shoulders, or arms, and spreads with more or less rapidity towards the limbs, the border being usually ill-defined, although to some extent perceptible to the touch. Doughy infiltration or erythema may precede the induration. As the skin becomes hard and stiff, mobility is affected, the joints becoming fixed and the face immobile. The patient cannot open his mouth widely, and the affected surface of the body has been compared to that of a frozen corpse, without, however, being cold. The skin does not pit, and cannot be pinched up. The patient is usually hidebound. The respiration is impaired, the breasts flattened, the limbs and fingers more or less flexed. The disease may even extend to the mucous membranes. The contraction of the skin leads to the disappearance of wrinkles, old persons looking younger than their years. The surface is generally smooth and shining, but sometimes dry and desquamating, the skin being pale, whitish, and waxy. The disease may reach its full extent in a period of weeks or months.

The temperature of the affected skin is on the whole normal, sometimes being slightly above and sometimes below the average. Pressure is felt, and the tactile sensibility is usually unaffected, but sometimes weakened. Secretion of sweat may be diminished. The sebaceous secretion is usually normal. The nutrition of the affected skin being impaired, it is liable to inflammation and ulceration from the ordinary sources of irritation. The limbs, from compression of the continually contracting skin, gradually become smaller. The palms and soles are rarely affected.

The course of the disease varies considerably. In the early stages a spontaneous cure may occur, involution sometimes taking place at one part while new development is showing itself at another. When shrinking and atrophy have proceeded to an extreme extent life becomes threatened. The general health in the earlier stages of the disease does not seem to be notably affected; but as atrophy and shrinking proceed, the patient falls into a condition of marasmus, and death occurs from intercurrent complications of various kinds. Kaposi refers to a case of Strassmann's, which had lasted thirty-one years without the health being materially affected.

Diagnosis.—Scleroderma is not likely to be confounded with other diseases characterised by hypertrophy and œdema. The tension, rigidity, hardness, and shrinking of the diffuse form are distinctive; in the circumscribed form the pigmented and hyperæmic zone surrounding the waxy patches distinguishes it from leprosy, and vitiligo. In anæsthetic leprosy, anæsthesia is characteristic. In atrophic conditions there is a history of a previous hypertrophic stage.

Prognosis.—Recovery may take place so long as the atrophic stage has not set in, improvement showing itself within a period of weeks or years. In the atrophic stage the prognosis is unfavourable, death being due to complications of various kinds.

Treatment.—Tonics, such as iron, quinine, vegetable bitters, cod-liver oil, and arsenic, are believed to assist a tendency to recovery when it is present. Baths, vapour-baths, hot packing, change of air, emollients, such as simple ointments, glycerine, or vaseline, and massage, are recommended. The continuous current applied to the affected skin and sympathetic nerve is believed by some authorities to be useful. It is recognised that iodine and mercurials have no value. Warm clothing and general protection against cold are indispensable.

G. Thin.

SCLEROMA (σκληρός, hard).—A term signifying a hardening of the softer tissues of the body under the influence of disease. *See* Sclerema Neonatorum; Scleroderma; and Sclerosis.

SCLEROSIS (σκληρός, hard).—Synon.: Fr. *Sclérose*; Ger. *Sclerosis*.

Definition.—A state of induration, hardness, or toughness. The term is also applied to the process by which such a state is brought about in organs and tissues.

Induration of organs has long been recognised; and before the microscope came into ordinary use this term, as well as its correlative, 'softening,' was very commonly employed by pathologists in their descriptions of certain morbid conditions found in different organs of the body.

Since Laennec, under the influence of a mistaken impression, first gave the name 'cirrhosis of the liver' to one of the common diseases of that organ associated with induration, it has gradually become more and more common to apply this name 'cirrhosis' to analogous conditions of induration in other organs. Hence the word 'cirrhosis,' and the phrase 'cirrhotic process,' have come to be used as the equivalents of 'induration' and 'process of induration,' although the Greek word from which cirrhosis is derived (κιρρός, yellow, or tawny) has a totally different signification. *See* Cirrhosis.

In recent times a limitation in the use of this phrase has sprung up. The real nature of indurations occurring in parts of the central nervous system, as well as the frequency of such processes, were recognised much later than the period above referred to. Yet, if we make allowance for the peculiarities in the texture of the brain and spinal cord, and remember that even its connective tissue (neuroglia) has a modified constitution as compared with that of other organs, it is evident that these indurations of brain and spinal cord are due to so-called 'cirrhotic processes.' Such processes, in fact, occur in them with great frequency, and constitute the anatomical basis of several distinct diseases, such as locomotor ataxy, spasmodic spinal paralysis, and cerebro-spinal sclerosis. Only it so happens that the old and etymologically unsuitable name has never been applied to them. It has always been common to speak of such an indurating process, as it occurs in the brain or in the spinal cord, by another word of similar import derived from the Greek language—that is, as a 'sclerosing process,' and of the pathological state itself as one of 'sclerosis.' This anatomical condition and the proper treatment of it will be found fully treated of in other parts of this work. *See* Insanity, Morbid Anatomy of; and Spinal Cord, Special Diseases of.

H. Charlton Bastian.

SCLEROSIS, Cerebro-Spinal
SCLEROSIS, Spinal }.—
See Spinal Cord, Special Diseases of: 18. Multiple Sclerosis of the Spinal Cord.

SCLEROSTOMA (*σκληρός*, hard; and *στόμα*, a mouth).—A synonym for ankylostoma duodenale. *See* Entozoa.

SCLEROTIC, Diseases of.—*See* Eye, and its Appendages, Diseases of.

SCORBUTUS.—A synonym for scurvy. *See* Scurvy.

SCRIVENER'S PALSY.—A synonym for writer's cramp. *See* Writer's Cramp.

SCROFULA (*scrofa*, a sow).—Synon.: Fr. *Scrofule*; Ger. *Scrofeln.*—The term 'scrofula' was used in times past for a large number of ailments believed to possess certain characteristics in common. It is significant that the word itself owes its origin to the swelling of the neck so often seen in the subjects of this disease. Glandular scrofula was, therefore, originally, and has ever been the type of what is scrofulous. For this reason we may commence by considering the topic of scrofulous lymphatic glands, or struma vera.

Anatomical Characters. — Matthew Baillie writes thus: 'The most common morbid affection of the absorbent glands is scrofula. In this case the glands are frequently a good deal enlarged, and sometimes feel a little softer to the touch than in a healthy state. When cut into, they sometimes exhibit very much the natural appearance; but it is more common to find that some of them contain a white, soft, cheesy matter, mixed with a thick pus: this is the most decided mark of a scrofulous affection.'

But this cheesy change is a late stage of the strumous affection. Scrofulous glands, which are only potentially, but not actually, cheesy, present to the naked eye very much the natural appearance, as Baillie says. If we take a chain of lymphatic glands, all somewhat enlarged, but only some of them cheesy, we should expect to find the earlier stage of the strumous lesion in the glands which look most natural. These apparently natural lymphatic glands, therefore, are those which we choose for examination first of all.

Virchow taught that the primitive strumous lesion consisted in a simple hyperplasia of the gland-tissue. But to Schüppel (1871) belongs the merit of having proved that a scrofulous gland is indeed a tuberculous gland. In the earlier stage of the lesion, the gland is studded with microscopic tubercles, possessing the usual characters. And the subsequent changes, cheesy and other, which the gland undergoes, are due to changes in these tubercles. *See* Tubercle.

Tubercle bacilli have been found in scrofulous lymphatic glands as in all other tubercular lesions, and experiment shows that inoculation of portions of the diseased glands produces tuberculosis in the lower animals indistinguishable from that resulting from infection with any other tuberculous material. The view expressed in the first issue of this work that glandular scrofula is a truly tuberculous disease has therefore been amply confirmed. The tubercle bacilli may be derived from a tubercular affection of the skin or mucous membrane, the lymphatic vessels of which enter the affected gland, or the microbe may pass into the lymph spaces through accidental abrasion of the skin, or through an unbroken mucous surface, such as that of the mouth, tonsil, or nose. That is to say, a primary tubercular lesion of some mucous or cutaneous district is not essential for the transmission of the bacilli to the neighbouring glands. This is well seen in the common case of primary tuberculosis of the bronchial and mesenteric glands without disease of the bronchial or intestinal mucous membrane. The tuberculous process may remain limited to the gland, or it may prove the starting-point of general tuberculosis. In the first case, the caseous material becomes encapsulated and often calcified, or suppuration may occur and the remnants of the diseased gland may be discharged. In the other case, the bacilli may pass through the gland into the efferent lymphatics, and reach the general circulation through the thoracic duct, and thus disseminate the disease throughout the body.

Symptoms.—In the living person strumous lymphadenitis may be distinguished from what we may call genuine lymphadenitis. The chief character of the scrofulous disease consists in its obstinacy, intractability, pertinacity. Once enlarged, the strumous gland remains enlarged for a long time. The reason of this lies in the nature of the tuberculous inflammation and its products. A genuine lymphadenitis, in a healthy person, will resolve, suppurate, or organise in a short time. In struma vera, resolution, suppuration, and organisation take place very slowly, even when they take place at all. Commonly the inflammatory products remain where they were produced, inert and passive, and sooner or later undergo the cheesy change. Hence the intractability of strumous lymphadenitis.

In many instances of persistent glandular enlargement associated with chronic eczema or dermatitis, the epithet 'scrofulous,' so freely used in former times, is not justified, as the disease, though chronic and intractable, is not actually tuberculous.

Other Scrofulous Affections.—In the case of the skin, scrofuloderma, a condition mostly secondary to suppurating caseous lymphatic glands, unquestionably merits the term 'scrofulous.' Again, lupus seems to be a chronic tuberculosis of the skin. But most of the diseases styled *scrofulides* by the French school are not tuberculous. A persistent swelling or chronic œdema of the subcutaneous tissue of the lips and eyelids is not uncommon in 'scrofulous' persons, but this condition cannot be regarded as characteristic. Turning now to the mucous membranes, a certain number of cases of otitis, rhinitis, and similar affections, can be shown to be tuberculous, but many chronic inflammations, from their obstinate nature, are erroneously ascribed to the same cause. Most, if not all, of the scrofulous diseases of bones, joints, and viscera, including cold abscesses, are tuberculous. For further information on this point the reader should consult the appropriate articles. It may be doubted whether the term 'scrofula' or 'struma' should be retained, seeing that from our present standpoint it is only applicable to tuberculous affections. If used in its former loose sense, to include tuberculous and non-tuberculous disorders, it is altogether misleading and objectionable.

The Scrofulous Diathesis. — After what has been said above concerning the relations of scrofula and tuberculosis, it is unnecessary to discuss the question of a scrofulous diathesis separately; and on this subject, as well as on the subjects of the ætiology and pathology of scrofula, reference should be made to the article on TUBERCLE.

TREATMENT.—The treatment of scrofula is preventive and curative; and relates, moreover, to the strumous disposition and the dependent structural lesions. The prevention of the disposition clearly consists in avoiding the predisposing and exciting causes thereof. Its cure is to be sought in carrying out the rules of health: fresh air and sunlight are especially needful (*see* PERSONAL HEALTH; and TUBERCLE). Iodine, once thought to be a specific, has much sunk in repute; cod-liver oil ought perhaps to be reckoned a food rather than a drug. The cure of the local lesions, by these or by surgical means, does not only relate to the sundry lesions themselves, but is also a means of preventing further development of the disease. Cure and prevention thus go hand in hand. The treatment of the primary local inflammations will be found in the appropriate articles. With regard to the glandular abscesses, the chief source of general tubercular infection, it would seem to be more reasonable to favour an outward discharge of the matter, than to strive to promote its absorption. S. J. GEE.
PERCY KIDD.

SCURF.—A popular name for the bran-like exfoliation which forms at the roots of the hair. It is composed of the normal desquamation of the epidermis of the scalp, with the addition of the epithelial exuviæ thrown off by the hair-follicles. *See* PITYRIASIS.

SCURVY.—SYNON.: Scorbutus; Fr. *Scorbut*; Ger. *Scharbock*.

DEFINITION.—Scurvy is characterised clinically by intense general debility; sponginess and swelling of the gums; ecchymoses, closely resembling bruises, about the thighs and legs; a brawny hardness about the flexures of the larger joints, and sometimes a contraction of the muscles of the calves; pearly conjunctivæ; and a sallow aspect somewhat akin to mild jaundice

From a pathological point of view the disease is characterised by effusion of a semi-organisable fibrinous material in the tissues of the gums, between the striæ of the muscles of the thighs, legs, and sometimes (but comparatively seldom) of the arms, and also between the periosteum and the bones of the extremities, and occasionally of the ribs; ecchymoses sometimes found about the thoracic and abdominal aortæ and the alimentary canal; and a generally blanched condition of all the tissues.

ÆTIOLOGY.—Scurvy is, in an eminent degree, cosmopolitan. It may prevail in a mild or severe, an intermittent or endemic form, in any latitude, in any country, or among any variety of the human race, inasmuch as the predisposing and exciting causes may exist anywhere under certain circumstances. War, famine, shipwreck, or any other accident or exigency that deprives human beings for a length of time of fresh vegetable food is sufficient to introduce scurvy into a community. Although very vaguely described by Hippocrates and other early writers, there is no doubt that in semi-civilised and savage countries scurvy was endemic. Most military historians, who have chronicled the sanitary circumstances of armies from the thirteenth century to the date of the last American war, speak of its ravages, and in the early months of the Crimean War the French lost more men by scurvy than by the guns of the enemy. It has also from the earliest times been a chief foe to sailors; and until the beginning of the seventeenth century, it constituted a formidable item in the mortality list of the navy in this as in other countries. In the spring of 1840 an outbreak of the disease occurred among the prisoners at the Millbank Penitentiary, and was confined exclusively to the military sections of the inmates, whose diet differed in one important respect from that of the other convicts. The last extensive outbreak on land, other than those that have arisen in consequence of war, occurred in Ireland during the potato famine in 1847, when the inhabitants suffered severely. Since, however, the prophylactic properties of a vegetable diet have been understood, scurvy, except in times of war, has—unless under very exceptional and always preventable conditions—ceased to assume formidable proportions either ashore or afloat. It is indeed, in civilised communities, very rarely found on land. It is almost extinct in the Royal Navy, except the outbreak in the last Arctic expedition under Sir George Nares; owing to the introduction of lime- and lemon-juice, and also to the greater variety in the scales of diet. During the last eight years it has diminished in the British Mercantile Marine by from 70 to 80 per cent., in consequence of legislative enactments that secure a proper quantity and quality of antiscorbutics to the crews of all long-voyage ships. Cases of the disease are still seen occasionally at the Seamen's Hospital at Greenwich, usually associated with some other disease, as dysentery, ague, &c.; but in some instances clearly caused by carelessness, either on the part of the captain in serving, or on the part of the crew in not taking, the lime-juice provided.

PATHOLOGY AND ANATOMICAL CHARACTERS. Although the ætiology of scurvy is so well understood, yet we are still in ignorance of the precise nature of the alterations of the blood and tissues which precede and accompany the development of the disease. The most important contributions hitherto made to our knowledge of the pathology of scurvy are those of the late Mr. George Busk and Sir Alfred Garrod. The former, in a series of analyses made of the blood drawn from scorbutic patients, showed that there was a considerable diminution of the red blood-corpuscles, an increase in the amount of fibrin and albumen, and no decrease in the amount of potassium salts. Sir Alfred Garrod observed that in scorbutic diets potassium existed in smaller quantities than in antiscorbutic ones, and was led to determine the amount of that substance in the blood and urine of a patient suffering from scurvy, and he found it considerably diminished. From this observation, he brought forward the theory that scurvy depended upon a deficiency of potassium in the system. The fact that potassium is diminished in the urine of patients suffering from scurvy has been confirmed by Dr. Ralfe and others. But it is doubtful whether the disease is produced by a deficiency of that base in the system, since the administration of large quantities of beef-tea, containing more potassium than in the ordinary antiscorbutic dietary of the Seamen's Hospital, fails to exercise a curative effect, and it is not till the patient obtains lime-juice or potato that he recovers. Dr. Buzzard considers that, although the organic acids and potassium separately do not represent the requisite material, it is to be found in the chemical combination of the acid and the base. The writer, from observations founded on the effect which the withdrawal, for a considerable period, of all fresh succulent vegetables and fruits has on the urine of healthy persons, and from the analyses of urines from patients suffering from the disease, has concluded that the 'primary alterations in scurvy seem to depend on a general alteration between the various acids, inorganic as well as organic, and the bases found in the blood, by which (*a*) the neutral salts, such as the chlorides, are either increased relatively at the expense of the alkaline salts; or (*b*) that these alkaline salts are absolutely decreased. This condition produces diminution of the normal alkalinity of the blood; and he suggests that this diminution produces the same results in scurvy patients as happens in animals when attempts are made to reduce the alkalinity of the body (either by injecting acids into the blood or feeding with acid salts), namely, dissolution of the blood-corpuscles, ecchymoses and blood-stains on mucous surfaces, and fatty degeneration of the muscles of the heart, the muscles generally, and the secreting cells of the liver and kidney.'

The most marked morbid changes of scurvy are the œdematous, spongy, and occasionally ulcerated gums; the bruised-like condition of the legs; and the brawny hardness, confined usually to the gastrocnemius and hamstring muscles. On cutting these across, tough fibrinous effusions are found packed between the muscular striæ, giving the cut surface a streaky appearance. If the anterior surface of the tibia be examined, the same kind of effusion will be often found between the periosteum and the bone. It would appear that the effusion is due, not to the degenerated condition of the vessels, but to a chemical alteration of the blood. Also hæmorrhagic effusions are sometimes found beneath the periosteum, or between the epiphyses of the larger joints, especially when scurvy has proved fatal in children.

In severe cases the ribs will sometimes be found detached from the cartilages, and old fractures occasionally become disunited. Beyond a general anæmic condition, and occasional ecchymotic spots about the pleura and pericardium, the contents of the thorax present no special appearances. In examining the abdominal viscera, attention should be directed to the spleen, which is usually friable, and often rotten and pulpy; to the external coats of the intestines, in which patches of effusion will frequently be found; and to the mucous coat of the large intestine, which, if, as is frequently the case, the disease be complicated with dysentery, will be studded with ulcers of varying depth, which have, however, entirely lost their dysenteric character, and become ragged along the edges, ill-defined, but not, as a rule, very much excavated. The body is not always badly nourished, and the cheeks are usually puffy on account of the swollen gums; but local or general dropsy is seldom present.

SYMPTOMS.—The most striking features of

scurvy are a complexion of sallow, dull leaden hue, analogous only to that of a patient who has been for a long time subject to attacks of some form of remittent or intermittent fever, or to that of a person recovering from jaundice; pearly-white conjunctivæ; puffy and sometimes bloated cheeks; gums spongy, bluish-red in colour, swollen sometimes to such an extent as to hide the teeth both in front and behind, and tending to bleed; teeth more or less loose, some already lost; tongue clean and pale; no special characteristic about trunk and upper limbs (though the latter are now and then slightly ecchymosed); shortness of breath, but no other chest complication; no abdominal tenderness or anything abnormal as to the functions of the abdominal organs; thighs and legs usually presenting a more or less bruised appearance, particularly just above and below the knees; brawny indurations of the hams and calves of the legs, often painful and tender; and the effusions previously described may be so dense and abundant as to fix the legs in a semi-flexed position. Node-like swellings are also often observed over the tibia, owing to effusions between the periosteum and the bone. The swelling of the gums is specially noticeable round decayed teeth, and old injuries to the limbs seem to determine the characteristic effusions more particularly than those free from injury. There are also usually a large number of spots and patches, very much like those of purpura, scattered indifferently about the lower limbs. There is sometimes considerable œdema about the ankles; but, in uncomplicated scurvy, pitting on pressure anywhere is the exception rather than the rule. The bowels are more or less constipated, the appetite is good, and there is no thirst. The breath has a peculiar offensive odour, and this may be aggravated by ulceration or sloughing of the gums, or necrosis of the jaw. General debility varies in degree, but may be excessive, with weak voice, and some tendency to fainting, if the patient is put or kept in a sitting position. He feels more or less general aching, and a sensation of contusion in the legs. The skin is dry and harsh, and desquamates over the legs. Heart and lung sounds are normal. The urine is free from albumin, of normal specific gravity, with abundant chlorides. Urea, phosphates, and potassium are said to be deficient.

Complications and Sequelæ.—Simple scurvy is now rarely seen inland, except among the extreme poor who may be unable to purchase vegetables, and who live merely on tea and bread. Nor is it very often seen afloat. It still, however, complicates to a considerable extent diseases or accidents that occur at sea, and so prolongs convalescence almost indefinitely. A sailor, for example, goes out from England to Calcutta, and shortly after arrival in that port is attacked with dysentery or intermittent fever, fractures a limb, or becomes syphilitic. He remains in India a very short time, ships in a convalescent and enfeebled condition, lies up before the ship has been at sea many days, and probably does little or no work during the entire passage. The berth that he occupies constantly (and with very little change of clothing) is probably wet, his food scanty and unvaried, and his lime-juice or other antiscorbutics (as he cannot go to fetch them) served out irregularly, or perhaps refused when given. Under such circumstances, scurvy soon begins to 'colour' the original disease. The intestinal canal in cases of dysentery, the spleen in cases of ague, buboes, and chancres in syphilis, are all attacked, so to speak, scorbutically. Wounds, scratches, ulcers, or any other breaches of surface will not heal, and fractures sometimes become disunited; so that, as a consequence, the recovery of the patient after his arrival is deferred (solely on account of the existence of this scorbutic condition) for several weeks or months. In fact, all processes of repair, internally and externally, appear to be arrested, and no advance is made until the scorbutic symptoms have entirely disappeared. Nyctalopia is sometimes associated with scurvy, and it may be considered that night-blindness is induced by scorbutic conditions, inasmuch as this affection has decreased *pari passu* as scurvy has diminished in the British Mercantile Marine, and is now seldom complained of by sailors. In bad cases, hæmorrhage may take place from mucous surfaces. Nausea and vomiting may also occur.

The sequelæ of uncomplicated scurvy are, practically speaking, *nil*, for the patient, when properly treated, makes a rapid and complete recovery, leaving no trace of the disease behind. There appears, however, to be little doubt that one illness renders the patient less able to resist successfully future attacks of the disease, if placed under the same predisposing conditions. Several instances are recorded of old sailors, who have been the subjects of two or three attacks; but these have been generally complicated with some other disorder, delirium tremens being occasionally superadded.

Diagnosis.—The diagnosis of scurvy cannot be difficult if the symptoms described above exist, and a dietetic history is carefully made out. As Parkes records, in a very valuable paper published on that subject in the second volume of the *British and Foreign Medico-Chirurgical Review*, 'it may be confidently asserted that an invariable antecedent of every case of scurvy is a deficiency or absolute want of fresh vegetable food.' This important item of information being established, the spongy gums, and the bruised-like condition of the lower limbs (this latter condition not being connected with any history of accident or injury), with great general debility, should be sufficient to determine the nature of the disease. For even in mild cases the condition of the gums is quite unlike that produced by mercury. Moreover, the mercurial fœtor is absent, but a fœtid, earthy odour exists. Nor has the dull blue margin seen in the gums in cases of lead-poisoning any resemblance to the scorbutic condition. Scurvy might be occasionally confounded with purpura, as in some cases hæmorrhagic spots only exist about the legs, with no ecchymoses or hardness round the calf and hamstring muscles. But the condition of the mouth, the absence of severe cachexia, and, as Niemeyer remarks, the comparative absence of epistaxis, hæmatemesis, hæmatoma, and bloody evacuations from the bowels in scurvy, will aid at once to settle the diagnosis. The disease is now, under ordinary circumstances, rare among women and children. The possibility of its existence should not, however, be overlooked. Single cases are occasionally noted by physicians, caused for the most part by pursuing strictly a scorbutic regimen, for the purpose of combating some other obstinate disorder.

PROGNOSIS.—Scurvy existing apart from other maladies is not a fatal disease. The patient may be seen in a state of excessive prostration, with feeble pulse, whispering voice, and a tendency to syncope unless the recumbent position be rigorously maintained; but a few days' rest, under favourable conditions, and proper treatment, produce a marvellous change, which results in a steady and very satisfactory convalescence. But before this prognosis is given, care should be taken to ascertain that the scurvy does not cover any other chronic or organic disease. Dysentery, syphilis, and the various forms of intermittent fever are undoubtedly its worst complications, and either of these maladies will, even under favourable circumstances, prolong convalescence considerably. The duration of the disease is limited only by the causes that produce it, for as long as the scorbutic diet and other predisposing conditions exist, so long will the disease retain the mastery, and progressively increase in severity.

TREATMENT.—If the patient, when first brought under notice, be so ill as to be unable to walk or stand, great care should be taken that the recumbent position is adopted and maintained. Many severe cases of scurvy have been lost by the neglect of this apparently simple precaution. The patient, in the absence of the nurse, sits up in bed, and has a sudden attack of syncope, from which he never recovers. Having regard to this, let the patient be undressed carefully, and washed (without a bath), any wounds or abrasions being covered with simple water-dressing. The direct treatment of the disease is almost purely dietetic, starting upon the principle that want of fresh vegetable diet has been the exciting cause of the illness. So the diet should consist of mashed potatoes; any variety of green meat (the *Cruciferæ* being perhaps the best); oranges, pears, apples; and, as a convenient antiscorbutic, lime- or lemon-juice at the rate of from three to four ounces daily, mixed with about eight times its bulk of water, sweetened to taste, and used as a drink. Solid animal food should be given at least once a day, and in liberal quantity, as soon as it can be properly masticated. We begin in bad cases with beef-tea, mutton-broth, milk, eggs, fish, and minced meat—in fact, any and all varieties of nutritious animal food, in conjunction with the vegetable diet; for the appetite is usually good, and the digestive powers almost unimpaired. If great prostration exist, brandy, in small and frequent doses, must of course be given; but, as a general rule, very little is required. Malt liquors are undoubtedly antiscorbutic, and it is well to give a pint of ale or porter daily if no dysenteric complication exist. Milk is also to a certain extent antiscorbutic, and should be given freely. As regards medicinal treatment, little or nothing need be done. All active treatment, general or local, is almost useless. The administration of mercury to scorbutic patients (through errors of diagnosis) did, in former years, an enormous amount of mischief, and, even in the presence of chest complications, all counter-irritants to the skin must be avoided. Chlorate of potassium, in the form of a mouth-wash, or given internally, probably assists to cleanse and purify the gums and mouth; and if old ulcers or open sores exist upon any part of the body, lint, wetted with weak lime-juice, is said to promote a healthy surface. But whether any complication be internal or external, no processes of elimination or repair will advance satisfactorily until the scorbutic symptoms disappear. If no grave disorder beyond the scurvy exist, recovery is very rapid, and few diseases are so eminently satisfactory to treat. The gum-swellings recede, and the ecchymoses on the legs begin to disappear after two or three days of treatment; and the brawny tenderness of the muscles of the lower limbs diminishes daily, the fibrinous effusions causing it being steadily and quickly absorbed. Dysentery is the most common complication of scurvy, and is usually tedious and troublesome. A fair trial should be given to the treatment above recommended, excluding malt liquors, and substituting a small allowance of brandy, and as a rule the dysentery and scurvy will disappear together.

The antiscorbutic treatment proper to combat the advent of this disease is sufficiently indicated in the above remarks, for it will be plainly seen that scurvy is due to the absence of certain necessary ingredients in diet. When these ingredients cannot be given in the usual form, the most convenient substitutes are lime-juice, lemon-juice, and in a minor degree citric acid. Sir Alfred Garrod recommends salts of potassium. But the great mass of evidence, collected during the last fifty years, goes to prove that lime- and lemon-juice contain, in natural combination, the best and most convenient prophylactic elements against scurvy. Its use in the Royal Navy has, since the close of the last century, been chiefly instrumental in driving the disease out of the Service; and legislative enactments passed in 1867, whereby a proper and genuine supply of juice was secured to all British sailors, have resulted in the decrease of scurvy in our own Mercantile Marine by from 70 to 80 per cent.

Charles H. Ralfe.

SCYBALA (*σκύβαλον*, dung).—Fæces in the form of hard rounded lumps, whether discharged or retained in the intestine. *See* Stools.

SEA-AIR; SEA-BATHS.—The physiological and therapeutical effects of sea-bathing cannot be separated from those of sea-air; for it is impossible to take sea-baths without being under the influence of sea-air; and the stay at the seaside alone, without sea-bathing, produces on many constitutions all the effects which are usually ascribed to sea-bathing. Residence at the seaside, that is, the influence of sea-air, is to be regarded as a special kind of climatic treatment, while the action of the sea-bath is analogous to the stimulating forms of the cold-water treatment.

As the sea-air and the sea-bath owe part of their properties to the constitution of sea-water, it will be well to begin with the latter, then to consider the characters and influences of the sea-air and the sea-bath, and add some notes on seaside watering-places.

Sea-water. — *Temperature.* — The sea-water is of more equable temperature than the surrounding air. It is, as a rule, warmer than the atmosphere in winter, and cooler than in summer; although on chilly days in summer, especially after a series of hot ones, the temperature of the sea-water is often higher than that of the air. The variations of the temperature of sea-water from night to day, and from one day to another, are much less than those of the air. It would, however, be erroneous to assume, as is sometimes done, that the temperature of the sea-water near the shore is the same at different times of the day. The writer has often measured it at the Riviera, and the south coast of England, and has repeatedly found it on calm and sunny days at one P.M. and two P.M., from 5° to 7° F. higher than on the same days at seven or eight A.M. As to the different seasons, the sea-water reaches its highest temperature in summer much later than the air; and as it loses its heat less rapidly than the latter, it is mostly warmer in autumn and winter than the surrounding air, and gives off warmth to the latter. During the sea-bathing season, namely, from the end of May to the beginning of October, the temperature of the sea-water at the coasts of England, the north of France, Belgium, Holland, and Germany, varies in general from about 56° to 72° F., while in the Bay of Biscay and in the Mediterranean it is considerably higher.

Constituents.—Sea-water holds in solution a large amount of salts, varying somewhat in different localities, and slightly even in the same place at different times. The Mediterranean is richest, with about 2¾ to 3½ per cent.; whilst the water at the coasts of the British Channel and German Ocean varies from 2¼ to 3¼ per cent. The water of the Baltic, owing to the large number of streams which enter it, is much less salt, containing only about ½ per cent. Five-sixths of all the salts are chlorides of sodium and magnesium, whilst the remainder consist of the sulphates and carbonates of calcium, magnesium, and potassium.

Sea-air.—The sea-air, and the air at the sea-shore, are considerably influenced by the constant evaporation taking place from the sea, and also by the temperature of the sea-water. Owing to these circumstances, the sea-air contains in general more moisture, relative as well as absolute; and is more equable in temperature, the summer being less hot, and the winter less cold, at the seaside than at inland places in the same latitude; the day also may be regarded as less warm in summer, the night as less cold in winter. A very important fact is the comparative purity of the sea-air from organic admixture and inorganic dust, while the occasional presence of a greater or smaller amount of saline particles cannot be regarded as a disadvantage. The amount of ozone is greater; that of carbonic acid smaller. The variations of the barometer are greater, but more regular in their occurrence, and this possibly exercises a beneficial influence on the functions of life. The greater density of the atmosphere, which means a comparatively large amount of oxygen in a given volume of air, is often considered as one of the principal causes of the stimulating effect of sea-air; but Frankland's and Tyndall's experiments on combustion render the usual reasoning on this point, with regard to combustion and tissue-change, rather doubtful. Nor is the fact to be overlooked that the air at the sea-shore is mostly in greater agitation than the inland air; and by this circumstance is probably to be explained the experience of Benecke ('Sea-air and Mountain-air,' *Deutsch. Arch. f. klin. Med.*, vol. xiii. p. 80; 1874) that the same body of hot water loses its heat more rapidly at the sea-shore than at various elevations in Switzerland, varying from 3,000 to 6,000 feet above sea-level—an experience from which we may infer that living bodies likewise give off more heat at the sea-shore than in elevated inland regions. The physiological effects of sea-air may be designated, with Braun (*Curative Effects of Baths and Waters*, English edition, 1875, p. 253), as 'powerful stimulation of the change of substance, both retrogressive and formative, expressed in a striking increase of urea, and decrease of uric acid and phosphoric acid in the urine, in the greatly increased requirements of food, and in the rapid and considerable increase of the weight of the body.' A certain power of responding to the increased stimulus of the sea-air is, however, required of the constitution; for the increased tissue-change necessitates an increase in the ingestion of food, and in the processes of excretion of the products of retrogressive tissue-change. If the digestive and assimilative organs be unable to satisfy the former demand, various digestive disturbances arise, the appetite fails, and emaciation is often the consequence. In many of these conditions greater benefit is derived from mountain health-resorts, where the demands made on the constitution are less great, and where less food is required. If the excretory functions be imperfect, as is the case in so-called 'bilious' individuals, and in some undefined gouty tendencies, headaches, giddiness, constipation, or other symptoms usually called 'biliousness,' make their appearance, and sometimes render the removal from the sea-shore necessary, though the use of aperient remedies, reduction in the amount of food and especially of stimulants, and active exercise at some distance from the sea, often suffice to correct this defective elimination and its consequences. In many cases of this kind, however, courses of mineral waters, especially the alkaline, saline, or common salt springs, ought to precede the stay at the seaside. *See* MINERAL WATERS.

Sea-baths.—The sea-bath may be regarded as a powerfully stimulating cold-water bath, modified in its action by the saline ingredients; by the admixture of mechanical particles, organic as well as inorganic; by the varying degree of motion through the waves; and by the alternation in the exposure of a part of the body to the waves and to the air. We have already discussed the temperature of the sea-water, and the saline ingredients; but the temperature of the surrounding air, and the degree of motion in the air, also exercise a modifying influence on the effects of the sea-bath. The motion of the water varies constantly, according to the size and force of the waves, and the effect of the bath to a great degree depends on this point. When the waves are in any degree powerful, the upper part of the body is exposed to the coming, the lower to the receding wave, and the cutaneous nerves are not only influenced by the temperature, but also by the force of the water, and by the sand and other substances mixed with it. In a quiet sea these influences are considerably lessened. The alternation of exposure to the water and the air, likewise occasioned by the waves, is peculiar to the sea-bath, and is another source of constantly changing impressions on the cutaneous nerves.

BATHING SEASON.—The season for sea-bathing varies according to the climate of the locality. Thus it extends on the Mediterranean shores from May to October and even November; on the shores of the English Channel and German Ocean from June to September and the beginning of October. The time of the day for sea-bathing must depend on the individual, on the weather, and on the tide. Delicate persons ought not to bathe with a perfectly empty stomach; but also never after a full meal. The duration of each bath is to be regulated according to the constitution of the bather, the force of the waves, and the temperature of the water. Weakly persons ought not to remain in the water over five minutes, but immersion for one or two minutes is in many such cases all that is useful or permissible; while stronger individuals may remain from five to ten minutes. The bather, we may say in general terms, ought to leave the water as soon as the reaction manifests itself.

In many cases, the warm sea-water bath may be recommended with advantage, when the cold sea-bath is forbidden. Indeed, courses of bathing in warm sea-water are not sufficiently used in a systematic way, though the medical practitioner possesses in them a gentle, manageable, and efficacious means of treatment during winter as well as during summer. They are in their action analogous to warm common salt-baths (*see* BATHS; and MINERAL WATERS). Unfortunately the arrangements at many localities are still very defective. Some physicians at seaside places are beginning to make more extensive use of them, and with excellent results. The tepid swimming-bath of sea-water we may regard as intermediate between the warm bath and the bath in the open sea, and likewise as very useful in appropriate cases. With due care it can be employed also in winter. It offers the advantage of the combination of one of the most perfect modes of muscular exercise, with the exposure of the skin to the influences of the sea-water bath.

The physiological effects of the sea-baths are similar to those of the sea-air. Abstraction of heat and stimulation of the cutaneous nerves lead to increased tissue-change, retrogressive as well as productive. Increased appetite and increased weight of body are usually observed in those who are benefited by sea-baths; while loss of appetite, headache, digestive disturbances, and loss of weight are often observed in those who are unable to bear the shock, or the increased demand on the body, or who remain too long in the bath, or take it too frequently.

CASES NOT SUITED FOR SEA-BATHING.—Persons affected with diseases of the heart, or of the blood-vessels and lungs, with angina pectoris, with epilepsy, with organic diseases of the nervous system, with fainting fits, with enlargement of the liver, or with other organic diseases of the abdominal viscera, ought to avoid bathing in the open sea, which may produce most injurious effects, such as violent palpitation and dyspnœa extending over many months, sleeplessness, total loss of appetite, and great emaciation. Old persons, and persons with feeble circulation, whether from age or otherwise, ought to avoid bathing in the open sea, excepting on warm days, and with a very quiet sea.

CASES TO BE BENEFITED BY SEA-BATHING AND SEA-AIR. — Sea-bathing is useful in many conditions connected with weakness or atony of the skin, such as tendency to profuse perspiration, or to taking cold at every change of temperature, or exposure to wind or draught.

In scrofulous complaints, long-continued residence at the seaside promises more than other climatic agents; but, as we have to deal with constitutional defects, and as our aim must be to alter the constitution, two, three, or even more years are often required. In many cases, judicious courses of sea-bathing, the use of warm sea-water baths, and sponging with sea-water, assist the climatic element of seaside residence. Education at schools situated at the seaside offers, in scrofulous children, the greatest advantages.

In muscular rheumatism, the moderate use of the sea-bath combined with sea-air is useful. In more recent rheumatic joint-affections the sea-bath is mostly injurious, whilst the more gentle action of the sea-air, combined with the use of warm sea-water in local and general baths, is frequently beneficial. Persons affected with so-called nervous rheumatism—a term which is applied sometimes to hysterical cases, sometimes to spinal irritation, and also to rheumatism combined with nervous weakness—often derive benefit from the gentle use of the sea-bath, and still more from the sea-air.

In some functional diseases of the nervous system, the sea-bath forms an excellent remedy, if it be adapted to the individual case; for instance, in hysterical paralysis and other forms of hysteria, in the milder forms of diphtheritic paralysis, and in nervous dyspepsia. It must, however, be borne in mind that many persons, with a tendency to neuralgia, nervous asthma, hysterical convulsions, and other forms of hysteria, are unable to stand prolonged residence at the sea, especially at the Riviera. In such cases, mountain climates are generally more advantageous during summer and autumn. In many forms of anæmia, when it does not depend on organic disease of the heart and blood-vessels or other viscera, but on direct loss of blood or its constituents, on confinement, grief, and imperfect food, on slow and imperfect development, sea-air exercises a good effect. Hence the benefit obtained in many cases of amenorrhœa, chlorosis, and allied complaints, if the tendency to constipation is sufficiently combated. Often, however, the demands made by the sea-air on the constitution are too great, and the invalids lose weight; whereas they gain on mountains of moderate elevation.

In chronic pneumonia, in the remains of pleuritic effusion, and in phthisis, the sea-air, by its purity and its more equable temperature, is useful; but as wind is in most cases to be avoided, sheltered localities are essential. Sea-bathing is in this class of cases hazardous. The beneficial effects in whooping-cough, when the first stage is over, are well-known. Regarding asthma, nothing can be said with certainty; some cases of nervous asthma are benefited at the seaside, while a large percentage are aggravated; on the whole, the writer's experience is more in favour of elevated regions than of the seaside. Whenever the effect is not yet known, the recommendation of seaside residence or mountain-air must be regarded as a trial; but in young persons affected with asthma, mountain climates are in general preferable. The advantage to be obtained in tendency to catarrh we have already mentioned.

In addition to the conditions named, there are many which cannot be designated by the name of any disease; but which are only states of weakness, manifesting themselves in various ways, as inability to sustain mental or bodily efforts, tendency to abortions, to leucorrhœa without any disease, &c. In such states of weakness the stimulating effect of the sea-air, combined with the grand aspect of the sea, are found eminently useful.

SEASIDE WATERING-PLACES. — England is remarkably well provided with seaside places, and the different localities offer considerable variety with regard to climate. The east coast, which may be designated as drier and more bracing, is especially to be recommended from the middle of June to the middle of October. The principal places on this coast are, beginning with the north, Berwick-on-Tweed, Tynemouth, Redcar, Saltburn-by-the-Sea, Whitby, Scarborough, Filey, Bridlington, Cromer, Yarmouth, Lowestoft, Aldborough, Felixstowe, Dovercourt, Walton-on-the-Naze, Southend, Margate, Broadstairs, Ramsgate, Deal, and Dover. On the south-eastern and southern coast, which may be regarded as intermediate between the eastern and the south-western coast, we have Folkestone, Sandgate, Hastings with St. Leonards-on-

Sea, Eastbourne, Seaford, Brighton, Worthing, Littlehampton, Bognor, the Isle of Wight, Bournemouth, and the Channel Islands. These places differ considerably with respect to the soil on which they lie; the position—close to the sea or on a cliff; the aspect; and the configuration of the locality itself and the surrounding country. Even different parts of the same place offer different advantages. Thus the lower part of Folkestone, near the lower Sandgate road, is sheltered from the north by the cliff, while the houses on the cliff itself are more or less freely exposed to the winds from all quarters, and therefore preferable during the summer months. Hastings with St. Leonards is remarkably sheltered from the north, north-west, and to some degree from the north-east winds, and is through this, and through the influence of the sea, some degrees warmer during the late autumn and the early winter months—we may say till February—than closely adjacent but less sheltered places. In the Isle of Wight, the Undercliff, with Ventnor and Bonchurch, is sheltered by the hills from north and north-east winds, like Hastings, and more so; and has during winter a more equable and a higher temperature than other parts of the island. The Undercliff is therefore more adapted for climatic treatment during the colder part of the year; while Sandown, Shanklin, Cowes, Ryde, Alum Bay, and Freshwater are more suited for sea-bathing and climatic purposes during the warmer months. Bournemouth is sheltered as well by the configuration of the hills as by the pine-woods, which serve as a protection from violent winds. On the south-western coast, which may be regarded as somewhat moister and more sedative, Swanage, Weymouth, Sidmouth, Budleigh Salterton, Dawlish, Torquay, Teignmouth, Falmouth, Penzance, and Newquay are the principal sea-bathing places, amongst which Torquay may be regarded as the most important winter health-resort. On the North Devon coast we may name Clovelly, Lynmouth, Ilfracombe, Westward Ho, and Minehead; on the Bristol Channel, Weston-super-Mare, Portishead, and Clevedon; on the Welsh coast, Tenby, Aberystwith, Penmaenmawr, Llandudno, Rhyl; and in Lancashire, Westmoreland, and Cumberland, Grange, sheltered by configuration, Southport, Blackpool, Fleetwood, St. Bees, and Silloth. Important by its island climates is the Isle of Man.

Scotland likewise offers abundant localities for sea-bathing, the most frequented of which are Nairn on the east coast, Rothesay in Bute, Ardrossan near the Firth of Clyde, and the Isle of Arran in the west.

Ireland is even richer, with Bray and Kingstown, near Dublin; Duncannon, Tramore, and Dunmore on the south coast; Rostrevor and Portrush farther north; Bundoran in the north-west; Kilkee in the south-west; and Queenstown, a sheltered and warm, but moist, climatic health-resort in the south, where are also Youghal and Ballycotton.

On the north coast of France, Calais, Boulogne, St. Valery, Tréport, Dieppe, Etretat, Fécamp, Havre, Trouville, Deauville, Villers-sur-Mer, and Dinard are the most favourite resorts; on the south-west, Arcachon and Biarritz; and on the south, Marseilles, Hyères, St. Raphael, Cannes, Antibes, and Nice.

The west and south-west coasts of Italy possess many good localities for sea-bathing for those requiring, or at all events bearing, heat, such as Bordighera, Alassio, San Remo, Castellamare, Sorrento, and the islands of Capri and Ischia.

On the coast of Belgium, Holland, and Germany the most important localities are Blankenberghe, Ostend, Scheveningen, Heligoland, Borkum, Norderney, Baltrum, Langeroog, Spikeroog, Wangeroog, Dangast, Cuxhaven, Wyk, and Westerland.

The shores of the Baltic possess likewise many delightful localities, such as Heringsdorf, Putbus on the island of Ruegen, Warnemuende, Travemuende, Doberan; but the sea-baths and the climate are less stimulating than on the shores of the German Ocean.

The coasts of Norway, Sweden, and Denmark offer likewise good opportunities for sea-bathing, combined with bracing sea-air, from July to September.

Hermann Weber.

SEA-SICKNESS.—Synon.: Fr. *Mal de Mer*; Ger. *Seekrankheit*.

Definition.—A peculiar functional disturbance of the nervous system, produced by shock, resulting from the motion of a ship. The most prominent symptoms are a state of general depression, giddiness, vomiting, and derangement of the bowels and of the urinary secretion.

Pathology.—The immediate cause of sea-sickness is referable to the shock, or series of shocks, to the nervous system produced by the motion of a ship. A precisely similar condition may frequently be induced by any forcible motion for which the individual is unprepared, or to which he is unaccustomed, as the motion of a swing. The nervous system is taken unawares, and is unable to adapt the emissions of nerve-force to the unexpected demands made on it. The momentary displacement of the viscera, especially the stomach, the unusual impression on the vision, and the feeling of insecurity, further contribute to the general shock.

The action of the heart and of the arteries is deranged through reflex influence, causing giddiness from anæmia of the brain, and diminished peripheral circulation. The stomach is also affected through reflex action, rendering it intolerant of the presence of any substance, and causing the gastric juice to be actively secreted. The acid secretion acts as a direct irritant to the stomach, and prolongs the sickness. At length *habit* enables the nervous system to adapt itself to the new condition of motion, and to overcome the disturbing influence; shock consequently ceases to be produced; the reflex derangements of the circulation and viscera, giddiness, nausea, and other disorders, are no longer called forth; and convalescence ensues. It is not within the scope of this article to notice the many theories which have been adduced to account for sea-sickness, but most late writers attribute it to reflex nervous disturbance. Some persons are totally insusceptible to the shock producing sea-sickness.

Constipation is probably the result of the want of the gastro-biliary juices and mucus in the bowels, these being vomited; and the diminution of urine may be accounted for, in part at least, by the increased secretion of mucus and saliva.

Anatomical Characters.—The writer has only had the opportunity of taking notes of one necropsy in a case of ordinary sea-sickness, in which the patient died suddenly. The appearances were those of death by simple syncope, there being no organic disease present. The brain, however, was not examined.

Symptoms.—Sea-sickness may be divided into the stages of (1) Depression, (2) Exhaustion, (3) Reaction, and (4) Convalescence.

The early symptoms are sudden giddiness, slight at first, but increasing with the motion of the vessel; and a sense of weight and uneasiness at the epigastrium, speedily followed by nausea and vomiting. At first any food that may have been in the stomach is rejected; and afterwards acid, greenish-yellow, gastro-biliary secretions, often in large quantity, with mucus. Diarrhœa is sometimes present, but constipation is more usually the rule throughout. The flow of saliva is increased, while the urinary secretion is lessened. Appetite is lost, even the sight or smell of food being loathsome. The secretion of milk is frequently arrested in nursing women; in others the menstrual flow is augmented. Sea-sick patients are always worse in the morning. Women suffer more severely than men as a rule, while old people and young children are but slightly affected, or escape altogether. In the majority of cases a favourable *reaction* takes place without further symptoms, the vomiting and nausea cease spontaneously, a ravenous appetite succeeds, and the patient feels well. In other instances great *exhaustion* supervenes rapidly or gradually. The patient feels miserably helpless. He suffers from coldness of the extremities, thirst, headache, and spasmodic pain in the stomach, and complains of numbness of the surface of the body. There is frequently a great tendency to heavy sleepiness; and vomiting of gastro-biliary fluids, sometimes mixed with striæ of blood, takes place whenever they collect in the stomach. A semi-comatose condition, from which the patient is with some difficulty roused, is sometimes met with in very severe cases, and requires assiduous treatment.

In these prolonged cases reaction may assume a febrile character, with a rapid pulse, flushed face, hot skin, and urine containing lithates; and convalescence is slow.

An occasional but rare form of sea-sickness is swooning, but without vomiting or any other symptom. The patient lies motionless and almost deathlike for a variable period. This state is not without danger. Another form is intense frontal headache, neuralgic or anæmic.

Complications and Sequelæ.—Fainting and hysterical attacks are the most common complications of sea-sickness in women. Pregnant women occasionally abort. A weak and irritable condition of the stomach, resembling subacute gastritis, or a state of general debility, may remain for a long time.

Duration.—The ordinary duration of sea-sickness in long voyages is from three to five days, but it may last for weeks.

Prognosis.—This is almost invariably favourable; yet death, although extremely rare, may occur from syncope or from exhaustion.

Treatment.—It may be premised that there is no known means of preventing sea-sickness in susceptible persons. The majority of cases get well spontaneously, but there are many which will require systematic treatment, especially in long voyages. Measures should be taken to counteract the nervous shock, and to sustain the system during its continuance.

Diet before embarking should be light. Fresh air is a powerful element in the treatment, to obtain which the voyager should remain on deck whenever the weather permits, or in a deck-room. The temperature of the body should be maintained by wrapping up in shawls, and hot bottles applied to the feet if necessary. The face may be bathed occasionally with eau-de-Cologne, and the vapour of ammonia inhaled through the nose. In the early stages alkalis are indicated, to counteract the irritant effects of the acid gastro-biliary secretions, together with diffusible stimulants frequently administered. A draught may be given, consisting of bicarbonate of sodium, grs. 10–20, ammoniated tincture of valerian, ♏xv, chloroform, ♏iii–v, dissolved in half a drachm of rectified spirit, mucilage of acacia, ʒjss, and camphor water to ℥j. Such a draught may be given every two hours, or, omitting the mucilage, it may be given in effervescence with citric acid. Chloroform is valuable as a sedative to the stomach, as well as being a general stimulant. Other useful drugs are compound spirit of ether, diluted hydrocyanic acid, and, in prolonged cases, bismuth salts. Iced champagne is often valuable. Ice slowly sucked allays thirst, and relieves vomiting. A full dose of opium sometimes acts like a charm, through the rest which it procures, or morphine may be injected subcutaneously. Hydrate of chloral is also a valuable remedy of this class. Nitrite of amyl and nitro-glycerine have been successfully employed in some instances. Phenazone, acetanilide, and other agents of this class are now much employed in the treatment of sea-sickness. Hydrochlorate of cocaine is also a favourite remedy.

External sedative applications over the stomach do good, such as a liniment composed of equal parts of belladonna, chloroform, and camphor liniments; and a binder rolled firmly round the body is useful. When the patient is in his berth he should lie on his back, with his head low, as immovable as possible. Notwithstanding the vomiting, food should be pressed on the patient; and, lest exhaustion occur, light semi-fluid food is the best, such as arrowroot, given frequently in small quantities. Afterwards toasted bread, with beef-tea or chicken-broth, and, when these are borne, boiled fowl, pickled meats, or corned meat with pickles, may be tried. Acids at this stage aid digestion, which has become weakened through the vomiting of so much gastric juice and bile. Beer and alcoholic drinks should be avoided in the earlier stages; but at a later period, claret, champagne, brandy, or stout may be allowed with benefit. Diarrhœa and other symptoms should be treated on general principles. For short voyages, the best that can be done is to remain on deck when possible, avoid alcoholic drinks, and follow the general directions above given. The application of ice along the spine is occasionally successful in arresting the vomiting. Isaiah de Zouche.

SEA-VOYAGES. — Sea-voyages have from remote antiquity formed a mode of treatment in chronic diseases, especially of the respiratory organs, and have more lately been much recommended in the treatment of consumption and scrofulous affections; but the different influences to which the invalid is exposed on long sea-voyages are but little appreciated in their details by the majority of the public, or by medical men.

The essential advantages which are generally ascribed to sea-voyages are the enjoyment of perfectly pure sea-air, abundance of light, and free exposure to the sea-breezes; absence, or at all events great limitation, of bodily exertion; and the probability of psychical repose. The uninitiated frequently regard these advantages as more or less fixed and, so to say, measurable qualities, and speak of sea-voyages in the same way as of sea-bathing, cold-water treatment, mineral-water cures, or mountain climates. The advantages of sea-voyages are, however, by no means fixed qualities, and they are often mixed up with unfavourable influences, such as bad weather, sea-sickness, improper food, &c. In everyday life it is an acknowledged fact, and not less so in all climatic cures, that the house in which the invalid lives exercises a most powerful influence on his chance of regaining and maintaining his health; and that the house alone often mars the effect of the best-adapted climatic change. In the same way the floating house, the ship, with its arrangements, forms one of the most important elements in the compound agent 'sea-voyage.' The arrangements of ships, however, are notoriously often very imperfect, and the narrow cabin never stands comparison with a good bedroom, the only counterbalance to this drawback often being that the invalid is forced to be the whole day long on deck, that is, in the open air, in order to escape from the confined state of the cabin. By this circumstance alone, however, the majority of the more serious cases ought to be excluded from sea-voyages in ordinary ships, as they cannot be easily moved from the cabins to the deck, and *vice versâ*. The hygienic conditions of the ship, the space allotted to each passenger, the ventilation of the rooms, the arrangement of the decks, must in every case be a matter of careful inquiry; but it would require too much space to enter into the details in this place. There are iron and wooden ships, steamers and sailing vessels. The iron ships have the advantage of being easily kept clean and free from smells, but they are apt to become very hot under the influence of the tropical sun. The sailing vessels can be kept more free from smoke and dust; but they are dependent on wind, and if they meet in the tropics with perfect calms (doldrums), the passengers may have to endure intolerable heat for several days and possibly weeks. The combination, therefore, of sailing power for ordinary conditions, with steam to be used only in case of need, would appear to possess the preference for ships to be used for therapeutic purposes (invalid ships).

A second point of paramount importance for every delicate person is the food, and in this respect again the ship-life on long voyages is less advantageous than the life in well-supplied health-resorts or at home. Although the food on first-rate ships is now much improved, compared with former times, yet it is impossible to offer the same variety, or the same delicate cooking, as in first-class hotels or private establishments. A certain amount of monotony in food is scarcely to be avoided, and invalids with a delicate appetite ought therefore not to attempt long sea-voyages, excepting under very favourable circumstances, as, for instance, on large private yachts provided with good cooks.

Sea-sickness, or rather the degree of liability to sea-sickness, depends on peculiarities of constitution, which are only to be recognised by exposure to the influences of the open sea in different states of agitation. *See* SEA-SICKNESS.

We have given, in the article on SEA-AIR, the prominent qualities of sea-climates; but the most cursory consideration of the climatic conditions to be encountered in a long sea-voyage shows that there must be great differences between the physiological and therapeutical influences of sea-climates in latitude 50° and in latitudes 15° and 5°. The air in the tropical regions has a much higher temperature, and a larger amount of absolute moisture; the atmospheric movement is, as a rule, though by no means always, slighter; the barometric pressure is somewhat less in the tropics than in the temperate zones; and the daily and annual variations of atmospheric pressure are greater in the former than in the latter. There is also a difference between the same degrees of latitude on the north and south of the equator, the temperature in the southern hemisphere, for instance, being somewhat lower than in the northern; but these differences are comparatively small. The effects on the constitution of the climatic conditions of sea-life in different latitudes are very complicated. We will here only point to a few facts, namely, that in some delicate constitutions the functions of life are performed more easily under the influence of greater heat; that many delicate persons can eat and digest better, are able to take more exercise, sleep better, and that their mental functions are more active under the same circumstances; but that in the majority of average persons continued great heat produces lassitude, a tendency to diarrhœa and other digestive derangements, and imperfect sleep. Further, that in most individuals the bodily temperature rises above the natural heat (in general about ½° F., and in some persons as much as 2° and 3° F.); and that pulmonary hæmorrhage occurs more frequently under high than under ordinary degrees of heat. Morbid states accompanied with pyrexia and with a tendency to pulmonary hæmorrhage ought therefore not to be exposed to tropical heat.

The climatic conditions to be met with in different voyages through the same regions vary at different seasons, but they vary still more in voyages through different seas, especially according to the longitude and latitude. Our knowledge of different sea-climates, that is, of the different climatic conditions in different parts of the ocean, is as yet not perfect. Dr. Faber (in a communication 'On the Influence of Sea-voyages on the Human Body,' *Practitioner*, March 1876) shows that the equability of sea-climates is by no means so complete as is generally assumed; and that great changes in temperature and atmospheric movements occur not rarely on successive days, and even on the same day.

THERAPEUTICAL USES.—The opinions of different writers on the therapeutic value of sea-voyages in the treatment of disease vary considerably. In the last century Gilchrist revived the practice of sea-voyages, and strongly recommended them in cases of phthisis. In more recent times Jules Rochard, the well known French climatologist, has collected a large body of evidence from the French Navy to dispel the faith in sea-voyages; but we must bear in mind that the hygienic conditions in which the sailors used to live were not perfect, and are no doubt inferior to those of well-arranged private ships of the present day. Dr. Walshe, on the other hand, was in favour of well-planned voyages; and Dr. C. T. Williams and the writer have likewise obtained fair results in well-selected cases. The majority of physicians entirely, or almost entirely, confine themselves to diseases of the respiratory organs in recommending sea-voyages; but their therapeutic field is no doubt much larger, and the result is probably more generally favourable, in some other complaints.

1. *Phthisis.*—The writer has had the opportunity of witnessing the effects of sea-voyages, of two to seven months' duration, in sixty-two cases of phthisis in the first or the beginning of the second stage. Of these sixty-two cases thirty-eight benefited considerably, twelve remained stationary, twelve became worse. The voyages were all either to the Cape of Good Hope and back, or to Australia and New Zealand and back, between the months of September and May. Of the twelve bad results, seven occurred in patients who went to Australia and India and back, with scarcely any rest on land; they seemed to have gained in the first part of the journey, but more than lost the gain in the latter part, apparently from dislike of food, from the monotony of the life, and from exhaustion. Out of twenty-six cases in the first stage twenty were more or less improved, three remained stationary, three lost ground. In eighteen cases of phthisis in the second stage, the result of sea-voyages was favourable only in eight, indifferent in five, bad in five cases. In seven cases in the third stage, the result was bad in three, indifferent in three, favourable in one. The writer has also notes of eleven cases of phthisis in the first and the beginning of the second stage, where long summer voyages (namely, from three to five months) with whalers to the northern seas were tried, the result being favourable in nine cases, indifferent in one, and unfavour-

able in one, apparently through inability to bear the want of variety in food.

2. *Laryngeal and bronchial catarrh and asthma.*—In simple chronic catarrh of the larynx, sea-voyages, or cruising in yachts from this country to the Mediterranean, to the Azores and Madeira, had very good results in twenty cases out of twenty-four. Satisfactory was also the effect of a similar plan in eleven cases of chronic bronchial catarrh. In a tendency to bronchitis from pulmonary emphysema the benefit was likewise evident in ten cases out of twelve; but here the effect was, from the nature of the circumstances, less permanent. Of eight cases of asthma, two cases of a bronchitic kind were benefited; two of a nervous character aggravated; and four were neither better nor worse. Eight cases of hay-asthma were, while on the high seas, quite free, but those who returned while the complaint was still in season, were immediately attacked.

3. *Scrofula.* In fifteen cases of scrofulous affections (caries of bones, affections of joints, glandular swellings and ulcerations) one or several long sea-voyages were tried; in eleven of them the effect was quite satisfactory, in four less decided.

4. *Vesical disease.*—In three cases of irritable bladder sea-voyages on yachts in warm climates have likewise proved useful.

5. *Cardiac disease.*—Decidedly injurious was the effect of sea-voyages in five cases of dilatation of the heart, combined with chronic bronchitis. In two cases of enlargement of the liver, connected with weakness of the heart, the result was likewise unsatisfactory.

6. *Skin-disease.*—Chronic eczema was, in five cases out of six, aggravated by sea-voyages.

7. *Nervous disorders.*—In four out of six cases of mental irritability, long sea-voyages, especially in yachts, had favourable results; in the fifth the mental condition was aggravated; in the sixth great improvement of the mental state was obtained, but this was accompanied by considerable exhaustion, from inability to take a sufficient amount of food. Of four cases of melancholia, two were apparently cured, the third remained uninfluenced, and one committed suicide by jumping overboard. In four cases of tabes dorsalis, in the earlier stage, cruising in comfortable yachts in the Mediterranean, with occasional landing, during the autumn, winter, and spring months, has been very beneficial; in two of these the disease has apparently been arrested, by persevering with this course during fifteen and sixteen years.

8. *Dipsomania.*—Finally, the writer has tried long sea-voyages in yachts in five cases of dipsomania, stimulants having been entirely excluded from the dietary. In one of these cases the result appears to be permanently good; in the four others it was good for the time with regard to the state of the body as well as of the mind, but there were relapses, which in two of the cases have led to several repetitions of the trial, each time apparently with more lasting, but as yet no permanent, result. Well-arranged sea-voyages deserve, therefore, at all events, a place in the management of this most terrible affection.

CONCLUSIONS.—From a comparison of these experiences with those of other observers, the writer is inclined to infer that, under favourable circumstances, sea-voyages of not too long duration may be rendered beneficial in the early stages of phthisis. The voyage to Australia and New Zealand and back, after a stay of a few months in these climates (Hobart's Town, in Tasmania, for instance), specially recommends itself. The invalids referred to left in the second half of September, or in October or November, and returned in May or June. In this way the more unfavourable seasons of England are avoided, and instead of the short and sunless days, long and bright ones are obtained. To go to Australia and to return immediately has proved exhausting in several instances. Another good plan is to go to the Cape of Good Hope, and ascend in easy stages, by diligence and bullock-carts, to the higher regions (Bloemfontein, for instance), and to return after a stay of three or four months or more. This plan, however, is rather expensive; and it requires a considerable amount of bodily strength, and the inclination to stand a certain amount of roughing with regard to accommodation and food.

The voyage to the northern seas requires a peculiar mental disposition, and would, under the present conditions, be resorted to only under exceptional circumstances; but it has been very beneficial in the nine cases of early phthisis mentioned—all of them possessing a satisfactory fund of strength, combined with love of sea-life and a good digestion.

The combination of yachting in the Mediterranean, and residence at one or several of the health-resorts of those regions, or with a visit to Upper Egypt, has repeatedly proved successful in cases under the observation of the writer, not only in pulmonary invalids, but also in cases of mental irritability, exhaustion, chronic rheumatism, chronic glycosuria, and gout. This plan, however, is somewhat expensive.

In hay-asthma, sea-voyages during the season of the complaint are to be recommended; but in other forms of asthma the result is uncertain, and the advice should not be given without consideration of all the circumstances. In most cases of younger persons alpine climates deserve to be preferred to sea-voyages.

In some forms of mental irritability, overwork, anxiety about business, and in the earlier stages of locomotor ataxy, sea-voyages, and especially yachting, in the subtropical regions, offer many advantages, particularly during the colder and damper seasons of our climate, as it allows of the combination of the enjoyment of sun, light, and pure air with rest of body and mental repose. In slighter forms of mental irritability or overwork, shorter voyages are often sufficient, and even preferable; and the voyages to Madeira, to the West Indies, or to Brazil and the River Plate, may thus be recommended during the colder season.

Dipsomania and other morbid passions may be treated with great advantage by sea-voyages and yachting, provided that stimulants and the other injurious influences which the weak person is unable to resist can thus be entirely removed.

The time is coming when we shall have *therapeutic ships*, specially arranged for different classes of invalids. It would, for instance, not be wise to mix those suffering from dipsomania with sick persons to whom a moderate amount of stimulants is useful.

Circumstances counter-indicating Sea-voyages.—The circumstances which render it necessary to avoid sea-voyages are:—

1. Unconquerable sea-sickness.
2. Great temporary or permanent weakness and exhaustion.
3. Permanent delicacy of appetite, with inability to become accustomed to a certain monotony of food, or to a certain coarseness in the preparation of food.
4. Inability to bear the glare of the sea, as it occurs in tendency to glaucoma.
5. Persistent sleeplessness while at sea.
6. Dilatation and weakness of the fibres of the heart, with or without valvular disease.
7. Enlargement of the liver, especially when caused by dilatation of the right ventricle.
8. Advanced stages of consumption, unless the affection be quite stationary.
9. Morbid conditions with a tendency to pyrexia.
10. A tendency to hæmorrhage.

It is the influence of great heat that ought to be avoided by the two classes of cases last mentioned. A voyage through tropical seas, especially in sailing ships, might prove dangerous in such subjects, from the possibility of being becalmed.

11. A tendency to epilepsy or maniacal fits. This ought specially to contra-indicate sea-voyages to tropical climates.

For further information regarding sea-voyages, reference may be made to *The Ocean as a Health-resort*, 1880, by Mr. William S. Wilson.

Hermann Weber.

SEAT-WORM.—A synonym for thread-worm. *See* Entozoa.

SEBACEOUS FOLLICLES, Diseases of. — Synon.: Fr. *Maladies des Follicules Sébacés*; Ger. *Krankheiten der Talgdrüsen.*

The sebaceous follicles of the skin are subject to disease depending both upon internal and external causes. Those follicles which are attached to hairs, and those which are isolated, show little difference in this respect.

Enlargement or *hypertrophy* of the follicles is often seen, and appears to arise chiefly from internal causes, occurring either at a particular stage of development, or from some general alteration of nutrition, such as follows a particular diet or excess of particular kinds of food. This form constitutes *acne punctata*, a disease in which the affected portion of skin appears covered with black spots; these being the openings of the enlarged sebaceous follicles, choked with plugs of sebaceous matter, the outer ends of which become blackened. The plugs or *comedones*, when examined, are found to consist of solid fatty matter (sebaceous secretion), closely packed epithelial scales, and imperfectly formed hairs. The parasite *Demodex folliculorum* is often present, but does not appear to exercise any influence on the disease. Acne punctata occurs in those parts of the body where there are numerous rudiments of hairs, and where hairs grow commonly, though not uniformly, in the male sex. Hence it is confined to the face, neck, and upper part of the back and chest, and usually begins at that period of life, puberty, when these rudimentary hairs normally undergo development.

When *inflammation* is set up in hypertrophied follicles suppuration follows, and we have *acne suppurativa.*

The condition called *lichen pilaris* is substantially the same as hypertrophic acne, being produced by overgrowth of cells in the sheath of the hair and the sebaceous follicle. *See* Acne.

J. F. Payne.

SEBORRHŒA (*sebum*, fat; and ῥέω, I flow).—An ungrammatical synonym for stearrhœa. *See* Stearrhœa.

SECONDARY (*secundus*, the second).—In contradistinction to *primary*, the word 'secondary' is used with the following significations. Ætiologically it implies that a disease is not local in its causation and origin, but is manifested as a *secondary* lesion—either as the result of some general or constitutional condition, or of an affection which has previously involved some other structure or organ, it may be in a remote part of the body. It also signifies the later manifestations of a disease, as distinguished from those which occur at an early period, as in the case of *secondary syphilis* or *secondary cancer.*

The term is, moreover, applied to symptoms, when they are more or less remote from the seat of mischief, or are only indirectly set up by the disease with which they are associated.

FREDERICK T. ROBERTS.

SECRETIONS AND EXCRETIONS, Disorders of.—Although the derangements affecting the chief secretions and excretions of the human body are considered separately in other parts of this work, it may serve a useful purpose to deal with them from a general standpoint, as there are several facts which apply to the entire group. Those which have principally to be borne in mind are the secretions poured into the alimentary canal—namely, the saliva, gastric juice, bile, pancreatic juice, and intestinal secretion; the milk; the urine; and the sweat. Of secondary importance, from a clinical point of view, are the various mucous secretions, the tears, and the semen; the serous secretions have also to be remembered. It is assumed that the physiological distinction between a secretion and an excretion is understood.

VARIETIES OF DISORDER.—1. Secretions and excretions are very liable to *changes in quantity.* A definite amount of each of these should be formed during the twenty-four hours, varying within recognised limits, and influenced by certain physiological conditions. The quantity produced, however, often deviates from the healthy standard, in the direction either of (*a*) *excess*, or (*b*) *deficiency.* In the former case, the amount of the secretion is often far above the normal, or beyond what is needful for its intended purposes; in the latter case various degrees of deficiency occur, culminating in an absolute suppression of a particular secretion or excretion.

2. *Changes in quality* are also frequently noticed, and these may be associated with changes in quantity, or they may exist alone. The qualitative changes include the absence or deficiency of one or more of the normal chemical ingredients of the fluid; excess of either of these ingredients; absence, deficiency, or imperfection of formed organic elements, as in the case of the semen; or the presence of adventitious and abnormal ingredients. It may also be mentioned here that the quality of secretions is often modified by admixture with excess of mucus, or with morbid products.

3. Another disorder affecting certain secretions and excretions is *interference with their escape* by the normal channels, so that they are retained. This applies particularly to those which have one or more special ducts for their exit, liable to be obstructed in various ways. The escape of the bile, pancreatic juice, urine, parotid secretion, milk, and other fluids may be thus prevented.

4. Allied to the deviation just noticed is that in which a secretion *flows in some abnormal direction.* As illustrations may be mentioned salivary fistula, in which the parotid secretion escapes through an opening on the outside of the cheek; external biliary fistula, or the opening of the gall-bladder in various other directions; vesico-vaginal or vesico-rectal fistula, where the urine passes from the bladder into the vagina and rectum respectively; and closure of the lacrymal duct, so that the tears flow over the cheeks. In this connexion allusion may also be made to those cases in which a reservoir of some secretion ruptures, and thus its contents escape. For instance, the gall-bladder may give way, or the urinary bladder, the bile or urine consequently escaping into the peritoneum.

ÆTIOLOGY.—The causes which produce one or other of the disorders of secretion just indicated are as follows: (1) Alterations in quantity and quality are often immediately induced by nervous disturbance. The influence of the nervous system upon the function of secretion is well known, and it may be centric in origin, as in the case of strong emotion: direct, when the nerve influencing a particular secretion is irritated, compressed, or otherwise disturbed; or reflex, due to some remote irritation affecting such a nerve. The effect of neuralgia upon the secretion of the tears, saliva, and perspiration is often very striking. (2) Similar disorders frequently depend upon derangements affecting the local circulation in the secreting gland. This is well exemplified in the case of the urine, which is abundant and watery as the result of active congestion of the kidneys; deficient, concentrated, and otherwise abnormal when these organs are the seat of venous congestion. The bile is also considerably modified in quantity and quality by congestion of the liver. (3) General conditions of the system materially affect secretions, from various causes, such as pyrexia, plethora or anæmia, shock or collapse, and the typhoid condition. Moreover, they may be disordered in connexion with diseases which produce marked effects upon the general system, such as phthisis. (4) Functional derangement of the glandular structures which form different secretions are very common, and may be due to many causes. Amongst others may be mentioned a want of adequate and proper stimulation; excessive or too frequent stimulation; injurious habits which affect certain secretions; and want of tone or imperfect nutrition of secreting tissues. Such causes frequently operate injuriously in relation to the secretions poured into the alimentary canal. The sweat is affected by neglecting cleanliness of the skin. (5) Organic diseases of the glandular structures necessarily modify secretions more or less, either temporarily from acute disease, or permanently from some chronic mischief, which may ultimately entirely check a secretion. These diseases are of different kinds, and cannot be specially indicated here, but they all tend to alter or destroy the secreting structures. (6) The secretions generally may be affected by certain abnormal elements which accumulate in the blood. Under such circumstances, however, some excretions become the special channels for the elimination of these elements, and thus are liable to be seriously deranged. Thus in diabetes mellitus, whatever its pathology may be, the accumulation of sugar in the system leads to the characteristic changes in the urine observed in this disease, while at the same time the cutaneous excretion is diminished. It may further be remarked here that, if the elements which ought to be removed by a certain excretion are not thus eliminated, they may find their way by other channels, and thus modify the quality of other fluids. This is exemplified by the elimination of urea in other directions when it is not excreted by the kidneys. (7) A secretion may be properly formed, but it is in many cases subsequently modified by admixture with morbid products derived from surfaces with which it has to come in contact, such as excess of or unhealthy mucus, or pus. Also, in the case of the alimentary canal, the habit of taking large quantities of water or other fluids may so dilute the digestive secretions as to make them unfit to perform their functions properly. (8) With regard to the causes which impede the escape of secretions, these are either of a mechanical nature, the duct being obstructed by something lodging in it, such as a calculus or plug of mucus, or being pressed upon from the outside; or due to organic disease, narrowing or closing the channel or its orifice; or possibly occasionally to muscular spasm or to paralysis of the duct. Such conditions may be temporary or permanent. The discharge of secretions in abnormal directions is the result of organic lesions, either congenital or acquired, as the result of which the unusual channels and communications are formed.

Effects and Symptoms. — Disorders affecting secretions and excretions are often directly accountable for a variety of symptoms, as well as for certain definite morbid conditions, and these effects are usually readily explained.

1. With reference to their *quantity*, secretions and excretions must be regarded as mere liquids of a particular kind, and symptoms may therefore simply depend upon their amount. For instance, deficiency or excess of saliva and buccal mucus will cause respectively dryness of the mouth, or a more or less profuse overflow; an undue abundance of gastric juice may account for acidity and acid eructations; the quantity of the secretions in the alimentary canal often aids in the causation of diarrhœa or constipation; and variations in the amount of the cutaneous excretion are evidenced either by free sweating or by dryness of the skin.

2. Certain *actions* are frequently influenced by disorders of secretion. Mere alterations in quantity may affect these actions. Thus, profuse salivation causes frequent spitting or swallowing; abundant secretion in the air-passages excites coughing and expectoration; excess of fluid in the stomach and intestine may cause vomiting or purging respectively; a free secretion of urine renders micturition more frequent. But, apart from the quantity, the quality of a secretion may further influence these actions. Of this we have a striking illustration in diabetic urine, which is in itself irritating, and often excites the bladder to empty itself. The bile is another example, for undoubtedly, in the writer's opinion, this fluid has an irritating effect upon the intestine, and may also increase the secretions of this canal, so that in these ways excess of bile may be a cause of diarrhœa, while its deficiency is an important factor in many cases of constipation, owing to the want of its stimulating action upon the intestinal wall.

3. Each secretion, as distinguished from an excretion, has certain definite *functions* to fulfil, and a number of symptoms may be due to the fact that a particular secretion fails to perform these functions. This may arise from the fact that it is suppressed or deficient in quantity; abnormal in quality, and therefore inadequate for its work; or for some reason or other does not reach the place in which this work is carried on, as when a duct is obstructed, or a fistula allows the escape of a secretion, so that it is lost. Symptoms arising from this cause are mainly observed in connexion with the alimentary canal, and they are of extremely common occurrence, as well as of diverse character. Many of the symptoms in dyspeptic cases are to be thus explained, and a knowledge of the physiological uses of the different digestive secretions will indicate the derangements to be anticipated when one or other of them is unequal to its work. It must be remembered not only that these secretions are concerned directly in digesting the different elements of food, but that some of them also prevent fermentation and decomposition, and their imperfect action in these respects may originate important symptoms. Under this heading the lacteal secretion may be alluded to. Deficiency in its quantity, or imperfection in its quality, often renders it unfit for its intended purpose, that is, the proper nourishment of the infant who is supposed to live upon the maternal milk.

4. If certain secretions or excretions are

seriously checked or altogether suppressed, or if they are retained in the body, so that they become subsequently absorbed, obvious effects on the *general system* are produced, which may be of a very serious character. Thus, in the case of the bile, jaundice and its accompanying phenomena are evident; in connexion with the urine we may have dropsy or uræmic symptoms. Impaired cutaneous excretion also produces effects upon the system, although these are not so characteristic.

5. What may be regarded as the *secondary effects* of disorders connected with secretions must also not be forgotten. If their escape be prevented, they are liable mechanically to produce more or less important lesions. Thus they often lead to distension of hollow organs, such as the bladder or gall-bladder. Moreover, they may at the same time excite irritation and inflammation, especially if, as in the case of the urine, decomposition, with the formation of irritating products, is likely to take place. By these combined effects, important organs may ultimately be completely disorganised, such as the kidney or liver. Retention of milk in the mammary glands is one important cause of inflammation and abscess in these organs. When certain secretions or excretions find their way into abnormal situations, they may also originate serious conditions. Thus, if urine or bile escape into the peritoneum, acute peritonitis will be set up.

TREATMENT.—Without entering into any details, it will suffice to indicate in this article the principles upon which disorders of the secretions and excretions are to be treated. (1) Any obvious cause of such disorders must be rectified or got rid of at the outset, if practicable, as, for instance, injurious habits, neuralgia, and many other causes. (2) When secretions are abnormal in their formation, either as regards quantity or quality, means are often within reach for correcting these errors. This result may not uncommonly be effected by acting upon the general system, by means of tonics or other suitable agents, and thus indirectly influencing secretion; but there are also special therapeutic agents employed for their immediate effects upon particular secretions or excretions, such as the gastric juice, the bile, the urine, and the sweat. With regard to quantity, remedies are used to diminish this when excessive, as well as to increase it when deficient. It may be mentioned here that measures for augmenting certain secretions, and especially excretions, are often resorted to for other therapeutic purposes, when they are not in any way abnormal, as in the case of the sweat and urine. Care must be taken not to carry stimulation of secretions too far, otherwise in the long run it is liable to do far more harm than good. This applies particularly to those cases where there is organic mischief affecting the glandular structures, and interfering with their formation. Secretions and excretions are often materially influenced in quantity and quality by acting upon the circulation in the organs which form them, either directly or indirectly. (3) It may be practicable to treat some disease which originates a disordered secretion, and thus to influence it. This may be illustrated by diabetes mellitus, and by diseases of some particular organ whose secretion is affected. In this way marked beneficial effects are sometimes produced. (4) When certain secretions are wanting or deficient, especially the gastric juice and bile, their place may be supplied by administering the essential and active elements of these secretions, or by making them artificially. The pancreas itself, as well as the active principle of the pancreatic secretion, are also now frequently given in different forms. Thus the want or deficiency of these fluids in the digestive process may often be entirely made up for. An important use of some of these substitutes for secretions is that introduced by Sir William Roberts, by which the food is artificially digested in different degrees before it is taken by the patient. (5) The symptoms which disorders of secretions give rise to often need special treatment, whether they be of a local or general character—for instance, constipation, diarrhœa, flatulence, jaundice, uræmia, and other phenomena. (6) In many cases attention has to be directed to the prevention of an accumulation of a secretion or excretion, or to its removal if it should have collected. This may be illustrated by retention of the milk in the mammary gland; and of the urine in the bladder. The effects of any such accumulation also need to be recognised in treatment, such as dilatation of an organ, inflammation, or rupture. (7) Operative procedures may be required in some cases, either to remove an accumulation which cannot otherwise be got rid of, or to cause a secretion to pass along its proper channel, in those cases where there is an abnormal communication or fistula, or a closed passage, such as an obstructed lacrymal duct.

It must be remembered that there are many disorders of secretions and excretions which are merely temporary, and which need no treatment whatever.

Disorders of the so-called 'internal' secretions—for example, of the secretion of the thyroid gland—appear to be associated with deterioration of the general nutrition. *See* SENILITY. FREDERICK T. ROBERTS.

SEDATIVES (*sedo*, I ease or assuage).—SYNON.: Fr. *Sédatifs*; Ger. *Beruhigende Mittel*.

DEFINITION. Therapeutic measures which exert a soothing action upon the system, by diminishing pain, lessening functional activity, or tranquillising disordered muscular movement.

Sedatives may be divided into the following groups:—

1. **General Sedatives.**—Constitutional sedatives, like stimulants, widely overlap other therapeutic divisions. The type of all soothing action assuredly must be a full narcotic, an anæsthetic vapour, or a subcutaneous injection of morphine, either of which renders the sufferer temporarily oblivious to any excruciating agony, such as that of biliary or renal colic. In fact, general sedatives must be looked for exclusively in the narcotic and anæsthetic class; and if the constant consumption of vital energy by disease be not compensated by sleep, we prescribe opium, chloral hydrate, hyoscyamus, and similar remedies.

2. **Local Sedatives.**—Under this heading we must place extreme cold, which, applied either in the form of ice, or more effectually by the ether spray, deadens the sensibility of the skin, and prevents the prick or cut of an operation from being felt. Next come aconite, opium, cocaine, belladonna, veratrine, and blisters, which soothe by a direct action on the sensory nerves, or by influencing the circulation of the parts around. These are useful in neuralgic or rheumatic pain, or in the acute suffering of superficial inflammatory conditions. Again, some substances may be regarded as sedatives, in virtue of their power in allaying the excessive itching of prurigo and other chronic skin-affections. Diluted hydrocyanic acid, carbolic acid, chloroform, borax, and chloral hydrate are among the best remedies for this purpose.

3. **Pulmonary Sedatives.**—Pulmonary sedatives are also deserving of mention; and, passing by emetics and nauseants, which undoubtedly depress the breathing power, we find that veratrine, Calabar bean, diluted hydrocyanic acid, and several other drugs, directly tend to paralyse the respiratory centre, on which action the greater part of their poisonous influence seems to depend.

4. **Spinal Sedatives.**—Spinal sedatives have precisely an opposite effect to spinal stimulants; and it has been amply proved that Calabar bean, bromide of potassium, and methyl-conine powerfully lower reflex excitability through the cord and the great ganglia of the brain.

5. **Gastric Sedatives.**—Irritable conditions of the mucous membrane of the stomach, giving rise to pain, vomiting, pyrosis, and other symptoms, are commonly met with, and require a considerable variety of treatment. If gastrodynia fails to yield to bismuth, soda, or diluted hydrocyanic acid, recourse may be had to small doses of nitrate of silver or of arsenic; or blistering over the epigastrium may produce the desired effect. If vomiting be the prevailing symptom, diluted hydrocyanic acid again proves useful, carbonic acid in the form of effervescing draughts, or minute and oft-repeated doses of nux vomica or ipecacuanha. Combined with this, we must take especial care to enjoin a mild and unstimulating dietary, of which milk and lime-water should form the principal ingredients.

6. **Cardiac and Vascular Sedatives.** This group have the power of lowering the heart's action. Emetics and tobacco do this by the general depression following nausea and the act of vomiting. Other drugs, however, act directly on the heart itself, either by paralysing the muscular tissue of which its walls are composed, or by a more special influence over its nerve-supply. Slowing of its action may be effected either by stimulation of the inhibitory branches of the vagus, or by interference with the sympathetic ganglia which work in the opposite direction; and experiment has not in all cases made it quite clear which is the true explanation. But whatever the exact physiological explanation may be, we have some practical rules for our guidance in the use of these remedies, especially of digitalis and strophanthus, which, cardiac tonics though they be, are also true sedatives to that organ. When the heart-muscle is weak and languid, its contractions are less efficient than in health; and in order to perform its allotted amount of routine work in propelling the blood, its cavities must fill and empty more rapidly than usual. The result of this is seen in the hurried, feeble, and often irregular pulsations of the organ; and digitalis, by bracing up the muscular fibres, and giving increased tone renders its action more efficient, and enables it to take more prolonged periods of repose. Other cardiac sedatives are aconite, veratrum viride, colchicum, and diluted hydrocyanic acid, but they are seldom used for this purpose, although aconite, whether through its action on the heart or on the small vessels, is very effective in early inflammatory conditions.

R. Farquharson.

SELTERS, in Germany.—Muriated alkaline table-water. *See* Mineral Waters.

SEMILUNAR VALVES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of.

SEMIOLOGY (σημεῖον, a symptom; and λόγος, a discourse).—A synonym for symptomatology, or the doctrine of the signs and symptoms of disease. *See* Disease, Symptoms and Signs of.

SENILE INSANITY.—*See* Dementia.

SENILITY (*senex*, an old man. Synon.: Senile Marasmus; Fr. *Vieillesse*; Ger. *Greisenalter*.

Definition.—That condition of body which usually supervenes naturally after the seventieth year, but sometimes occurs prematurely.

Senility is separated from the previous period of maturity by the climacteric stage, which in men occurs between the ages of fifty and sixty, and in women about ten years earlier. When of premature occurrence this state is commonly hereditary, or secondary to some exhausting illness, where failure of the trophic influence of the nervous system has been marked. All the signs and symptoms of senility have been seen in individuals under twenty years old.

We do not know why the body, after it has reached a state of maturity and vigour, should gradually decline; why, when once an even balance between tissue-waste and restitution is established, it is not maintained indefinitely. How far the failure is due to some inherent tendency, and how far to external influences, is wholly conjectural. Among the most recent hypotheses is one based upon the theory that the various glands, secreting and ductless—and also perhaps some of the tissues—exert some material influence upon the blood, and through it upon the tissues generally, whereby the normal metabolism of healthy activity is maintained; and, conversely, as this influence —effected, as is supposed, through some 'internal secretion,' *i.e.* a secretion which is retained in the organism and is not excreted—fails, so does the general nutrition deteriorate. The treatment of myxœdema by extract of thyroid gland is based upon this theory, and according to Dr. Brown-Séquard the weakness and characteristic phenomena of old age are due to 'a natural series of organic changes and the gradually diminishing action of the spermatic glands and ovaries.' To refer the senile state to an impairment of the trophic influence exerted by the nervous system, or to a diminution in the water contained in the protoplasmic elements of the tissues, or to any other such cause, however true each and all may be so far as they go, only places the difficulty a step farther back, and does not remove it.

Anatomical Characters.—Recent observations, especially those of Sir George Humphry, have shown that many of the morbid conditions which are usually regarded as essential features of advanced life are really manifestations of disease occurring at this period, and do not of necessity pertain to senility, which may supervene and progress to death undisturbed by any actual disease —in short, an old age that is healthy just as any other period of life may be. The term 'involution' has been suggested to express the normal senile changes in the tissues and organs, of which a progressive *atrophy*—a simple diminution of material—is the most universal and characteristic. The degree of wasting varies, but there is a general diminution in body-weight and height, except in persons whose climacteric has been marked by an increase of the adipose tissue, when the total loss of weight may be inconsiderable. Among the organs which exhibit simple atrophy in the highest degree are the brain and spinal cord, the shrinking of the former with increase of the subarachnoid fluid being sometimes very considerable; the generative organs, especially the ovaries, and to a less extent the testes, the uterus, and the mammary glands; the mucous membrane and glands of the digestive tract; the bronchial and vesical mucous membranes; the spleen and lymphatic glands, the latter even to complete disappearance; and the kidneys. A most important change, and one that exerts a very direct influence on tissue-nutrition, is an extensive shrinking or even obliteration of the capillaries in almost all the textures. The skin becomes much diminished in thickness, especially in the papillary layer, the constituent papillæ being very indistinct; and loss of hair and change of colour are well-known features. The senile changes in the skeleton are of peculiar interest. The bones, which in the earliest stages of formation are solid, become, as development proceeds, hollowed internally, by the formation of cancellous tissue and, in the long bones, of the medullary canals. As the absorption of the central part proceeds, the bones nevertheless increase in weight and bulk until maturity is reached, by subperiosteal ossification; but in the decline of life, as this process takes place scarcely at all, and the atrophy continues, the bones, whilst retaining their general size and form, become much thinner, lighter, and weaker. The change takes place especially in the cancellar parts, which are most vascular, and where the agents for absorption are most active—hence the special weakness of the ends of the long bones, and their liability to fracture. The alveolar parts of the upper and lower jaw-bones, consisting as they do chiefly of this loose spongy tissue, are characteristically wanting in the aged; and since these parts carry the teeth, this atrophy of the bone leads to their falling out. The lower jaw is one of the few bones in which an alteration in shape takes place, the ramus and body coming to be more nearly in a straight line, with proportionate widening of the angle. The bone thus resembles the shape it has in the infant, with the difference that it then consists mainly of the alveolar part, whilst in old age it is the denser basal or sub-alveolar part that alone remains. The altered shape of the mandible has been attributed to the loss of teeth causing a deviation in the line of action of the masticating muscles. Sir George Humphry finds no confirmation of the commonly accepted statement that the angle between the neck and shaft of the femur becomes smaller with age. The same observer has drawn attention to two exceptional conditions of an opposite character met with in the skull. One of these occurs as nearly symmetrical areas of atrophy of the outer table and diploë, forming well-marked depressions extending obliquely across the parietal bones, which he is inclined to attribute to 'the pressure of the occipito-frontalis tendon stretched upon, and playing over, the most prominent part of the vertex.' The other condition he has described as a considerable thickening of the calvaria, especially towards the frontal region, with great density of the bone. The explanation of this very anomalous state, so contrary to what takes place in the cranium and entire skeleton generally, is not obvious, though it may be connected with the diminished pressure of the wasting brain. The age at which these changes in the osseous system set in is very variable, but they commonly commence earlier in women than in men. Slight atrophy takes place in the cartilages, costal and articular, the latter accounting for the diminution in height of the old person; but calcification is not invariable, and is indeed evidence of disease. Corresponding to the loss of strength in the bones is an increasing weakness in the power of the muscles, which explains, *inter alia*, the fact that fracture by muscular action is no more frequent in the aged than at other periods of life. It is to the weakening of the dorsal muscles that the stoop of age is attributable.

Associated with this atrophy it is usual to find *degenerations*—fatty, calcareous, or pigmentary—all of which are to be regarded as evidences of deficient nutrition, and may be contrasted with the differentiation and growth which characterise the commencement of life. The arcus senilis, the atheroma and calcareous degeneration of the vessels, the calcification of cartilages, the fatty degeneration of muscular and glandular epithelial tissue, the deposition of pigment in some spots, and the deficiency of the same in the hair and skin of the coloured races, are illustrations of true degenerative changes. Inasmuch, however, as these conditions are frequently wanting even in persons dying at an advanced age, they cannot be regarded as essential characteristics of senility; though it may be admitted that the cause, whatever it be, that determines the above described simple atrophic changes might easily be supposed to favour the closely allied states of degeneration. It might, indeed, be reasonably argued that it is the very absence of these and other degenerative changes which permits the attainment of great age, whilst their occurrence, as is usual, at a somewhat earlier period tends to a rate of mortality below that of these advanced ages.

Another expression of impaired nutrition, not so profound perhaps as degeneration, is a fibroid overgrowth in certain tissues, especially the arterial coats, which are often much thickened therefrom, and the prostate gland, which is commonly enlarged in elderly men from this same morbid change—the so-called hypertrophied prostate. The meninges, and capsules of liver and spleen are sometimes thickened from the same cause; and a similar cirrhotic condition may be set up in the kidney and testis.

The blood contains fewer corpuscles and less solid constituents, is more watery, and is said to coagulate more readily. The total quantity is less.

The semen is very frequently wanting in spermatozoa, and contains in their place granular fatty cells, like colostrum-corpuscles, with a few red blood-corpuscles; but this is not invariably the case, for perfect spermatozoa are occasionally met with at an advanced age.

Physiological Characters.—The results of such structural imperfections appear in deterioration of the purely physical, as well as of the specially vital, properties of the tissues. There is an increased rigidity in some parts, as the tendons and blood-vessels; and a diminished cohesion in others, as the nails and bones, which are brittle and easily broken. Perhaps the most prominent and distinguishing mark of old age is a loss of elasticity; the skin, cartilages, blood-vessels, and lungs show this to a very marked extent, in the wrinkled integuments, dilated vessels, and distended air-cells. It has been noticed that this dilatation particularly affects the thin-walled veins, and more especially those which do not run with arteries, are more superficial in position, and are concerned less with nutrition than with the proper return of blood—the 'derivative circulation' of Sucquet. The advantage of this is apparent, for such an arrangement must be a safety-valve in the case of the brain, to which organ there is a liability to determination of blood, and where the vessels are apt to rupture; hence the frequent turgescence of the nose and ears, and development of the veins of the diploë, in the aged. The muscular contractility and nervous irritability are diminished; and atrophy and degeneration of the gland-cells lead to failure in their powers of secretion.

The heart's beat is weak, and frequently intermittent, from defect in rhythmical nervous stimulation; the cardiac sounds are feeble and often altered; and there is a general tendency to venous congestion. The mean rate of pulse after the age of sixty-five years is 75, gradually diminishing to 70.

The tissues, which differ in chemical composition from those of mature life, must in their metabolism form different products of waste; whilst the altered blood, circulating in a restricted area with diminished force, must offer to the organs a different pabulum from that which they have hitherto received, supplied as it is by impaired digestive organs. The enfeebled respiration prevents complete oxidation; and the excretory organs, being less capable, but imperfectly withdraw from the body the results of metamorphosis. The quantity of urine is often diminished to fifteen or twenty ounces *per diem*, in old men enjoying good health. It contains a total amount of solids less than the normal standard, but the urine itself may be relatively of higher specific gravity, and deeper colour, from its diminished quantity.

As the nutritive functions fail, so do those of the neuro-muscular system. The sense-organs imperfectly receive impressions, which are but dimly communicated to the sensorium, whence feebly emanate the impulses needful to determine movements in muscles, the protoplasmic contractility of which is gradually diminishing. Meanwhile, the higher mental qualities, such as memory, judgment, and reason, dependent as they are upon the most perfect nutrition, gradually fail. The opposite conditions of wakefulness and drowsiness are frequently met with, and seem to be due to brain-wasting, as well as to some change in the cerebral circulation.

As a further manifestation of the lowered vitality, recent careful and continued observations have shown that the average body-temperature is slightly lower than it is in adult life, and the power of resisting cold is diminished.

The power of reproduction, lost by women at the climacteric, before the stage of senility sets in, is occasionally preserved by men to an advanced age.

Thus the old man presents a strong contrast in his vitality to that of the child; for whilst the life of the latter is so largely dependent upon, and so readily responsive to, external or peripheral impressions, the former lives more and more within himself; the distinctive animal functions gradually failing, as his existence becomes restricted to the performance of those of self-nutrition. The progressive impermeability of the capillaries, and the lessened vitality of the skin, alike tend to withdraw from the surface towards the central organs the manifestations of life.

Diseases of Old Age.—In a certain number of cases, the progressive deterioration in structure and failure in functional capacity mutually adapt themselves, and produce an old age which may be as healthy as the maturity or childhood may have been. But in the course of the atrophic changes which normally mark this period, the body is liable to certain influences, both intrinsic and extrinsic, which lead to diseases characteristic of this stage of life, as there are those of infancy and puberty. Death from old age, when the organs have gradually and uniformly failed, is not unknown, but the fatal end is more commonly due to some disease, which has either lasted from an earlier period, or is especially the acquirement of this stage.

The maladies particularly characteristic of old age are marked by certain general features, which they owe to that condition of nutrition in which the tissues are at this period. Thus, as a rule, they present but little activity in their progress, or but slight severity in symptoms, though they are none the less likely to bring about a fatal result, from the ill-resisting power of the whole system. Diseases of an acute character are rare at this time, and such as do occur assume an adynamic form, and are very liable to run a most insidious and even latent course. When once established, an illness tends more perhaps towards maintaining an isolated attitude, without those sympathetic disturbances of many other organs so pre-eminently the case in children. The power of reaction possessed by the aged is but very slight; owing to this, diseases readily lapse into a chronic state, or even present a chronic character from the outset, whilst comparatively trifling causes may lead to serious results. The observations of Sir George Humphry, however, go to show that the reparative power even in persons of advanced age is often greater than is supposed, and he adduces well-authenticated cases of complete recovery from severe accidents and illnesses; and in such we may reasonably infer that the degenerative changes are wanting or but very slight.

There is probably no single disease which is met with in advanced age only; rather is it the case that many diseases which prevail at certain periods of life are wanting in old age. The atrophy of every tissue and organ entails a general failure in function; and should this failure predominate in any one system, as may readily follow from a marked degeneration of certain special parts, we have some exception to what may be taken as the normal standard of the senile state, and therefore a disease of it. The same difficulties surround the question, why one set of organs should be affected rather than another, as at other ages; but there nevertheless does exist a preference towards affections of the nervous, circulatory, and respiratory systems. But a very large proportion of old people are entirely free from disease—of 824 persons over eighty years old, 55 per cent. of the women and 35 per cent. of the men were reported to be healthy (Humphry, *Collective Investigation Records*).

Diseases of the brain.—The cerebral lesions may be a general senile wasting and softening, with complete enfeeblement of nerve-function; or of a more localised character, from rupture or occlusion of some vessel.

The liability to venous engorgement is very prone to manifest itself in the brain, and cerebral congestion of varying extent is frequent. The cerebral vessels are especially liable to atheroma, and hence the great frequency of apoplexy in old age. The meninges are free from morbid change beyond thickening, and offer none of the inflammatory conditions so common in early life. Muscular tremors especially involving the head are frequent, and are probably due to wasting of the cerebral cortex. All degrees of deafness and impaired sight are met with.

Diseases of the heart.—The degeneration of the cardiac substance may lead to a state of asthenia, gradually becoming fatal; dilatation of the orifices may be the more prominent lesion, with all the consequent symptoms of obstructed circulation; or they may be constricted, from atheroma or thickening of the cusps or rings. Cardiac dyspnœa and every form of irregularity in cardiac rhythm occur to variable extents.

Diseases of the lungs.—Pulmonary diseases are important, since they are commonly the immediate causes of death in the aged. A bronchial catarrh, or at least a considerable increase in the bronchial secretion, is a normal state in the very old; and this has been regarded as a compensation for the arrested skin-action. The transition from this to severe bronchitis is both easy and frequent, and is favoured by the liability to lung-congestion, and the enfeebled heart-power. Even more serious is a senile form of lobular pneumonia, which seems to be set up in the congested and œdematous areas, possibly as a further stage of the bronchitis. Such pneumonia is of very frequent occurrence, and often requires carefully looking for, since direct symptoms are wanting. When a generally ill-defined illness is present in an old person, this condition should be suspected.

Diseases of the digestive organs.—The digestive organs, supposing they have escaped the dangers of earlier periods, are not often the seat of disease at this time of life. The perversions of function they present, such as constipation and flatulence, may be conveniently comprised under the term 'atonic dyspepsia,' and are mainly to be attributed to deficient muscular power in the alimentary canal, and to a deficiency in the digestive fluids. Nevertheless, a good appetite and very fair digestion are far from being the exception in old people. An acute form of diarrhœa of a dysenteric character has been described as occurring at this period.

Diseases of the skin.—The skin, which suffers so much diminution in nutrition and thickness, often exhibits as a result marked changes in sensibility, even to the existence of an intolerable pruritus, no cause for which is visible. The scratching which is resorted to for relief sets up a prurigo which intensifies the discomfort. The unhealthy integument offers a very favourable nidus for pediculi, and phthiriasis is accordingly a common senile affection.

Diseases of the urinary organs.—The most characteristic appearances in the senile kidney are those of a diffuse interstitial nephritis, with progressive atrophy of the tubes, similar in many respects to the 'gouty kidney,' but not, like it, associated with cardiac hypertrophy. The urine is in such cases albuminous, but the general symptoms of Bright's disease met with in middle life are usually wanting. Glycosuria, often intermittent, is of very frequent occurrence in old people; but is rarely attended by the constitutional disturbance of diabetes. Notwithstanding the very imperfect action of the skin and kidneys as excretory organs, diseases directly attributable to non-elimination of waste products are not characteristic of old age, except, of course, so far as helping in the general degeneration.

Irritability of the bladder, or even vesical catarrh, is very common in old men, being largely determined by the enlargement of the middle lobe of the prostate, but the hypertrophy of the organ may exist to a considerable extent without causing any symptoms until the mid-lobe is affected. Both retention and incontinence of urine follow, from the diminished tone of the viscus.

Vascular disease. — The frequency of atheroma of the vessels and thickenings from peri-arteritis has been alluded to. The tendency of the blood to coagulate, added to the opportunities it has for stagnating in the dilated channels and cavities of a weak heart, makes thrombosis and embolism very liable to occur in the senile state. The result of the obstruction is gangrene (*gangræna senilis*), which is readily established in tissues the capillaries of which have wasted or are obliterated, with corresponding deficiency of nutrition.

Arthritic lesions.—Very few old people escape chronic rheumatism in one or other of its many forms, though it may be questioned whether the constant pains complained of are not oftener due to neuritis than actual rheumatism. The fibrous tissues of the joints, fasciæ, and tendons are thickened, and less flexible from lack of moisture, with the result of producing that stiffness of the limbs so characteristic of the aged. The pain is rarely acute, but it is lasting, and aids in bringing about the general deficiency of motor power. Renal disease is to be found in many of these cases. True gout is scarcely a disease of old age, though often continued on from an early period of life.

Scrofula, Cancer, and Syphilis. — Sir James Paget and recently Mr. Howard

Marsh have described a senile form of scrofula occurring in people over sixty years of age, in whom the constitutional signs may have appeared in early life, with almost complete freedom during maturity. Marked evidences of this affection have been seen for the first time in persons over seventy-five years of age. The general features of this condition are similar to those in childhood, but slower in their course, more complete in the degeneration produced, and far more resistant to treatment. The cancerous and syphilitic cachexiæ very rarely manifest themselves for the first time in old age.

Treatment.—Old age itself, as a period of life, is clearly no more to be treated as a state of disease than life at any other stage. But regarded as a marasmus or cachexia, it has been sought to avert it as long as possible, or mitigate its effects; and for the attainment of longevity many means have been proposed, though as yet without any reliable result, the most diverse plans having been equally successful or futile. *See* Personal Health.

Based upon the hypothesis above mentioned, Dr. Brown-Séquard claims that much benefit to old men has followed the daily subcutaneous injection of a milligram of a watery extract of the testis of an adult guinea-pig filtered through a Pasteur filter. Others have affirmed the same, but further confirmation is wanting.

It is unnecessary in the present article to explain the treatment of the diseases of old age, as appropriate remedies are set forth under the special headings. It is sufficient here to indicate that, whatever may be the malady, and whatever be the treatment pursued, it must not be forgotten that we are dealing with organs in which the structure is deteriorating and the vitality of which is failing, and that all measures of a depleting or depressing character must be avoided. The feeding of the aged, therefore, becomes a matter of the greatest importance. Speaking generally, the food should be of the most nutritious character, and given in small bulk and frequently. The old person, whether ill or well, should not be allowed to go for many hours without food, as is too often the case, through the night. A light meal in the small hours of the morning is of the greatest benefit, and goes far to counteract the wakefulness so common at this period of life. In view of the presumably deficient power of the digestive juices, some of the artificial semi-digested foods may be advantageously employed, or the active principles of the digestive secretions administered with the food. The need for alcoholic stimulants is usually imperative, especially for those who have always taken them, but they should only be given with other food. Medicinal tonics are seldom of the same benefit that they are at earlier ages; probably strychnine is of most value. A daily aperient, such as two grains or more of the extract of cascara sagrada, is frequently necessary; and it is generally undesirable to forbid any habit, whether of drugs, food, or smoking, which has been previously long continued. Among the most important hygienic indications is the maintenance of warmth. A fall in temperature both lowers the general vitality, and tends to establish a local disease, and its effects are more easily prevented than cured when once established. Warm clothing is therefore indispensable, and cold feet should be specially guarded against. Equally prejudicial with cold and damp is exposure to high winds, which is frequently responsible for a fatal pulmonary attack.

W. H. Allchin.

SENSATION, Disorders of.—The sensory apparatus—consisting of, 1st, a peripheral end-organ for receiving impressions; 2nd, an afferent nerve which conducts them; and, 3rd, a ganglionic nerve-centre which undergoes a change, perceived by the consciousness as a feeling—may be disordered in various degrees. The lesion occasioning the disorder may exist at any point of the apparatus. As regards (A) the nerves of *special sensibility*—the olfactory, optic, auditory, and gustatory, the terms *hyperæsthesia* or *excess of feeling*, and *anæsthesia* or *want of feeling*, are applied respectively to conditions of exaggerated or defective sensibility. In reference to (B) the remaining sensory nerves, the perceptions produced by which are known as *common sensations*, the same terms are used, as well as certain others, indicating perversions of sensibility, which can scarcely be included in this simple classification. There is a good deal of confusion existing in the employment of these terms, and their use can only be defended on account of their possessing a certain amount of convenience for purposes of distinction. *Pain* is separately described. *See* Pain.

A. Special Sensibility.—1. *Olfactory hyperæsthesia.*—This is probably always of central origin. It is shown by subjective sensations of strong, usually disagreeable odours; and occurs in the insane, the epileptic, the myxœdematous, and the hysterical. *See* Olfactory Nerve, Morbid Conditions of.

2. *Olfactory anæsthesia.* Synon.: *Anosmia.*—This is occasionally congenital, but otherwise rare, and (unless where the mucous membrane of the nares has been destroyed by ulceration) is usually dependent on disease of the brain, or growths upon the olfactory lobes. It may also arise from laceration of the olfactory filaments, as a result of *contre-coup* in blows upon the occiput. There may be complete anosmia, whilst the common sensibility of the nares is

retained. On the other hand, in peripheral lesion of the fifth nerve there may be partial loss of smell, associated probably with impaired nutrition of the nasal mucous membrane. Integrity of the mucous membrane is apparently necessary (probably for mechanical reasons) to the perfect functioning of this special sense. It sometimes happens that there are subjective sensations of bad odours, where the power of perceiving objective odours is absent. Anosmia may occasionally result from a long-continued nasal catarrh, and is then probably connected with some modification of the mucous membrane which receives olfactory impressions.

3. *Optic hyperæsthesia.*—This disorder is marked by the production of luminous and chromatic sensations, independent of external influences. The disordered function may be caused by, or associated with coarse disease of the brain, over-stimulation of the optic nerve by light, insanity, delirium tremens, epilepsy, or hypochondriasis. Spectra of luminous angularities resembling the lines of fortifications, showers of sparks, or bright colours, occur sometimes in the course of migraine. A subjective sensation of colours (most often red) occurs occasionally as the aura of an epileptic fit.

4. *Optic anæsthesia.*—This may depend upon changes in the retina, in the trunk of the optic nerve or tract, or in the nervous ganglia which form its central termination. The terms *amblyopia* and *amaurosis* are usually employed to designate different *degrees* of imperfect vision, the latter the most advanced. *Amblyopia* is often met with in the disused eye in cases of strabismus, without any structural change being necessarily capable of detection by the ophthalmoscope, such as would explain the loss of nervous sensibility. In some instances, however, of this kind, the optic disc has a shrivelled, ill-nourished look; it is dull; and the retinal vessels are small. Amblyopia may consist in a general obscurity of vision, a deficiency in the power of definition, a contraction of the field of vision, or anomalies of colour-vision. It occurs occasionally in hysterical hemianæsthesia, and may then be limited to one eye, on the same side as the other defects of sensation; it is frequently the prelude of an epileptic fit.

Ophthalmoscopic examination of the eye, together with the patient's general condition, will usually reveal the cause with facility. *Amblyopia* may be a symptom of *optic neuritis.* The optic neuritis will probably be dependent upon tumour, abscess, aneurysm, or some coarse change within the cranium, such as meningitis. Or there may be *neuro-retinitis*, in which the retina still more largely participates in the inflammatory changes, a condition liable to be induced, amongst other causes, by syphilis, diphtheria, or over-lactation. But the symptom is frequently absent in both conditions up to a certain point, the patient being able to read small print even when the pathological changes are strongly pronounced. Sometimes amaurosis also occurs in diabetes, from retinal changes. *See also* Nyctalopia.

5. *Hemiopia.*—This is a condition in which a half of the field of vision—usually a lateral half—is cut off. It may depend upon coarse disease, such as a tumour or clot, pressing upon an optic tract. It occurs sometimes in hemiplegia, complicated with paralysis of the third nerve opposite to the side on which the limbs are paralysed, and depends then upon lesion of the corresponding crus cerebri. It is frequently seen in a hemiplegia which is attended with strongly marked and persistent anæsthesia of the affected limbs, and dependent upon coarse disease in the neighbourhood of the optic thalamus. Lesion of the cortex cerebri in its posterior portion may be the cause. It is not rarely met with also, but only as a transient symptom, in megrim. It is occasionally, but only seldom, met with in hysteria.

6. *Auditory hyperæsthesia.* — In certain states of nervous exhaustion, in fever, and sometimes in hysteria and hypochondriasis, sound-producing vibrations painfully affect the auditory nerve. It is doubtful whether the proper function of the nerve is ever really much intensified. At a certain stage, however, of anæsthetisation by ether, chloroform, or other agent, sounds appear to be greatly exaggerated. Pain, rather than an increased power of hearing, is usually the result of hyperæsthesia of the auditory nerve.

7. *Tinnitus aurium.* — This is almost always subjective, although it must be borne in mind that an aneurysm in the neighbourhood of the temporal bone may occasion tinnitus. The sounds may be of various kinds—rumbling, hissing, musical, roaring, hammering—and may depend either upon some irritation of the auditory nerve itself, or upon affection of some other part of the organ of hearing. It seems probable that affection of any portion, from the external auditory meatus to the Eustachian tube, may give rise to the condition. The difficulty of diagnosing the seat of the affection is very great.

Tinnitus aurium may also be dependent upon some altered condition of the walls of blood-vessels, in connexion with anæmia or cerebral congestion. It is often produced by large doses of quinine. In certain cases it is of central origin. The sensation of a loud noise occasionally marks the commencement of an epileptic seizure or of a syncopal attack. Deranged digestion may produce it. There may be subjective sensations of sound in an ear which is quite deaf to external impressions.

It is not uncommonly found to be dependent simply upon an accumulation of wax in the external auditory meatus. Tinnitus aurium is very often associated with vertigo. Not uncommonly occurring in persons of gouty habit, it is possibly sometimes caused, in such cases, by a deposit in a joint of the ossicles, causing inflammation and stiffness. It seems likely that it is sometimes due to irritation of the auditory nucleus in the medulla oblongata by uric acid or some such agent.

Tinnitus aurium is always a distressing, and often an intractable affection. Where it depends upon some anæmic condition, it is most likely to be cured by remedies appropriate to this state. Of course, if caused by accumulation of wax, the removal of this is a simple remedy. Subjective sensations of sounds, especially of voices of men or animals, occur frequently in various forms of insanity, in which case they are spoken of as hallucinations.

8. *Auditory anæsthesia.*—This may be due to disease or suspended functional activity of the auditory nerve; and probably, in some cases, to lesion of the superior temporo-sphenoidal convolution of the brain—Ferrier's centre for hearing. Hardness of hearing and deafness are the forms taken by varying degrees of acoustic anæsthesia. The cause may be disease in the osseous labyrinth of the bone itself or its lining membrane, or tumours which cause compression and atrophy of the nerve, basilar meningitis, extravasations, or new-formations. Syphilis may bring about acoustic anæsthesia by causing periostitis and consequent pressure upon the auditory nerve. A most fruitful source of deafness is disease of the temporal bone from scarlatina. In some instances the auditory nerve is atrophied, as part of that generalised disorder of the sensory nervous system which is called tabes dorsalis. In cases of so-called nervous deafness inquiry should be made as to the occurrence of 'lightning pains,' and the state of the patellar tendon reflex should be investigated.

Disease of the pons Varolii or medulla oblongata may occasion deafness, through lesions affecting the nucleus of the auditory nerve or the commencement of its trunk. It is more likely than not that in these circumstances the auditory nucleus would not suffer alone, but that there would be evidence of other cranial nerves being involved, which would aid the diagnosis.

9. *Gustatory hyperæsthesia.* — This disorder occurs probably only in the course of mental and epileptic disorders, and in myxœdema where the subjective sensation of a taste (most often perhaps of an offensive character) is sometimes complained of. Such a condition is of central origin.

10. *Gustatory anæsthesia.*—This is of frequent occurrence. There may be a total inability to appreciate the taste of substances applied to the tongue, or more or less delay in their recognition. It is sometimes observed in cases of peripheral paralysis of the facial muscles, and then depends upon the lesion of the portio dura involving also the chorda tympani. It is the anterior portion of the tongue which, in such circumstances, exhibits the loss of function. So also in disease of the trigeminus in the floor of the skull, there is frequently gustatory anæsthesia in the anterior portion of the tongue. The glosso-pharyngeal nerve by its terminal branches presides over the sense of taste in the posterior third of the dorsal aspect of the tongue. Disease or lesion of the trunk of this nerve destroys the sense of taste in this region. *See* Taste, Disorders of.

The disorders of special sensation which have been described are so bound up with lesions of the various nerves subserving the functions, or of the nervous centres, that they can only be considered from an ætiological and therapeutical point of view in connexion with these. Reference must, therefore, be made to the articles devoted to such lesions.

B. **Common Sensibility.**—Disorders of those centripetal nerves, the perceptions produced by which are known as 'common sensations,' are considered under the head of Touch, Disorders of. T. Buzzard.

SEPTICÆMIA (σηπτικός, putrid; and αἷμα, blood).—Synon.: Fr. *Septicémie*; Ger. *Septicämie*.

Definition.—A disease due to the entrance into the blood of the products of putrefaction.

Description.—When putrefaction occurs in a wound there is an active development of bacteria, and this is accompanied by the production of a virus which, gaining entrance into the blood, produces symptoms of blood-poisoning of a severity proportioned to its dose and virulence.

If the dose of the poison be a large and fatal one, its absorption is quickly followed by rigors and elevation of the temperature, to which may be added sweating, vomiting, and diarrhœa. The pulse soon becomes rapid and feeble, delirium and collapse ensue, the temperature rapidly descends to below the normal, and the circulation fails.

Post mortem we find general congestion of the viscera, subserous ecchymoses, especially beneath the endocardium, and marked injection of the vessels of the alimentary canal. The blood is darker than natural, the corpuscles collect in irregular masses, and many of them are undergoing disintegration and solution.

If the dose of the virus be of less severity, the rise of temperature is succeeded by a more gradual fall; the sweating and diarrhœa diminish; and the patient is left weak and anæmic, but may eventually completely recover.

Cases of every degree of severity are met with, varying with the amount of the poison absorbed: some rapidly fatal, some of such slightness that they would probably be overlooked but for careful thermometric observations.

But the duration of the disease depends chiefly upon the repetition or continuance of the entrance of the poison, for the poison does not multiply, and, unless it continues to be produced and absorbed, the symptoms to which it has given rise come naturally to an end.

In many cases, therefore, the symptoms of septicæmia consist of a repetition of those described above, corresponding with successive doses of the poison—repeated rigors, irregular elevations and depressions of the temperature, frequently recurring diarrhœa, steadily increasing anæmia and emaciation -until either the source of the poison is removed, or the patient is exhausted by fever and diarrhœa; a low pneumonia, a bedsore, or some other complication, bringing the disease to a fatal end. Such cases may continue for an indefinite time without the occurrence of any secondary deposits, such as are seen in pyæmia; and in those who recover, the most marked effect of the disease is the condition of extreme anæmia and muscular weakness in which the patient is left.

Prevention and Treatment.—The septic poison requires for its production the presence and development of bacteria; and the septic bacteria need for their life and multiplication a lowered vitality or a damaged condition of the tissues. The blood of a healthy person does not contain such bacteria or their germs, which must therefore gain entrance to the body from without. Evidently, therefore, the chief measures for the prevention of septicæmia are: (1) scrupulous cleanliness in the treatment of wounds, for the avoidance of the introduction of septic germs and of the condition of wound which is favourable for their development; (2) the use of antiseptics for the destruction of such germs as may accidentally be present; and (3) the healthiest possible environment for the sick and injured, so that the body may be maintained at the highest level of vitality, and therefore in a condition of resistance to adverse influences, and also that the patient may be defended as far as possible from everything tending to the development of the septic process.

When, however, septicæmia is once established, our efforts should be directed, firstly, to the removal or destruction of the source of the poison; secondly, to the maintenance of the powers of the patient till the effects of the poison are at an end.

For the first purpose, the wound, if there be one, must be thoroughly cleansed and disinfected, and by the careful use of antiseptic dressings an aseptic condition established and maintained. If the source of the poison be an inflamed or necrosed bone, the removal of the bone, or of the limb, must be considered. If the disease originates in inflammatory products confined within one of the cavities of the body, as the uterus, the pleura (empyema), or the peritoneum, free drainage must be provided, and, if this is insufficient, antiseptic irrigation should be used. If foul suppuration is going on within the body, as, for instance, an abscess of the lung, or a pelvic abscess communicating with the bowel, an attempt should be made to provide a free exit for the matter, and to bring antiseptics into contact with the infected surface. The patient should be placed, if possible, in a large, well-ventilated room, from which all sources of contamination are carefully excluded. Plenty of nourishing and easily assimilated food should be administered, together with whatever stimulant seems called for.

Of medicines, sulphate of quinine is by far the most useful, and seems often to be productive of marked benefit. *See* Pyæmia.

J. Warrington Haward.

SEPTUM CORDIS, Deficiency of. *See* Heart, Malformations of.

SEQUELÆ (*sequor*, I follow).—Consequences or sequels. This word is applied to symptoms or morbid conditions which either remain or supervene after various diseases have run their course; such as renal disease after scarlet fever, paralysis after diphtheria, or cardiac disease after acute rheumatism. *See* Disease.

SEROUS FLUID }
SERUM }.—In physiology the liquid portion of the blood, which separates after coagulation, is named the *serum*, and this is taken as a type of fluids of more or less similar composition, consisting of a watery solution of albumin with certain salts. In pathology we have to deal with serum outside the blood-vessels, either as a mere dropsical accumulation, or as an inflammatory effusion. It may be thus met with in the cellular tissue under the skin or a mucous membrane, and in other parts; in serous cavities; in certain organs, as the lungs and the ventricles of the brain; or as a discharge from the surface of the skin, as in cases of eczema. Its precise composition varies considerably under different circumstances. Clinically serous fluid is, as a rule, of chief importance on account of its mechanical effects, when it accumulates in quantity in various parts, and these effects may be most serious. Its presence can usually be detected by direct objective, or more methodical physical examination. The treatment required will be that either for dropsy or that for inflammation, modified by local indications, according to the principles laid down in other special articles.

Frederick T. Roberts.

SEROUS AND FIBRO-SEROUS MEMBRANES, Diseases of.—Synon.: *Maladies du Système Séreux*; Ger. *Krankheiten der Serosenhäute*.—These constitute an important class of diseases; and although they are discussed under the headings of the several serous membranes, it will be advantageous to consider them generally, according to the plan followed in the case of the mucous membranes. Serous membranes line closed cavities, except in the case of the peritoneum in the female, which communicates with the uterus through the Fallopian tubes, and thus with the exterior of the body. They consist of a basement-membrane, covered with epithelium, usually of the scaly variety, and a subserous cellular tissue underneath. In addition to their more obvious function, of allowing free movement for organs, they are intimately connected with the absorbent system, the vessels of which freely open on their surfaces. Fibro-serous membranes constitute a variety, in which there is an outer fibrous covering, lined by a serous layer, and of which the pericardium is an example. The nature and causes of the several diseases of serous membranes will now be pointed out.

1. **Injury.**—The serous membranes are liable to be injured from without, chiefly as the result of wounds penetrating the cavities which they line, but also by fractured bones, especially in the case of the ribs and skull. It is highly probable that a severe external contusion may affect an underlying serous membrane. Another important cause of injury to these structures is some perforation or rupture taking place within the body (*see* Perforations and Ruptures). They are frequently more or less injured in various operations. Any kind of injury to this class of membranes was formerly regarded with great dread, and operations in which they were in any way interfered with were considered highly dangerous; more recent experience has, however, shown that mere damage to a serous membrane is not serious in itself. More or less grave consequences are liable to follow, from hæmorrhage: from the admission of air, especially if highly charged with septic matters; or from the escape of solid or liquid materials into a serous cavity. In addition to their direct effects, these sources of irritation often set up inflammation, which may prove fatal.

2. **Inflammation.** — Serous inflammations are of common occurrence; and, without entering into details, their causes may be thus summarised: (*a*) Some injury from without, under which may be included that set up by fractured bones. (*b*) Perforations and ruptures within the body, the inflammation being then mainly due to the materials which gain access into the serous cavity. (*c*) Mechanical or chemical irritation of any kind. Many cases belonging to the former groups would come under this variety; as well as those in which inflammation is set up by necrosed bone, diseased organs, and tumours, or as the result of over-distension of a serous membrane. This class would also include cases in which a serous inflammation is purposely excited by the injection of certain chemical irritants. The occurrence of peritonitis from the entrance into the peritoneum of noxious materials from the uterus along the Fallopian tubes may also be mentioned here. (*d*) Morbid growths in connexion with a serous membrane, especially tubercle and cancer. These deserve separate mention, though they likewise act by causing local irritation. (*e*) Extension of inflammation from other structures. In this way the morbid process may pass from one serous membrane to another. Some forms of inflammation may probably extend to the serous membranes through the channel of the lymphatics. (*f*) Certain general states of the system, in connexion with low fevers, pyæmia, Bright's disease, and other affections. (*g*) Causes acting upon the whole body from without, such as cold, when the inflammation is often spoken of as *idiopathic*. Different serous membranes present different degrees of liability to be affected by one or other of the causes mentioned; and these produce different effects, according to their nature.

Cases of serous inflammation present much diversity as regards their severity and rate of progress, and the morbid changes are thus materially influenced in their character, as well as by the cause of the inflammation, the particular membrane affected, and other circumstances. In general terms they may be grouped as *acute*, *subacute*, and *chronic* in their origin and course; but those which are more or less acute at the outset usually leave behind permanent morbid conditions. Taking an ordinary case of an acute serous inflammation, running a regular course, it presents the following more or less obvious stages in regard to its anatomical characters: (*a*) Increased vascularisation, with consequent redness of the membrane, and sometimes small hæmorrhages, accompanied with dryness, loss of polish, opacity, and swelling. (*b*) Deposit of organisable lymph or fibrinous exudation upon the surface, containing a variable number of cells, mainly leucocytes. (*c*) Effusion of fluid into the serous cavity, more or less of the nature of serum, but also containing a variable proportion of fibrinogenous elements and cells. (*d*) Absorption of the fluid. (*e*) The formation of fibrous thickenings, or of adhesions, bands, or agglutinations between the opposing surfaces of the serous membrane.

Such being the usual course of events in a typical case of serous inflammation, it must suffice to point out, without entering into any details, some of the more common variations. There may be little or no fluid, the exudation being the prominent morbid product. This exudation varies much in its quality, and may be of a very low, unorganisable type, resembling in some instances thick pus. Again, a fluid effusion is, under certain circumstances, liable to become sero-purulent or actually purulent, or it may be so from the first. In other conditions it is hæmorrhagic. Its quantity is very variable. There is a class of cases in which the prominent morbid change is the accumulation of a serous effusion, not uncommonly in large amount, and it may take place very gradually and insidiously, or, on the other hand, with remarkable rapidity. The slow and chronic formation of localised adhesions is very common in connexion with certain serous membranes, without any clinical indications of their development. Gas may be present in serous cavities in cases of inflammation, and then results from decomposition of the effusion, unless it should have been introduced from without. In rare instances pus collects in the subserous tissue; or actual destruction or gangrene of the involved tissues may occur.

With regard to the extent of the disease, cases of serous inflammation are usually divided into *general* or *diffuse*, and *local* or *circumscribed*, though the former terms do not necessarily imply that the whole of a serous membrane is implicated. As a rule the effusion is freely movable in the cavity, but it may be more or less limited by former adhesions, or even completely loculated and encysted. Serous inflammations are often accompanied with changes in the organs and structures which they cover, these being either the cause or the effect of the inflammatory changes. Moreover, an effusion, especially if purulent, may open in various directions, and thus originate secondary consequences more or less serious. Not uncommonly it has to be removed by operation.

The following appear to be the chief microscopical changes which take place in connexion with an inflamed serous membrane. The epithelium undergoes marked alterations, its cells usually becoming enlarged and swollen, granular, and cloudy, while its nuclei divide and multiply, and active proliferation goes on. In low forms of inflammation they merely undergo fatty degeneration and destruction, and are shed abundantly. A coagulable fluid escapes from the blood-vessels, and migration of corpuscles also takes place. The cells in the substance of the serous membrane, and the connective-tissue corpuscles, proliferate more or less. Vascular granulations often form on the surface, which are believed to be of much service in absorbing the effusion, as well as subsequently in forming adhesions. Pus-cells are derived from the epithelium, and from leucocytes. Adhesions ordinarily result from the development of the cellular elements in the exudation, the fibrinous material undergoing fatty degeneration; after pus is formed they originate by granulation, and are then likely to be thicker and firmer. In these adhesions blood-vessels, elastic fibres, lymph chambers, and even nerves may ultimately be developed.

3. **Dropsical Effusion.**—The serous cavities are often the seat of a mere dropsical accumulation, owing to the escape of fluid of a more or less serous character from the vessels. It may be in very large quantity, and collect either rapidly or gradually. Sometimes it is not easy to draw the line between an inflammatory and a dropsical effusion; and it is probable that the latter, when very abundant, by distending a serous membrane, may really set up a secondary inflammatory condition. The fluid is occasionally blood-stained or milky in appearance. The condition may be entirely local, or a part of a more or less general dropsy. It may arise from: (*a*) Local obstruction to the venous circulation, which is best exemplified by ascites associated with portal obstruction. (*b*) General venous obstruction in certain cases of cardiac and pulmonary disease. (*c*) Bright's disease. (*d*) Chronic adhesions and thickenings originating in past inflammation; and morbid growths, such as tubercle or cancer. These probably act mainly by pressing upon the small vessels. (*e*) Possibly exposure to cold, sudden suppression of chronic skin-diseases, and other causes which are supposed to originate active internal congestion.

4. **Hæmorrhage.**—As has been already stated, more or less blood, or its colouring-matter, may be present in inflammatory or dropsical effusions in serous cavities. As a distinct morbid condition, hæmorrhage into these spaces may be due to: (*a*) External injury. (*b*) Rupture of an organ, whether healthy or diseased. (*c*) The bursting of an aneurysm. (*d*) The rupture of vessels in connexion with some morbid growth, especially cancer. (*e*) Purpura and scurvy in exceptional cases.

5. **Accumulation of Gas.**—This condition, in connexion with serous cavities, may result from: (*a*) Decomposition of inflammatory products, or of gangrenous materials. (*b*) Perforation or rupture of a hollow organ containing air or gas, whether due to external injury, or originating from within. This accounts for most cases of escape of air into the pleura from the lung, and of gas from the intestine into the peritoneum. (*c*) Transmission of gas through the walls of a hollow viscus into a serous cavity, which sometimes happens in the case of the intestine. The gas varies much in its composition, according to the cause of its presence, and its seat. In pneumothorax

it is usually modified air; in pneumo-peritoneum it is offensive and fœtid. Not unusually the gas is associated with inflammatory effusion or other materials; or it may set up inflammation, and thus cause effusion.

6. **Foreign Materials.**—Various objects may be found in serous cavities, either introduced from without, as the result of injury; or having entered from internal organs, especially in the case of the peritoneum. Amongst others may be mentioned dirt, bullets or shots, food, fæces, urine, worms, and calculi. These are very liable to set up inflammation, often of a very severe and dangerous character.

7. **Morbid Growths.** — Tubercle and cancer are the two important growths which may be found associated with serous membranes. In the folds of the peritoneum accumulation of fat often occurs. Amongst rare morbid formations may be mentioned hydatids; other cysts of different kinds; fibromata; myxomata; and remnants of blood-clots. They may give rise to inflammation or mere serous effusion.

8. **Malformations.**—The serous membranes sometimes present unusual arrangements, especially the peritoneum, and these may possibly become of clinical importance.

SYMPTOMS.—The clinical phenomena which are associated with diseases of serous membranes come within well-defined limits, and can be readily understood and appreciated, as the following outline will show.

1. *Morbid sensations.*—Pain is usually a prominent symptom in acute serous inflammations. It is not uncommonly very severe; variable in its character, but often sharp and darting; subject to exacerbations; and increased by any movement or action which disturbs the inflamed membrane. Where the membrane can be affected by pressure, as in the case of the peritoneum, marked tenderness is observed, and it may become extreme. It must be remembered, however, that pain is by no means a necessary accompaniment of acute inflammation of a serous membrane. In connexion with adhesions and thickenings, painful, dragging, or other sensations may be experienced, owing to the implication of branches of nerves, and other causes; and also in other conditions associated with chronic inflammation. Another kind of morbid sensation, often felt in diseases of serous membranes, is that of distension or fulness, due to various accumulations in their cavities.

2. *Effects on neighbouring structures.*—These account for most of the prominent symptoms associated with diseases of serous membranes. (*a*) Acute inflammation will at first cause irritation of certain muscular organs, such as the intestines, bladder, or heart, and thus excite or otherwise disturb their actions. A similar effect is liable to be produced on the brain and spinal cord. Subsequently these organs tend to become weakened or even paralysed, owing to their tissues being involved in the inflammatory process; and thus striking or even dangerous symptoms may arise. (*b*) The various accumulations in serous cavities produce more or less mechanical effects, often of great importance, especially if the accumulation takes place rapidly. The most evident are distension of the walls of cavities lined by serous membranes; compression of organs and tubes, as of the lungs; displacement of various structures; and embarrassment of the action of organs, such as the heart and lungs. In these several ways not only may subjective sensations be produced, but different objective phenomena, which may prove very serious, or even fatal. In the case of inflammation of the cerebral membranes, lymph may affect important nerves by enclosing and compressing them. (*c*) Another important class of symptoms are those due to the effects of adhesions, agglutinations, thickenings, or morbid growths in connexion with serous membranes. Thus, organs may be fixed in abnormal positions, their actions interfered with, different structures directly pressed upon, or hollow organs strangulated and obstructed. *See* ADHESIONS.

3. *Ruptures and discharges.*—Accumulations in serous cavities may rupture in various directions, and in this way originate symptoms. If they burst internally, they will also probably set up secondary lesions, with their corresponding phenomena. When liquid accumulations open into organs which have an external communication, such as the lungs or intestines, they are discharged through the corresponding channels. They may also burst externally, either directly, or after having first made their way into the subcutaneous tissue.

4. *Physical signs.*—These are of great importance as clinical indications of morbid conditions of most of the serous membranes, of which they may be the only evidence. They are described in other appropriate articles, and it must suffice to state here that they reveal one or other of the following conditions: (*a*) Some deposit upon, or roughness of, the surfaces of the membrane, associated with inflammation or morbid growths. (*b*) Accumulation of a fluid, of whatever kind, and whether freely movable in the cavity or localised. (*c*) A collection of gas, or of gas and fluid together. (*d*) Adhesions or agglutinations. (*e*) The presence of solid infiltrations or masses, due to inflammatory thickening, or to morbid formations, especially cancer. (*f*) Physical effects produced on organs by various abnormal states of the serous cavities or structures.

5. *General symptoms.*—The system is liable to suffer in different ways in cases of

disease of serous membranes. Thus syncope, shock, or collapse may occur in connexion with injuries and hæmorrhages. Inflammation causes pyrexia, usually varying much in degree, but in some instances very high. Septicæmia or pyæmia may arise from the absorption of septic inflammatory products; and collapse occurs in many cases of peritonitis. Signs of the general cachexia may be present in cases of cancer or tuberculosis.

Treatment.—It is scarcely practicable to give any serviceable general outline of treatment directed to diseases of serous membranes, this being so much influenced by a variety of circumstances. In the large majority of cases the measures adopted have some relation to acute inflammation, being intended either to prevent, limit, or subdue this process; to get rid of its products, either by absorption or in other ways; to obviate or relieve its effects upon organs and other structures; to alleviate symptoms; and to affect the general condition. Attention may also have to be directed to the after-effects of inflammation, in the way of adhesions, or to similar conditions arising from chronic inflammation. In a considerable group of cases the object of treatment is to endeavour to remove accumulations, especially of fluid, from serous cavities, whether of inflammatory or other origin. For this purpose it is not uncommon at the present day to resort to operative interference, by means of aspiration, tapping with the trocar and cannula, and other methods. General and local rest are often of much service in the treatment of morbid conditions connected with serous membranes; and local applications are also frequently useful for various purposes. Bleeding, either general or local, has been, and is still, extensively practised in the treatment of serous inflammations, and also the exhibition of calomel and opium; but, in the writer's opinion, the routine adoption of this line of practice cannot be too strongly deprecated. Medicines and local measures which tend to promote absorption are often of decided value, especially in the case of inflammatory or dropsical effusions.

Frederick T. Roberts.

SERPIGINOUS (*serpo*, I creep).—This term is used in connexion with certain morbid conditions, such as ulcers or eruptions, when they spread in a creeping manner.

SETON, Use of.—A method of counter-irritation, which consists in the insertion of a tape or cord beneath the skin. *See* Counter-irritants.

SEVENTH NERVE, Diseases of.—*See* Facial Paralysis; Facial Spasm; Hearing Disorders of; Salivation; and Taste, Disorders of.

SEVILLE, in Spain.—A variable, rather bracing, inland winter climate. *See* Climate, Treatment of Disease by.

SEXUAL FUNCTIONS IN THE FEMALE, Disorders of.—Introduction.—The influence of the sexual functions on the general health is alluded to in the article Puberty, Disorders of. But, as the ætiological importance of the reproductive system is by no means limited to that period, we may here briefly consider the effect of sexual disorders generally on the bodily health.

The connexion between female sexual disorders and some derangements of the general health hardly admits of any satisfactory explanation beyond their dependence on reflex action originating in utero-ovarian irritation. Long, however, before this doctrine was applied to these complaints, their existence in connexion with uterine and ovarian disorders was well recognised, and was ascribed by old writers to what they termed the *consensus nervorum*, or sympathy, by which, as Prochaska says, 'the operation of a stimulus is not limited to the nerves immediately irritated, but is extended to distant parts in known or unknown connexion with the irritated nerves.'

The remarkable difference in the constitutional sympathies with sexual disorders in the opposite sexes, is accounted for by the comparatively subordinate character of the male reproductive organs. In the female, on the contrary, the utero-ovarian functions are connected with every vital action, from the evolution of puberty until the climacteric period, which terminates her distinctive sexual or reproductive life, is passed. Woman is therefore always liable, as Dr. Storer observes, 'to a host of diseases peculiar to her sex, to which we find neither homologue nor analogue in man.'

Ætiology.—First, with respect to the effect of the general health in the causation of sexual disorders in women, there can be no doubt that these are in many cases the result of some constitutional diathesis.

Gout, rheumatism, struma, neuralgia, and secondary syphilis should be recognised as amongst the constitutional causes of chronic uterine or peri-uterine disease.

Results.—We turn next to consider the converse question—the effect of sexual disorders on the bodily health. In many instances, the local symptoms of disease of the uterus, ovaries, and Fallopian tubes attract so much attention, that the practitioner may neglect the constitutional conditions with which the local sexual disorders are connected. Thus, derangements of the catamenial function are generally associated with the nervous complaints of women. Many forms of hysteria, and the morbid excitability and perversion of the natural feminine instincts, without any tangible delusion or perceptible affection of the intellectual powers, which are so frequently met with, are thus conjoined with amenorrhœa or dysmenorrhœa. The connexion between hysteria and uterine or ovarian disorders is too obvious to call for any notice here (*see* HYSTERIA; and INSANITY, Varieties of). In the present article a few of the principal disorders which may thus originate in sexual disturbances will be briefly noticed.

Epilepsy.—Epilepsy in women is very often symptomatic of uterine or ovarian disorder.

Perversions of tastes and temper.—The influence of the sexual system in the causation of nervous disorders is well illustrated by those strange alterations in tastes and dispositions, that irritable condition of mind, those unreasonable likings or aversions, irresistible longings and foolish fancies which, even in women naturally strong and well-minded, commonly accompany and are produced by pregnancy. Of a similar nature are the nervous excitability, waywardness of temper, physical and mental lassitude, and depression of spirits which have been generally noticed as constant attendants on the menstrual periods in many women. These are also of interest as demonstrating, despite any exceptional cases to the contrary, the futility of that hopeless contest with Nature's laws, in which those are now engaged who would have woman abandon her own high sphere, to become in every profession and in every avocation the rival, instead of the helpmate, of man.

Erotomania and nymphomania.—In connexion with this subject erotomania and nymphomania must be referred to. The former is but an undue exaltation of that sentimentality which to some extent is a natural characteristic of female youth, and which is fostered into morbid development by ill-directed education, and the prevailing sensuous tone of much of our popular literature. Highly coloured amatory word-pictures fill the minds of the young, unfit them for the duties of life, and give rise to those predominant illusions which morbidly occupy the thoughts of the erotomaniac, and may ultimately pass into the grosser pruriency of nymphomania. Whether originating in this way or not, nymphomania, when developed, is an entirely distinct disorder from the last-named complaint, and is generally connected with physical irritation or disease of some part of the sexual organs. Frequently it is associated with subacute endometritis or with oöphoritis, resulting in irritation and congestion of the erectile structure of the internal, as well as of the external, generative organs. In these cases pruritus of the vulva generally exists; and the local hyperæsthetic condition is followed by structural disease in the affected parts, hypertrophy of the nymphæ and clitoris, vaginismus, and chronic follicular vulvitis.

TREATMENT.—The moral, hygienic, and medical treatment of these conditions is discussed in other articles in this work. Here it is only necessary to add that in the treatment of no forms of disease is the exercise of the highest qualities of the physician more required than in the management of erotomania and nymphomania. In these cases he must act on the religious and moral as well as on the physical constitution of his patients; he must seek to turn the perverted current of thought into better channels; insist on healthy occupation of mind and body; and clearly point out the physical ill-health and mental debasement which surely await on sexual abuses. At the same time the judicious practitioner will endeavour to strengthen the physical powers by tonics; to diminish general plethora by saline purgatives, to remove local congestions by appropriate treatment; and to lessen nervous irritability by the bromides and other nerve-sedatives. Generally such patients are idle and over-fed, and require work and abstinence; and in addressing these persons their medical attendant may well re-echo the advice given to Falstaff by his quondam friend Prince Hal, and desire them to 'Purge, forswear sack, and live cleanly.'

With regard to local treatment in cases of nymphomania, all that need be said is that vaginal examinations, being likely to increase the irritability of the hyperæsthetic parts, should, as a general rule, be altogether avoided; or, at least, should be resorted to only in exceptional instances, and when absolutely indispensable. At the same time, however, it is obvious that where nymphomania is the result of local disease, neither moral nor general medical treatment can be of use until the topical exciting cause is removed. It may be admitted that, in certain exceptional cases and with suitable restrictions, clitoridectomy is a useful procedure.

Insanity.—The effect of sexual disorders on the mental functions can be only very briefly alluded to. The fact is certain that insanity in women is frequently connected with functional derangement or organic disease of some portion of the utero-genital organs. Indeed, in both sexes, although less obviously in men, reflex irritation from the sexual system has, probably, much to do with the causation of insanity. In the insane there is usually a peculiar insensibility to the ordinary symptoms of disease, resulting from the impaired nutrition and lowered vitality of the nervous centres and nerves of sensation. Therefore, in such cases, in the absence of the usual evidences of sexual disorders, the existence of these diseases is very likely to be overlooked. During the last few years several instances of mental derangement, of hysteria approximating to insanity, and of other forms of nervous disturbance arising from ovarian causes, have come within the writer's observation. In some of these cases the nervous disorder had existed for a considerable time before its local exciting cause was suspected. And, more than once, the writer has seen this ultimate recognition and treatment of obscure uterine or ovarian disease in a woman, who had been for years in a lunatic asylum, followed by the restoration of mental as well as physical health.

The ordinary occurrence of menstrual irregularities, and especially of amenorrhœa, in the early periods of insanity, is recognised by nearly all writers on this subject; and there seems a general concurrence of opinion as to the direct connexion between suppression of the menses and mental derangement in many instances. One of the most remarkable cases of this kind is that of a girl, mentioned by Pinel, who 'from the age of puberty was in a state of incoherence accompanied with suppression of the catamenia. One day on rising from bed she ran and embraced her mother, exclaiming, "Mamma! I am well." The catamenia had just flowed spontaneously, and her reason was immediately restored.'

Puerperal mania.—Puerperal mania is another instance of the influence of uterine or peri-uterine causes in disturbing the nervous system. The ætiology of this disease is very complicated, and it must be ascribed to the combined operation of several distinct factors. Foremost amongst these is the local congestion of the uterus during involution; and the shock and exhaustion consequent on parturition under conditions of mental depression, as shown by the fact that twelve out of twenty cases that came under the writer's notice occurred amongst unmarried patients in the Lying-in Hospital. Any circumstances that occasion suppression of the lochia or of the mammary secretion at this time, when the nervous system is in a state of peculiar tension, and the physical powers lowered, act directly as exciting causes of puerperal mania.

Alcoholism.—Uterine and ovarian disorders must also be reckoned amongst the predisposing causes of intemperance. The craving for alcohol in women of all classes may frequently be dated from the first painful menstrual period, when stimulants are often forced by foolish mothers into reluctant lips. The pain of dysmenorrhœa being thus relieved, at the next epoch the girl naturally, and no longer unwillingly, seeks similar solace, until, finally, the victim of dysmenorrhœal alcoholism may become a habitual, and perhaps an incurable, drunkard.

Cardiac disorder.—Of the cases of supposed heart-disease in nervous women which daily come before those connected with any large hospital, in a considerable number of instances the cardiac complaints are the result of hysteria, originating from chronic uterine or ovarian disorder, on the cure of which all the cardiac symptoms will subside. It is needless to dwell further here on the functional irregularities—palpitation, dyspnœa, and other symptoms of the same kind—which are thus connected with over-stimulation and irritation, or disease, of the female sexual system.

General health.—The consequences of premature or excessive indulgence and abuse of the sexual appetites on the general health claim merely a passing notice in this article. At no former time was it so necessary as at present for medical practitioners to recognise the evidences of these abuses and excesses; to which are due a large and increasing proportion of the disorders, mental and physical, by which human life is embittered or its duration shortened. The pathological results of these abuses, acting through and upon the nervous system, and the long train of maladies thus occasioned, must be familiar to every experienced physician.

THOMAS MORE MADDEN.

SEXUAL FUNCTIONS IN THE MALE, Disorders of.—The most important disturbances of the sexual functions in the male are described under the following headings, to which the reader is referred: IMPOTENCE; MASTURBATION; SPERMATORRHŒA; STERILITY IN THE MALE; and TESTES, Diseases of.

SEXUAL ORGANS, Diseases of. The diseases of the sexual organs in the male and female respectively will be found described under their special headings. *See* PENIS, Diseases of; TESTES, Diseases of; OVARIES, Diseases of; VAGINA, Diseases of; WOMB, Diseases of; &c.

SHAKING PALSY.—A synonym for paralysis agitans. *See* PARALYSIS AGITANS.

SHAMPOOING.—*See* MASSAGE.

SHANKLIN, in the Isle of Wight. Exposure E. Prevailing winds westerly. A bright, picturesque, tonic health-resort, with good sea-bathing. *See* CLIMATE, Treatment of Disease by; and SEA-AIR and SEA-BATHS.

SHINGLES (*cingulum*, a girdle).—A popular name for herpes zoster. *See* HERPES; and ZONA OR ZOSTER.

SHIVERING.—*See* RIGOR.

SHOCK.—SYNON.: Fr. *Choc*; Ger. *Shok*; *Wundstupor*; *Wundschreck*.

DEFINITION.—A condition of sudden depression of the whole of the functions of the body, due to powerful impressions upon the system by physical injury or mental emotion.

Its more obvious manifestations are signs of lowered activity of the cardiac, respiratory, and sensorial functions; and reduction of the surface temperature.

General Description.—If a person be unexpectedly subjected to the influence of extreme terror, if a large bone or joint be shattered, or an important viscus injured, the entire system receives a profound impression, and its functional activity is more or less stunned. The whole body appears to sympathise with the injury inflicted on one of its parts; the patient is prostrated by an indescribable sense of bodily anguish and oppression; he feels sick and faint; is seized with tremor; totters or falls; the surface becomes pale, cold, and covered with sweat; the expression of countenance is vacant, yet anxious; and the respiration and circulation are weak and irregular.

Shock varies in degree, from the most trifling amount, which rapidly disappears, to that producing instantaneous death, as in the case of lightning stroke, or of a severe blow on the epigastrium.

The intensity of shock depends on the nature and extent of the injury producing it; on the co-existence of internal or external hæmorrhage; and also upon the age, habits, temperament, and idiosyncrasy of the individual, and his mental condition at the time of the injury. Direct violence applied to the brain or spinal cord produces shock in the most intense form; but in such cases, which are beyond the scope of this article, the symptoms due to the local lesion predominate, and are, of course, the more important.

Shock is usually immediate in its effects, but sometimes these may be for a time deferred by intense mental preoccupation or excitement. 'Nature,' as Hunter said, 'does not feel the injury.' The soldier during the excitement of battle may be unconscious for a time of the severity of his wound, but presently he is recalled to a sense of danger, and the depression which ensues will be increased in proportion to the previous excitement.

Ætiology.—Intense mental impressions, such as extreme terror or apprehension of death or mutilation, are capable of producing shock in persons of excitable nervous temperament. Some individuals are so readily affected that a certain degree of shock may be induced by the most trifling lesion, or even by the sight of an injury inflicted upon another.

It may be stated generally, however, that whatever is calculated to produce psychical depression will aggravate the shock induced by other causes. Wounds, for instance, inflicted on the soldiers of a beaten army, or on those in a closely besieged town, are often followed by greater shock than are wounds of a similar severity occurring under more favourable circumstances.

Injury is the chief cause of shock. As a rule the more extensive the injury, the nearer it is to the centre, and the more it assumes a crushing character, the greater will prove the amount of shock. The crushing of a finger or bruising of a testicle often occasions severe shock; so also do extensive burns and scalds. Intense pain, without serious organic lesion, is capable of producing shock, as may be witnessed during the passage of a gall-stone through the duct, or of a calculus through the ureter.

Loss of blood associated with the injury greatly augments the degree of shock; and it may be impossible to separate the symptoms due to the more direct physical impression from those caused by the hæmorrhage. Shock is, however, independent of the presence both of pain and of hæmorrhage. During the operation of castration a patient, while under the influence of chloroform, and in the absence of hæmorrhage, may sometimes present symptoms of severe shock the moment the cord is divided. After disarticulation at the hip or shoulder joints, and in other great operations, the patient may present features of shock altogether independently of either pain or loss of blood.

The frequency of shock after operation has diminished since the introduction of anæsthesia, but the prolonged administration of chloroform may itself occasion some of the symptoms; and it is by no means unlikely that fatal accidents during chloroform-administration may be due to the combined depressing influences of the shock and the anæsthetic.

Injuries extensively involving the bones and joints are prone to induce shock. The temperature has been observed in some instances to fall during the sawing of the bone in amputation.

Railway accidents, happening as they do very suddenly, and occasioning great alarm; acute peritonitis caused by the escape of irritating substances into the abdominal cavity, as in perforation in typhoid fever; the strangulation of a hernia; or a sudden and severe intussusception, may each and all be attended by symptoms of shock in a more or less intense degree.

Pathology.—It is still difficult to explain the *modus operandi* by which any kind of physical injury, of sufficient severity, implicating a portion of the body, may produce the set of phenomena known as shock. The story told by the symptoms is one of depression of all the vital functions, associated with the evidence of a diminished circulation of blood in those portions of the periphery which we can examine during life. The integument is blanched and shrunken; the pulse is thready or imperceptible; the veins are collapsed; and open wounds, unless involving large arterial trunks, bleed slightly, or cease to bleed; while the lowered temperature, as registered in the axilla and mouth, marks a coincident diminution of tissue-metamorphosis. That the brain suffers from a similar privation of blood is indicated by the enfeebled pulsation of the carotid arteries; by the anæmic condition of the retinal vessels, as shown by the ophthalmoscope; and by the mental torpor and diminished irritability, conjoined or separate, which constitute invariable features of the condition. How far these changes are shared in by internal organs it is at present impossible to say; but, awaiting further investigations, the facts already known are sufficiently definite and constant to guide us in the direction of a rational pathology.

The manifestations of inadequate blood-supply to the tissues in general are almost identical with those of hæmorrhagic asthenia; but no hæmorrhage may have taken place, and we must seek the blood which has left the anæmic parts in some other vascular territories.

If we make a *post-mortem* examination in a case where death has forestalled nature's effort at reaction, one striking phenomenon is revealed, namely, an enormous distension of the abdominal vessels governed by the splanchnic nerves. Into this capacious set of vessels has been diverted a great mass of the blood destined for other regions; and being thus practically withdrawn from the general circulation, it has produced a useless congestion of the abdominal viscera, at the expense of the nutrition of the rest of the system, while the weakened heart contracts feebly but hastily upon the scanty supply which now passes through its cavities.

Physiologists have taught us the probable cause of this. Long since it was demonstrated that stimulation of the central end of the divided depressor branch of the vagus, in the rabbit, produces an immediate lowering of the blood-pressure in the arteries of the head, neck, and extremities; this effect coinciding with, and depending upon, a dilatation of the abdominal arteries, and a consequent deviation of the blood-flow in the direction of least resistance, or towards the abdominal viscera. If, however, the splanchnic nerves be cut, the reflex circuit is broken and the balance of the circulation becomes restored, or nearly so, although the irritation of the depressor nerve be continued. The experiment of Goltz, of directly paralysing the splanchnic of a frog by sharply striking the abdomen, was followed by the same result as is the reflex paralysis of the same branches through the depressor nerve; and it is likely that the severe shock caused in man by a severe blow on the epigastrium owes its origin to a similarly induced paralytic dilatation of the visceral arteries. Thus for the present we may accept, as the most plausible interpretation of the symptoms of shock, a sudden dilatation of the abdominal vessels, attributable to the loss of inhibitory influence exerted upon the splanchnics, through the medium of a special reflex centre, which is in more or less direct communication with the sensorium, and with all parts of the body. It has been shown that when a rabbit is narcotised by chloral hydrate, stimulation of the central end of the divided sciatic nerve will induce a lowering of arterial pressure, corresponding closely to that initiated by stimulation of the depressor branch; and in all probability a similar experiment upon any nerve containing afferent fibres would be followed by the same result. But if, on the other hand, the same stimulation be performed while the animal is paralysed by curare, it is remarkable that the effect is reversed, the vessels controlled by the splanchnics contracting, and the general arterial tension being consequently increased. These observations are in the highest degree suggestive, and may hereafter form the basis for a plan of treatment of shock that will be a landmark in surgical therapeutics.

Symptoms.—The symptoms of shock are of two kinds—namely, first, those due to a stunning or blunting of the vital powers, aptly styled *Wundstupor* by the Germans; and, secondly, those attributable to mental terror, anxiety, and agitation—*Wundschreck*. These may exist together, or separately, or one may pass into the other.

1. *Pure* or *torpid shock*, as distinguished from the latter form, which may be termed 'erethistic shock,' is manifested, if only slight in degree, by transient symptoms. The patient becomes pale and faint; complains of nausea; trembles; and experiences a sense of oppression, confusion, and anxiety; the surface becomes cold and moist; beads of sweat form on the brow; and the limbs may be unable to support the weight of the body. The duration depends much on constitutional peculiarity; the symptoms either passing off in a few minutes, or lasting for an hour or two. If the shock be severe, the patient immediately after the receipt of the injury is stunned: his senses and consciousness are benumbed; the countenance and the surface generally become deadly pale, and are bathed with sweat; the animation of the face is replaced by a mingled expression of torpor and anxiety; from time to time muscular contractions and uneasy movements of the body may occur, but usually there is an absence of voluntary effort; the eyes are dull, vacant, and motionless, and the pupils are generally dilated; the temperature—an important index to the severity of the shock—ranges from one to two degrees or more below the normal, and is still lower when there has been extensive loss of blood; the respiration is remarkably slow and irregular—faint, scarcely perceptible, inspirations alternating with deep sighs; and the pulse may be almost or quite imperceptible at the wrist, very weak, insufficient, and very rapid. The patient is con-

scious, but he sees and acts as through a haze, and cannot realise his position; urgently questioned, he replies slowly and with evident effort; his voice is weak and hoarse; he may complain of coldness and numbness of his limbs, but appears scarcely sensible of pain. There may be nausea, and even vomiting; and relaxation of the sphincters, with involuntary discharge of fæces, is occasionally observed.

The fall of temperature in shock, excluding cases of injury to the brain and spinal cord—where it is greatest of all—is proportionately greater, other things being alike, in injuries extensively involving bones and joints, in burns and scalds, and in the cases where there has been considerable loss of blood. It is greater in amount in men of forty than in those of twenty. During the War of the Commune a number of observations were taken, and the average temperature varied from 96·5° to 97·5° F., the lowest temperature observed being 93·5° F. The fall was greater after shell- than bullet-wounds; and amongst the insurgents than in the regular troops.

2. In the *shock with excitement—restless* or *erethistic shock*—symptoms of anxiety and restlessness predominate. This form is often witnessed in association with previous hæmorrhage; or when there is great pain, as in crushing injuries of important parts, and in burns or scalds. Individual idiosyncrasy, however, has an important influence upon the condition. The ordinary symptoms of shock, such as pallor, cold surface, frequent pulse, and feeble respiration, are present. The patient in addition betrays a marked and unceasing restlessness, tossing about in bed, and throwing his arms and head from side to side; his consciousness is but little impaired, yet he pays no heed to questions; nothing seems to comfort or quiet him; he appears as if overwhelmed by some indescribable anxiety and oppression, of which he vainly struggles to rid himself. Vomiting and painful eructations are usually present in such cases. There is often considerable tremor, and sometimes the case will pass into well-marked delirium tremens. The torpid may pass into the erethistic form of shock; or shock with excitement may lapse into a torpid condition, which is always a change of bad omen.

Duration.—Shock, unless it be the result of serious or fatal injury, is generally recovered from speedily and completely. It may be quite gone in fifteen minutes or half an hour; or it may continue five or six hours, or longer, and then pass away. The erethistic or restless form of shock does not continue so long as the torpid. The less important the vital lesion; the less it has been complicated with loss of blood; the greater the power of the individual; the less his nervous susceptibility; and, finally, the more efficient the treatment, the shorter will prove the duration of the shock.

Terminations.—Recovery or reaction takes place readily from the milder forms of shock, especially when aided by suitable treatment. From the more severe, it is more difficult and protracted; or the case may end more or less rapidly in fatal collapse. When the reaction proceeds favourably, the pulse becomes stronger and fuller, the respiration deeper, and the bodily warmth returns. The mind appears to awaken to the exercise of its faculties, to shake off its oppression, and to appreciate the nature of the previous injury, and of the existing circumstances; and both the mental and physical equilibrium are by degrees restored. Vomiting is often an early symptom of recovery.

After severe shock symptoms of excessive reaction are not uncommon; and their gravity will vary with the intensity of the previous shock.

The reaction is not always steady. Fluctuations may occur; and relapses after an improvement often occur once or twice, each time, however, with diminished severity. In other cases the symptoms of shock will endure for a much longer period, may increase in intensity, and terminate fatally.

When the torpid form of shock passes into the erethistic, the condition becomes one termed 'prostration with excitement'; the respiration is hurried, the skin hot, and the face flushed. There are great thirst, headache, and scanty urine, with restlessness, tremor, incoherence or delirium, and sleeplessness; and death from exhaustion frequently follows, preceded by a haggard, wild expression of face, a pulse that cannot be counted, subsultus, and hiccough.

Complications and Sequelæ. The complications which may arise are those due chiefly to loss of blood, or peculiar to the form of injury received. From ordinary uncomplicated shock recovery is usually perfect, but occasionally, especially after railway shock, permanent deterioration of health follows, or some impairment of a special sense; or the mental vigour or temper of the individual may be changed for the worse. In these cases organic changes in the nerve-centres have probably supervened. In drunkards the shock of injury very often terminates in an attack of delirium tremens.

Pre-existing organic disease, especially of the heart or kidneys, renders persons more susceptible of the effects of shock, which is then more severe and dangerous.

Diagnosis.—The phenomena of shock bear some resemblance to those of concussion and of syncope. Concussion is usually distinguished from shock by the predominance of intellectual disturbance over the circulatory symptoms; and syncope is in most cases marked by its more transitory duration, and by its origin in loss of blood, or in other well-known causes of the condition. Shock, however, may co-exist with either concussion or syncope.

Prognosis.—This mainly depends on the nature of the injury, and the physical and mental power of the individual. Otherwise, the longer the shock endures, the feebler the manifestations of life, and more especially the lower the temperature falls, the more unfavourable becomes the prognosis. A fall of temperature below 96° nearly always presages a fatal issue. It is a very unfavourable sign when no rise of temperature takes place in four or eight hours after the receipt of injury. Extreme feebleness of pulse and respiration, marked tremor, profuse cold sweats, singultus, a feeling of impending dissolution, and involuntary evacuations, all indicate the gravity of the case.

Treatment.—The objects of treatment in shock are to sustain the lessened vitality, but not to over-stimulate it; and to moderate subsequent reaction when it is excessive.

To apply external warmth is the first and plainest indication, as it is one of the most potent appeals to the misdirected circulation. Hot-water bottles and hot blankets may be applied to the extremities; hot turpentine epithems and sinapisms to the præcordia; and turpentine may be rubbed along the spine with advantage. If the patient cannot swallow, an alcoholic stimulant may be injected into the rectum; and ammonia may be inhaled, or ether subcutaneously injected. Slapping the hands and feet promotes recovery in some cases, but this measure is improper and inefficacious in cases of severe injury, or those accompanied by great loss of blood.

In profound shock, unaccompanied by loss of blood, the breathing must be carefully watched, and failure guarded against by artificial respiration. The phrenic nerve may be usefully stimulated by electrodes placed along its course in the neck and over the epigastrium. If the external jugular vein be gorged with blood, it may prove advantageous to open it, and thus relieve the stagnation of the venous circulation. Where shock has been accompanied by severe hæmorrhage, transfusion of blood, serum, or normal saline solution in extreme cases should be resorted to (*see* Transfusion of Blood). As soon as practicable, nourishment must be administered, as well as stimulants. Tincture of belladonna has been given in half-drachm doses every hour in some cases, with the view of stimulating the cardiac action, and helping to contract the paralysed arterioles. The use of Calabar bean has been recommended, on account of its alleged power to diminish the venous accumulation in the abdomen, by causing contraction of the veins.

If shock be associated with excitement, which should be regarded as a sign of want of power, the patient always requires support; and opium, or, when this drug is not admissible, henbane or chloral hydrate may often be given with advantage. An ice-coil to the head allays excitement and promotes sleep. In the torpid form of shock narcotics are inadmissible. Should inflammatory reaction take place, a regulated diet, rest to mind and body, a gentle mercurial purge when the secretions are deranged, and in young plethoric subjects the cautious administration of antimony, or a local blood-letting, are the chief means to be adopted. Throughout the treatment caution should always be exercised not to strain the action of remedies too far.

The question of operation in shock may occasionally be difficult to solve. As a rule, a patient suffering from severe shock should never be operated upon; unless, indeed, bleeding be going on, or the arteries and nerves are much exposed and lacerated from the violence of the injury. When an operation appears to be compulsory no anæsthetic is required. It is better, however, to await partial reaction whenever it is possible to do so; but in some cases operation, by relieving the patient of the pain and distress caused by, for instance, a crushed limb, will at once procure an abatement of the condition of shock.

William Mac Cormac.

SHORTNESS OF BREATH.—*See* Respiration, Disorders of.

SHORT - SIGHTEDNESS. — *See* Myopia; and Vision, Disorders of.

SIALAGOGUES (σίαλον, saliva; and ἄγω, I move).—Synon.: Fr. *Sialagogues*; Ger. *Speicheltreibende Mittel*.

Definition.—Remedies which increase the secretion of saliva.

Enumeration.—The principal sialagogues are Dilute Acids, Ether, Ginger, Rhubarb, Horseradish, Iodide of Potassium and other iodides, Jaborandi, Mezereon, Mercury and its salts, Mustard, Tobacco, Physostigmine, Pyrethrum, and Pebbles.

Action.—There are two essential factors in the secretion of saliva: the first is the activity of the secreting cells in the gland; the second is a sufficient supply of nutritive material to them, from which they may form a secretion. This nutritive material, though it may be derived directly from the lymph-spaces around the cells, must be ultimately supplied by the blood circulating through the glands. Usually, therefore, when the gland is in action, the supply of blood is greatly increased, the arteries dilating, and the blood flowing rapidly through them. Some drugs, such as physostigmine, will stimulate the secreting cells, while they contract the blood-vessels; under these circumstances, although the secretion may begin actively, it soon comes to a standstill from want of material. The secreting cells may be excited to activity by substances which stimulate the nervous structures within the gland itself, as, for example, Calabar bean (physostigmine); by stimuli proceeding directly from the encephalon, as seen in salivation occurring from the mere idea of savoury food; and by stimuli applied to the mouth and exciting the gland reflexly. Nausea is almost always accompanied by salivation, and substances which cause nausea almost invariably cause salivation, the irritation of the stomach causing reflex salivary secretion. The stimulus here passes up the afferent nerves to the medulla, and travels down the efferent nerve to the gland.

Sialagogues are divided, according to their mode of action, into two classes—(1) *topical* or *direct*; and (2) *specific*, *remote*, or *indirect* sialagogues. The names *direct* and *indirect* are complete misnomers, just as they are in the case of emetics, and they ought to be discarded, inasmuch as the so-called 'direct' sialagogues are those which do *not* act directly on the gland, but on the mouth; and the 'indirect' are those which do act upon the gland, affecting either the nervous structure contained within it, or the nerve-centres directly connected with it.

The *topical* sialagogues are dilute acids, ether, ginger, rhubarb, horseradish, mezereon, mustard, pebbles, pyrethrum, and tobacco. The *remote* sialagogues are iodide of potassium and other iodides, jaborandi, mercury and its salts, physostigmine, and tobacco.

Topical sialagogues excite secretion of saliva reflexly, the afferent nerves being the lingual and buccal branches of the fifth, and the glosso-pharyngeal nerves. The afferent nerves, through which nauseants probably excite the salivary secretion, are the vagi.

Of remote sialagogues, iodide of potassium probably acts upon the gland-structures, but upon which part has not yet been determined. It may, however, also act reflexly, by stimulating the sensory nerves of the mouth, as it is excreted in the saliva, and the taste of it is often persistent. Mercury probably acts partly by affecting the gland-structures, and partly by affecting the mouth. Jaborandi, physostigmine, and tobacco appear to affect the terminal branches of the secretory nerves in the glands.

Uses.—Saliva is useful in keeping the mouth moist, and thus facilitating mastication, deglutition, and the movements of the tongue in speaking. By moistening the fauces it also prevents or lessens thirst. A pebble placed under the tongue, or masticated, will keep up a slight flow of saliva, and may be useful for these purposes. Where this is insufficient, dilute acids are employed (*see* Acids). As the flow of blood to the glands is greatly increased during secretion, sialagogues, and especially pyrethrum, have been used as derivatives, to lessen inflammation, congestion, and pain in other parts of the head, as in toothache, earache, and inflammation of the ear, nose, or scalp. Saliva has also, however, a digestive power upon starch, and increase of the flow may be advantageous in imperfect digestion of this substance. When swallowed, the saliva stimulates the secretion of gastric juice, and increased salivary secretion therefore tends to aid gastric digestion. To attain this object it is best to chew a piece of ginger or of rhubarb.

T. Lauder Brunton.

SIBBENS.—This term, derived from a Scotch word signifying 'kindred' (cf. German *Sippschaft*), is suggestive of a disease prevalent in families, and presumed to be a form of syphilis.

SIBILANT RÂLE or RHONCHUS: SIBILUS (*sibilus*, whistling).—A variety of dry *râle* or rhonchus, of a whistling or high-pitched musical character, usually produced in the smaller divisions of the bronchi. *See* Physical Examination; and Rhonchus.

SICILY.—A warm, moist, winter climate. Climate of base of Etna more variable than of N. coast. *See* Climate, Treatment of Disease by; and Palermo.

SICK-HEADACHE.—A popular synonym for megrim. *See* Megrim.

SICKNESS.—A common synonym for vomiting. *See* Vomiting.

SIGHT, Disorders of.—*See* Vision, Disorders of.

SIGNS OF DISEASE.—*See* Disease, Symptoms and Signs of; and Physical Examination.

SIMPLE IDIOPATHIC MUSCULAR ATROPHY. — *See* Progressive Muscular Dystrophy.

SINGULTUS (Lat. sobbing, hiccough). A synonym for hiccough. *See* Hiccough.

SINUS (Lat.). — Pathologically, sinus means a narrow track of variable length, leading from a chronic abscess to a free surface. *See* Abscess.

SINUSES, CEREBRAL, Diseases of.—*See* Meninges, Diseases of.

SINUSES, NASAL, Diseases of.—*See* Nose, Diseases of.

SIXTH NERVE, Diseases of.—The sixth nerve, or *abducens oculi*, confers motor power on the external rectus muscle of the eyeball, and its morbid states of excessive or defective function are indicated by corresponding spasm or paralysis of that muscle.

1. **Spasm of the external rectus.**—This condition is very rare, except as a consequence of some change in the visual functions

of the eye. The external rectus may then habitually overact. Permanent contraction occurs when there is complete paralysis of its antagonist, the internal rectus. Spasm may occur from irritation of the nucleus or fibres of the sixth nerve, as in meningitis of the base. The symptoms are inclination outwards of the affected eye, and consequent divergent strabismus. The treatment is that of the cause on which it depends. *See* STRABISMUS.

2. **Paralysis of the external rectus.** ÆTIOLOGY. — Among common causes are tumours, and other lesions within the pons, and various forms of syphilitic disease. The latter may cause a specific growth on the nerve, or damage it by inflammation and compression by the new tissue which is so abundantly formed in syphilitic meningitis. It suffers also in other forms of meningitis with great readiness, on account of its long course, which renders it liable to be involved in various regions of the base, and to be affected more frequently than any other cranial nerve. Its exposed course also causes it to suffer with readiness from distant pressure, and it often first reveals a general increase in pressure beneath the tentorium. Hence tumours of the base of every kind are frequent causes of its paralysis. From disease in the anterior part of the base, at the orbital fissure, and within the orbit, the nerves to other ocular muscles are usually also involved. Isolated neuritis, due to cold, is a rare cause. Transient or permanent paralysis of the sixth nerve sometimes accompanies sclerosis of the posterior columns of the spinal cord (locomotor ataxy); its cause is obscure.

SYMPTOMS.—Paralysis of the external rectus causes inability to move the affected eye outwards, and hence convergent strabismus, and homonymous diplopia when looking at an object on the affected (*e.g.* left) side of the middle line, the images becoming more distant as the object is moved to the left; but parallel, and on the same level, so long as it is on the horizontal plane. When looking up or down as well as out, the second image slants, the two being nearer together at the lower end, and the second image the lower of the two when looking up and out. On looking down and out, the two images are nearer together at the top than at the bottom, and the second image is on a higher level than the other. There is erroneous projection of the field of vision, and a tendency to giddiness when the affected muscle is used.

DIAGNOSIS.—Paralysis of the sixth nerve is easily recognised, except when slight in degree. In the latter case it may often be detected by a careful search for the diplopia, or by the secondary deviation of the sound eye in the same direction when that eye is covered and an object fixed by means of the weak muscle. *See* STRABISMUS.

PROGNOSIS.—The prognosis is most favourable when the paralysis is due to cold or syphilis; least favourable when due to meningitis or tumour. When associated with ataxy, it is usually recovered from, but a return is common, and a recurrence frequently does not entirely pass away.

TREATMENT.—When the complaint is of rheumatic origin, the treatment should consist of hot fomentations to the temple; counter-irritation by blisters; and iodide of potassium and tonics internally. If of syphilitic origin, iodine or mercury should of course be given.

In spinal mischief, strychnine and arsenic may be employed. In obstinate cases the use of faradisation, or the slowly interrupted voltaic current, has been recommended, applied to the muscle through the eyelid, or to the temple to produce a reflex effect. The direct application to the muscle through the conjunctiva is too painful. The value of any electrical application is, however, extremely doubtful.

W. R. GOWERS.

SKIN, Discoloured.—*See* PIGMENTARY DISEASES OF THE SKIN.

SKIN DISEASES.—SYNON.: Fr. *Maladies de la Peau*; Ger. *Hautkrankheiten.*—INTRODUCTORY.—It is necessary in the first place to explain clearly what is included in the expression 'diseases of the skin.' The skin itself is a complicated structure containing a large number of glands, and made up in the main of fibro-vascular and nervous tissues. Its structure being similar to that of many other parts of the body, we should expect to find it liable to similar diseases, and this is in fact the case. We meet with, for example, the various pathological changes common in other organs, such as morbid growths, hypertrophy, atrophy, and hæmorrhage; it is also liable to congestion and inflammation, similar to if not identical with those found in the mucous membranes; and its glands are equally liable with other glandular organs to functional derangements. This being the case, it must be always borne in mind that skin diseases, although they present to the naked eye appearances quite peculiar and unlike anything that we are in the habit of seeing in other parts of the body, yet are due to exactly the same pathological processes that we are familiar with elsewhere.

Most writers on diseases of the skin have included under this head not only diseases proper, but also what we may call symptomatic rashes, such, for example, as the eruptions of contagious fevers, and the rashes produced by drugs. They have, in addition, included some general diseases in which the changes in the skin form a striking or prominent feature, such, for instance, as leprosy and syphilis. With regard to the class of exanthematous eruptions, it may be said that they are not now usually classed among skin diseases, although it must be admitted that such affections as small pox and chicken-pox are quite as much diseases of the skin as many others that are still retained in that category. The fact that the eruptions of the exanthemata are really symptomatic of certain general maladies has tended to foster the belief that skin diseases are also only symptomatic of changes going on in other parts of the body; this, however, is by no means always or even generally the case. A similar erroneous view, that skin diseases are only eruptions, has been much favoured by the nomenclature and classification of Willan, which has had an enormous influence on all subsequent writers nearly up to the present time; so that even at this day it is not very uncommon to hear a medical man of the old school speak of a patient as suffering, for example, from eczema, lichen, and psoriasis at one and the same time on different parts of the body, according as the eruption is vesicular, papular, or scaly.

NOMENCLATURE.—At the present time, when there is a free interchange of views between different members of the profession both at home and abroad, a uniform nomenclature for skin diseases is highly desirable. A very close approximation to this has already been attained in all the principal countries of Europe and America. This result has been gradually brought about, not by any sudden change, but by a steady exclusion of those names that are useless or obsolete, and the retention of those only that have a definite meaning or indicate definite diseases. Most of these names have become familiar by long use, but have now assigned to them a more exact and scientific value than formerly.

In addition to the exclusion of superfluous names and the more accurate application of others in use, a further change has been made by the introduction of a small number of new names. Some of these merely replace old ones, as, for example, 'xanthelasma' replaces 'vitiligoidea'; in other cases, old but suitable names have been substituted for inconvenient ones, as 'lepra' for 'elephantiasis Græcorum'; and, lastly, a very few newly discovered diseases have required new names. It should always be remembered that, *cæteris paribus*, *single* are preferable to double names. The latter, however, cannot be entirely avoided; but in this respect we are slowly moving in the right direction—for instance, the names 'lepra,' 'zona,' and 'area' are preferable to their synonyms, 'elephantiasis Græcorum,' 'herpes zoster,' and 'alopecia areata'; indeed, everything that tends to simplify names is an advantage. The *Nomenclature* published by the Royal College of Physicians is the one now in general use, and leaves little room for improvement.

To those who have not made a special study of skin diseases, the nomenclature, in spite of all improvements, is still puzzling. This is easily explained: it arises from the fact that a large number of synonyms have gradually accumulated in past times. Each writer who thought he had discovered a new disease gave it a name; sooner or later it was found to be no new disease at all, but the error lasted long enough to add another synonym—for example, there are at least six synonyms for tinea tonsurans, all more or less in use; and so with other common skin diseases.

Up to this point all writers are agreed. There are, however, the following eruptions with regard to the nomenclature of which some difference of opinion exists: (1) mixed or hybrid skin diseases; (2) syphilitic skin diseases; (3) medicinal rashes.

1. *Mixed or hybrid skin diseases.*—It is rather unusual to see two definite diseases of the skin occurring at the same time in one and the same person; it does, however, sometimes occur. It is obvious, for instance, that scabies and ringworm may be met with in those who are liable to eczema or psoriasis, or that acne may be present in a person suffering from lupus. When two skin diseases are present at the same time, they generally remain quite distinct, so that it may be stated definitely that hybrid skin diseases rarely, if ever, exist; and therefore hybrid names, such as 'lupus-psoriasis,' should be avoided.

2. *Syphilitic eruptions.*—It was formerly the custom to apply to syphilitic eruptions the names of those ordinary diseases of the skin which they most closely resemble, preceded by the name 'syphilitic.' Thus we have syphilitic psoriasis, syphilitic lupus, and even syphilitic varicella. These names have not been used to indicate any mixture of two diseases, but simply as a convenient form of nomenclature. Syphilitic psoriasis would, of course, mean not a hybrid disease, but a syphilitic eruption resembling psoriasis. It is admitted that the nomenclature is convenient, but it is nevertheless erroneous, and it is especially misleading to beginners. Take, for example, one common misnomer—syphilitic lupus; what can be more puzzling to a student who has studied the pathology of lupus than to hear his teacher speak of *syphilitic* lupus? Although we may lose some descriptive force in speaking and writing, yet on the whole it is better to use such terms as macular, papular, vesicular, squamous, pustular, and ulcerating syphiloderma, than to retain the old erroneous nomenclature. And when we consider how very polymorphic syphilitic eruptions are, we soon perceive that the modern nomenclature has its advantages; it is always awkward, for example, to speak of a patient as suffering from syphilitic psoriasis in one part of the body and syphilitic lupus in

another, whereas we can more easily and correctly speak of squamous and ulcerating dermato-syphilis.

3. *Medicinal rashes.*—Cutaneous eruptions are occasionally produced by the administration of drugs, and the nomenclature often applied to these rashes is similar to that formerly applied to syphilitic eruptions, and is open to the same objections. In these cases it is better to name the eruption from the drug which has produced it; for example, whatever the form of the eruption produced by bromide of potassium, it is best to call it simply a bromide of potassium rash.

We may briefly sum up our conclusions thus:—

(1) It is very doubtful whether hybrid skin diseases exist at all; and certainly there is no justification for a hybrid nomenclature.

(2) Syphilitic eruptions differ from ordinary skin diseases in their ætiology, pathology, and treatment; and that this difference should be fully recognised in our nomenclature.

(3) Medicinal rashes are not diseases of the skin, but simply eruptions, and should be so named.

Classification.—Dermatologists have always found a fascination in attempts to classify diseases of the skin; it must be admitted, however, that the results of such attempts, though interesting, have been of little practical value.

In natural sciences—such, for example, as botany and zoology—the value of classification is evident enough; but when you have to deal with so small a number as seventy or eighty diseases at most—which, moreover, are not natural and therefore do not admit of a natural classification—the difficulty and practical inutility of the result become obvious. The past history of classification is both interesting and instructive.

About the year 1780 Plenck, a professor at the University of Buda-Pesth, published a classification of skin diseases, which has practically held its ground till recent times. Plenck's classification was based chiefly on the anatomical characters of the eruption or elementary lesions, and he divided skin diseases into the following fourteen classes: (1) Maculæ; (2) Pustulæ; (3) Vesiculæ; (4) Bullæ; (5) Papulæ; (6) Crustæ; (7) Squamæ; (8) Callositates; (9) Excrescentiæ; (10) Ulcera; (11) Vulnera; (12) Insecta cutanea; (13) Morbi unguium; (14) Morbi capillorum. This method of grouping was a very good one for the time in which it was published. Willan followed Plenck very closely, and his eight orders correspond to eight of Plenck's. He, however, wisely omitted the order Crustæ, and introduced the order Exanthemata, a doubtful gain. Willan's classification was based entirely on the elementary lesions, and in this respect was more logical, though less comprehensive, than Plenck's. Hebra has in his system of classification reintroduced Plenck's orders 10 and 12.

Alibert tried to classify skin diseases according to their natural relationship, but his attempt was a signal failure. In the year 1844 Hebra introduced his system of classification, based chiefly on morbid anatomy, and up to the present time it has been almost universally adopted as a basis of classification which, on the whole, presents fewest objections. Hebra divides skin diseases into the following twelve classes:—

(1) Hyperæmic affections of the skin; (2) Anæmic affections of the skin; (3) Morbid conditions of the secretions of the cutaneous glands; (4) Exudations; (5) Hæmorrhages; (6) Hypertrophies; (7) Atrophies; (8) Innocent growths; (9) Malignant growths; (10) Ulcers; (11) Neuroses; (12) Parasites. Of these he remarks: 'For the denomination of the first eleven classes or families I have employed the name of a pathological process—that is to say, of a thing which, being only a conception of the mind and invisible, can be recognised only by its effects. On the other hand, the name of the twelfth class is derived from the cause of the diseases which belong to it, which cause is positive and has a real existence. But, although I must thus admit the logical defect in the principle of classification which I have adopted, yet I have not been able to remedy it without risking the practical usefulness of the system.' He further remarks: 'The separation of the eighth from the ninth class may be termed arbitrary and even incorrect from the histological point of view. Again, in accordance with precedent, it was not necessary to have introduced ulcers into dermatology, at least not as a distinct class.'

A study of the correlation of skin diseases is always interesting and useful, but when any attempt is made to reduce their relationships to an exact system of classification, the difficulties of the task become apparent; and time does not tend to remove them, for as our knowledge becomes more exact and extensive, the more clearly do the difficulties appear.

Diagnosis.—The diagnosis of skin diseases is often attended with difficulty. This arises from the fact that their development is liable to great irregularity, so that no two cases, even of the same disease, are exactly alike. Nothing is easier than the diagnosis of typical cases, such, for example, as we should choose for the purpose of illustration; unfortunately a considerable number are abortive, and present an appearance quite different from what we are in the habit of regarding as the usual type. These remarks apply not so much to rare diseases as to many of the common forms; but, in addition to this, we meet from time to time with altogether anomalous cases which do not correspond with any of those described in our text-books. These latter, however, are extremely rare, and do not form any serious impediment to ordinary diagnosis.

In order to make a successful diagnosis of diseases of the skin, the following points are worthy of especial attention:—

1. A rule of great importance is to examine as far as is possible the different parts of the body on which the eruption is present. The necessity of this arises from the fact that a disease may exhibit a very different appearance in one region from what it does in another; it may, for example, be abortive in one part and typical in another. Syphiloderma supply us with many examples which illustrate this point. Some portions of the eruption may be highly characteristic, while others would hardly serve as a means of diagnosis.

2. In conducting an examination, our object is in the first instance to take a broad view of the eruption as a whole, irrespective of the particular elementary lesions. We do this almost instinctively, and comprehend at a glance the importance of combination and arrangement, and that this or that elementary lesion, taken singly, does not constitute the skin disease; thus, when we speak of a vesicular, papular, pustular, or squamous disease, we convey but a very imperfect idea of its nature. The parts of the body affected, the tissues involved, the form, arrangement, and grouping of the eruption, the degree of inflammation, and many other points, are often of as much importance as the minute anatomical details.

3. In any given case under observation we should always distinguish what is essential from what is non-essential or accidental; what belongs to the original affection from what has been superadded; and we should select for special examination those portions of the skin in which the disease is least complicated; for example, in order to demonstrate the presence of the itch acarus, we do not choose a part of the body that is thickly covered with crusts, but we endeavour to find it in a patch of soft skin nearly free from secondary inflammation. Endless examples might be given of the changed appearance that skin diseases present from being complicated with cutaneous hæmorrhages or urticaria, or with the excoriations produced by scratching or even by treatment.

4. The distribution of the eruption is often a valuable aid to diagnosis. As a rule, when eruptions appear symmetrically on various parts of the body, we have to deal with a more or less constitutional malady, or one due to a specific poison pervading the system. Psoriasis and prurigo would furnish examples of the former, and the exanthemata and secondary syphilis of the latter class of cases. Some diseases, on the other hand, are invariably confined to certain parts, as gutta rosea and sycosis. Other affections, though not so strictly localised, yet have a marked preference, to use a common expression, for certain regions; for instance, erythema nodosum is commonly confined to the legs, acne to the face and shoulders, tinea versicolor to the trunk, lupus erythematosus to the face and ears, area to the scalp and hairy parts of the face; and to these examples many more might be added.

5. Hitherto those phenomena in skin affections which are appreciable to our senses of sight and touch have alone been referred to, namely, the general character of the eruption, the tissues involved, and the parts affected. There are, however, other means of diagnosis, less perfect in their nature, and less under our immediate cognisance—the subjective sensations of the patient. The more important of these are itching, burning, or tingling and neuralgic pains; they are, however, of minor diagnostic value.

6. The history of the case may sometimes be valuable as an aid to diagnosis; its value is, however, generally over-estimated. It is quite common, for instance, to lay too much stress on a previous history of syphilis; on the other hand, the history of two or three members of a family suffering from the same disease may occasionally assist the diagnosis in a doubtful case of ringworm or scabies. The age, sex, and occupation of the patient should always be included in our consideration in dealing with this part of the subject, as these factors are not without their bearing on the development of certain cutaneous maladies.

We may sum up the foregoing remarks on diagnosis briefly thus: (1) Examine all parts of the body on which an eruption is present; (2) take a general view of the eruption regarded as a whole; (3) separate it into its component parts, and distinguish what is of the essence of the disease from what is superadded; (4) observe the regions affected; (5) investigate the subjective sensations; (6) ascertain the past and present history, and the general condition of the patient.

Treatment.—Little need be said on the treatment of skin diseases generally; each disease, and indeed one may say each case, requires special treatment of its own. A few points may, however, be mentioned which are of general application.

There are several different methods of treatment in common use: (1) The strictly local treatment by means of ointments, lotions, powders, bandages, and other appliances; (2) the treatment by various kinds of baths, including vapour and Turkish baths; (3) treatment by internal medicines; and (4) general treatment, including diet, rest, change of air, and other similar remedies.

With regard to the first of these, namely, treatment by strictly external remedies, it is all that is required in dealing with those skin affections which are entirely local—such, for instance, as scabies, ringworm, tinea versicolor. When, however, we attempt to cure diseases such as psoriasis or eczema simply by local means, though we may have little difficulty in getting rid of the eruption, the cure is usually of very short duration. For example, the cure of psoriasis by chrysophanic acid ointment, or of symmetrical eczema by ichthyol ointment, is usually followed by a speedy return of the malady. If, on the other hand, the local treatment is combined with the use of suitable medicines, and other more general remedies, especially such as have some definite or specific effect on the disease, we may reasonably hope for a more lasting cure; at all events, the results of experience prove that this is the case, whatever may be the therapeutical explanation of the fact.

Treatment by baths occupies an intermediate position between the strictly local and the general remedies, though no doubt they belong more to the former than to the latter category. They are especially useful in dealing with chronic scaly diseases, such as psoriasis, and also in the treatment of syphiloderma.

Lastly, some forms of skin diseases, such as gutta rosea and many kinds of eczema, are aggravated and perpetuated, if not produced, by indigestion, want of rest, and mental troubles and anxieties; therefore suitable diet, rest, and change of air and of surroundings, will not be without their influence in effecting a lasting cure.

Robert Liveing.

SKIN-BOUND DISEASE.—A popular synonym for sclerema neonatorum. *See* Sclerema Neonatorum.

SKIN-GRAFTING. — Skin-grafting consists in the transplantation of portions of skin of varying size and thickness from a healthy part of the body of the patient himself, or of some other person or animal, on to a recently made raw surface or a granulating sore.

Skin-grafting thus differs from a plastic operation, which involves the shifting of a flap of skin and subcutaneous tissue from one part of the body to another, without completely dividing its vascular connexions with contiguous parts.

Methods.—Several years ago Reverdin introduced the plan, which might more properly be called epidermis grafting, of placing minute portions of the superficial layers of the skin, containing, however, the cells of the *rete Malpighii*, on a healthy granulating surface, to which they adhered and served as the starting-points for the spreading of epidermis over it. The grafts were shaved off from any healthy part of the skin with a sharp knife, the incision being barely deep enough to draw blood. They were then placed, with the deep surface downwards, on the sore, and not very far from one another, as each graft does not, as a rule, grow readily to a larger size than that of a sixpenny-piece. It is presumed that in all operations for skin-grafting close attention will be paid to keeping both the graft and the sore aseptic, the way of doing which will be given in a later paragraph. Neglect of this precaution exposes the grafts to the irritating influence of putrefaction, which much endangers their vitality.

More recently Thiersch has brought forward a great improvement on this method. It consists in shaving off with a razor a strip of the superficial parts of the skin (as in Reverdin's plan, going just deep enough to draw blood, but no deeper) one inch wide and of any required length, and preferably from a part where the skin is soft, such as the aspect of flexion of the arm. This strip is cut into pieces half an inch or more long, which are to be placed quite close together over the granulating or raw surface. If the former, the superficial granulations must be previously scraped away so as to remove any irregularities and leave behind only a material which, though highly vascular, is little prone to contract, because it has already contracted as much as is possible. The grafts must not be placed in position until all bleeding has stopped, and this result may be encouraged by exerting pressure with a sponge over a piece of some smooth material like the oiled-silk protective placed upon the wound. Mr. Cheyne has more recently still recommended that the whole thickness of the skin should be used for the grafts. This has the disadvantage that contraction must occur in the part from which the graft is removed, but the advantage that it is reduced to a minimum in the part to which the graft is transplanted. It should certainly be adopted in cases such as excisions of the mamma, where a piece of redundant skin from the axilla is used to fill a gap between the flaps on the front of the chest. The deep surface of the graft may be prepared by chipping off, with a sharp pair of fine scissors curved on the flat, any pieces of fascia or fat remaining adherent to it.

Precautions.—In performing the operation, the part from which the graft is to be taken must be purified by shaving it and washing it thoroughly with a solution of carbolic acid 1 to 20, of corrosive sublimate 1 to 500, or a mixture of the two; and, if any time is to elapse between its removal and its application to its new seat, it may be kept in a solution of boric acid heated to the temperature of the body. If it is to be placed on a surface which is already septic, this must be prepared by the application for a few days of a moist antiseptic application frequently changed, say, boric lint soaked in a 1 to 2000 sublimate solution; and it is often well to begin this treatment by purifying the skin with 1 to 20 carbolic acid lotion, and the sore with a solution of chloride of zinc, 40 grs. to 1 oz. A piece of oiled-silk protective should be placed on the grafts before the antiseptic dressing, whatever it may be, is applied. If the grafts be not placed close together, lines of granulations may form between them, and much interfere with the presentableness and stability of the scar.

Some surgeons have obtained the grafts from the skin of frogs and other animals, but we have not sufficient knowledge yet to speak positively in recommending this plan. The best and safest source of supply is undoubtedly the skin of the patient himself, for it has happened that both tubercle and syphilis have been transmitted when the graft has been taken from another person.

In *plastic operations* a flap of skin and subcutaneous tissue decidedly larger (as three to two) than the surface to be covered is turned up from some contiguous or distant part, but left attached by a sufficiently wide base to ensure its retaining its vitality. The flap is then shifted round and secured by sutures to the raw surface, which it must accurately fit. If the part from which it is to be transplanted be at some distance from that to which it is to be adapted, the part on which the latter is situated must be firmly secured in position until the flap has formed its new connexions, when the pedicle is to be divided, and the part to which it has now become adherent is allowed to assume its natural position.

RICKMAN J. GODLEE.

SKODAIC RESONANCE.—A peculiar high-pitched resonance, found chiefly at the sterno-clavicular region of the chest, in some cases of pleural effusion and certain other conditions. The importance of this physical sign was first pointed out by the late Professor Skoda of Vienna. *See* PHYSICAL EXAMINATION; and PLEURA, Diseases of.

SKOLIOSIS (σκολιός, crooked). — A synonym for lateral curvature of the spine. *See* SPINE, Diseases and Curvatures of.

SKULL, Diseases and Deformities of.—SYNON.: Fr. *Maladies du Crâne*; Ger. *Krankheiten des Schädels*. The principal diseases and deformities of the skull will be discussed in the following order: (1) Changes of shape; (2) Variations in size; (3) Meningocele and Hernia Cerebri; (4) Cephalhæmatoma; (5) Inflammation; (6) Rickets; (7) Craniotabes; (8) Syphilis; and (9) Tumours.

1. Changes of Shape.—The shape of the skull not only varies much amongst the different races of mankind, but in each race variations are to be found, sometimes depending upon, sometimes independent of, disease in the individual. A glance at any extensive collection of crania is sufficient to indicate how much longer some skulls are than others, in proportion to their width; how in some the vertical diameter is proportionally great, in others small; how some have wide cheekbones, some depressed noses, and others projecting jaws. The old classification of Blumenbach has now been superseded by the numerous and minute observations of recent investigators. For a short account of the methods of craniometry now in use, and of the present transitional state of the science, the reader is referred to the tenth edition of Dr. Jones Quain's *Anatomy*, vol. ii. p. 82, where he will also find references to most of the important works upon the subject.

The skull is seldom perfectly symmetrical; the asymmetry being usually more marked behind than in front. This is shown not only by a coarse examination of the exterior, but by referring to the differences between the sulci and foramina on the two sides, which are so commonly met with. A familiar illustration is afforded by the fact that the nose is rarely, if ever, exactly in the mid-line of the body; but much more striking deviations from perfect symmetry may occur, as, for instance, in a case reported by Mr. Pearce Gould to the Pathological Society, in which one half of the cerebellum was absent, and there was a corresponding deficiency of the cerebellar fossa on the occipital bone. Many savage races produce abnormalities of the shape of the skull, by the application of external pressure during early infancy; and a similar result has been supposed to be consequent on the method of wrapping up the heads of children that is adopted in some parts of France. A marked asymmetry of the skull accompanies that rare disease, 'hemiatrophy of the face,' which is said by Mr. Hutchinson to be related in some way to morphœa. There are also recorded cases of hypertrophy of the bones of the face and skull. A remarkable instance of this disease, or rather of the development of enormous hyperostoses, was shown by Mr. Hutchinson, in his lectures on *Surgical Affections of the Nervous System*, at the Royal College of Surgeons. Here the hyperostoses appeared closely confined to parts which were supplied by branches of the fifth nerve. Some of these hypertrophic cases are, no doubt, examples of exostosis, others of inflammatory enlargement. An uniformly thickened skull, depending presumably, though not certainly, on the latter cause, may be either porous like cancellous bone, or dense and heavy like ivory. There is in the museum of the College of Surgeons an example of both varieties, each of which measures in many parts no less than ½ in. in thickness; in the porous variety the sutures are usually more or less completely ossified. The writer has seen a case in which, without apparent cause, the growth of one half of the lower jaw appeared to be arrested about the age of puberty, which gave a peculiar inequality to the face. Great deformity of the skull may result from the constrained position in which the head is held by patients suffering from torticollis.

2. **Variations in Size.**—The size of the skull is also subject to considerable variations in different races. It is somewhat larger, on the average, in men than in women. Amongst individuals also there are very great differences. Great intellects have sometimes been associated with large crania, but oftener there has been no such relationship, and not infrequently the opposite has been the case. Far greater, however, are the modifications of size which depend upon pathological conditions and defects of development. Some of these are briefly as follows:—

(*a*) *Microcephalic idiots.*—Amongst this class of idiots, which must be made to include the cretins, the skull is remarkably deficient in size. Microcephalic skulls may be caused by a too early union of the sutures, in which case the want of development of the brain may be looked upon as a result of this synostosis; or there may be a normal condition of the sutures as regards union, but both the brain and the skull may remain undeveloped. The low forehead and animal face which are characteristic of this condition give a strangely repulsive appearance to the child. The degree of idiocy depends upon the size and structure of the brain, and the development of the convolutions. *See* CRETINISM.

(*b*) *Anencephalic monsters.*—This class exhibits a more or less complete deficiency in the development of the cranial bones, as well as of the brain. The great variety of abnormalities which may be met with will be found described in the article BRAIN, Malformations of.

(*c*) *Hydrocephalic infants.*—The skulls of these infants are of a size proportionate to the amount of fluid which is present, and they may thus sometimes reach enormous dimensions. The forehead reaches far over the face, so that the plane of the upper wall of the orbit is continuous with that of the perpendicular part of the frontal bone. The bones become excessively thin, and are often in part replaced by membrane. The sutures gape, and the fontanelles remain open far beyond the normal time of closure, occasionally indeed beyond the period of infancy. *See* HYDROCEPHALUS, Chronic.

In this connexion must be mentioned that extremely rare disease in children—hypertrophy and sclerosis of the *brain*, which involves a corresponding increase in the size of the skull. *See* BRAIN, Hypertrophy of.

3. **Meningocele and Encephalocele.** Closely related also to hydrocephalus are the cases of meningocele and encephalocele. It may briefly be stated here that they involve the existence of a deficiency at some point of the skull, through which the membranes of the brain, containing either cerebro-spinal fluid only, or some part of the brain itself, may protrude. The most frequent seat of this disease is the occipital bone, and the next in frequency the nasal part of the frontal bone, but tumours of this nature have been met with in other situations. It is of the highest importance to diagnose these two kinds of tumour from those developed in the bones of the skull or outside them; mistakes in diagnosis have not infrequently led to most disastrous results, as, for example, when a meningocele has simulated a polypus of the nose, and its removal has been undertaken. If patients who have suffered from meningocele or encephalocele recover—a most rare occurrence—a small hole may remain in the bone which presented the deficiency, or the opening may be completely obliterated.

4. **Cephalhæmatoma.** — True cephalhæmatoma is a collection of blood between the periosteum and the skull. It occurs congenitally, usually on the right parietal bone, but often on the left, and as a rule varies in size from an inch to two inches in diameter; and it is surrounded by a hard, well-defined margin, which at first consists merely of blood-clots, but, if absorption be long enough delayed, is ultimately the seat of a deposit of bone. It is probably in most cases, if not in all, the result of mechanical violence during delivery. An exactly similar condition is often seen as the result of a contusion in later life. If left alone, a cephalhæmatoma generally disappears. If suppuration have taken place, incicion becomes necessary. *See* CEPHALHÆMATOMA.

The term 'cephalhæmatoma' might equally well be applied to collections of blood between the dura mater and the skull. Such effusions are probably always traumatic, and result from the rupture of a meningeal artery or vein. If serious results do not immediately follow from pressure on the brain, considerable thickening of the dura mater may be set up, accompanied by the symptoms known as those of pachymeningitis. *See* MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.

5. **Inflammatory Diseases.**

(*a*) *Inflammation of the diploë and its veins.*—In cases of injury to the skull, whether of the nature of fracture or of simple exposure in a scalp-wound, inflammation of the diploic veins is not uncommon, if the wound be allowed to putrefy. In a bone so affected, if the outer table be removed, the whole diploë and its veins are found to be filled with pus, or, on applying a trephine, the pus may be seen to exude from the divided veins. The dura mater, under such circumstances, may be inflamed, or pus may collect between it and the bone. Pyæmia, with its characteristic concomitant symptoms, is the frequent, if not the invariable, result. It is not assumed that in this affection the outer and inner tables of the skull escape, but it is only in the diploë that the pathological process is obvious to the naked eye.

The only treatment that has been suggested—trephining—does not offer any hope of curing the disease.

(*b*) *Chronic osteitis.*—This may affect the bones of the skull without apparent cause, but in the majority of cases it depends upon the syphilitic taint. Sometimes all the bones of the skull become thickened and enormously massive, the surface being much roughened and often worm-eaten. At other times irregular hyperostosis may be the result. Considerable thickenings of some of the cranial bones, the result of an imperfect vascular osseous deposit, are found in some infants affected with congenital syphilis. These are mostly met with about the fontanelles, especially on the frontal and parietal, and sometimes the temporal bones. The irregular hyperostoses are mostly the result of local periostitis; in fact, they are ossified nodes. Chronic osteitis is the cause of the falling-in of the bridge of the nose, or the massive condition of the same part, which gives such a characteristic appearance to a child suffering from congenital syphilis. It is also the cause of some of the exostoses of the external auditory meatus.

The treatment must be directed against the constitutional taint, if any is to be discovered.

(*c*) *Caries.*—Chronic osteitis can hardly be considered apart from caries, which, again, in the majority of cases, depends upon syphilis, though less commonly on the strumous diathesis. It is usually caused by the penetration of a superficial ulcer into the deeper structures, or by the separation of the periosteum, resulting from periostitis. It is frequently associated with more or less chronic osteitis and necrosis. One of the most frequent seats of caries of the skull is the forehead, as a sequence of tertiary syphilitic ulceration (*corona Veneris*). Another common seat is the hard palate, which is often perforated as the disease advances. Caries may occur in the occipito-atlantal articulation (Pott's disease), followed by a train of symptoms which will be found discussed in other parts of this work. Caries of the temporal bone, either of the petrous or mastoid portions, frequently follows *otitis media*, and is not uncommonly the intermediate stage between this disease and thrombosis of the lateral sinus, meningitis, or cerebral abscess. It usually arises by extension of disease from the middle ear to the mastoid antrum and mastoid cells.

Treatment.—Beyond the administration of iodide of potassium and of mercury, the cautious scraping away of the diseased bone, and the adoption of precautions for maintaining cleanliness, little or nothing can be done to relieve syphilitic caries by the surgeon; and with regard to other cases of caries of the skull, whether considered pathologically or clinically, nothing can be added which does not apply to the same disease in other parts of the body. Caries of the occipito-atlantal articulation is best treated in the early stages by the actual cautery.

(*d*) *Necrosis.*—Necrosis of the skull not infrequently depends upon a traumatic cause, such as a scalp-wound or a burn; but here again the syphilitic form is exceedingly common. It may also depend upon disease of the middle ear. Simple traumatic necrosis leads to the separation of a sequestrum in the usual way. Syphilitic necrosis often depends upon some form of ulceration, or upon periostitis, and may be accompanied by extensive caries and chronic osteitis. It often affects the diploë and causes separation of the inner and outer tables. The separation of syphilitic sequestra is generally an exceedingly tedious process; and they are, moreover, often surrounded by little or no reparatory callus, so that after their removal it is no rare occurrence to find the dura mater pulsating over a large area at the bottom of the wound. At the same time, this rule is not invariable; it is common to find great thickening if necrosis of the bones of the orbit occur, which may cause permanent displacement of the eyeball. The writer has seen a large piece of the body of the sphenoid separated as a sequestrum, including the sella turcica, and removed through the nose without the slightest evil result to the patient. Tubercular necrosis sometimes causes death of the whole thickness of the skull, sequestra of varying size being thrown off and leaving the dura mater exposed.

Necrosis is not infrequently met with affecting the bones of the face. Thus a part or the whole of the upper or the lower jaw may die, and come away as a sequestrum. Necrosis of the jaws often depends on inflammation set up by carious teeth. It sometimes accompanies actinomycosis. Another cause, happily not now frequently met with, is the poisonous effect of the fumes of phosphorus in persons employed in the manufacture of this substance, and in that of lucifer matches (*see* Phosphorus, Poisoning by). The same remarks apply to the abuse of mercury. But, besides these more special causes, necrosis of the bones of the face may depend upon those more general states which are supposed to stand to necrosis of other bones in the relation of cause and effect: such as fevers and the like. The amount of thickening round a necrosed upper jaw has not infrequently led to its removal in mistake for a tumour; it is, therefore, [illegible] importance to examine all swellings in this region with great care.

TREATMENT.—If the membranes be left exposed, some protection must be provided for the cranial contents; in other respects the treatment of necrosis of the skull must be conducted on general principles. Sequestra in the mastoid process or around the tympanum should be carefully dealt with, on account of the danger of setting up meningitis or injury of the internal carotid or lateral sinus which any surgical interference involves. In dealing with necrosis of one half of the lower jaw it must be remembered that, unless sufficient callus have been thrown out before the removal of the sequestrum, the other half will lose its support and assume an altogether unnatural and almost useless position, being drawn to the opposite side and leaving the patient in a condition in which he can hope for but little relief from surgery.

(*e*) *Periostitis.*—Periostitis of the skull has been already referred to. It may depend upon syphilis or struma—most commonly the former; and give rise to what are known as *nodes.* The inflammatory subperiosteal effusion may be fluid or solid (*soft* and *hard* nodes); and it may undergo true or spurious suppuration or ossification, or may be completely absorbed. The most common but by no means the invariable position for cranial nodes is the frontal bone. As in the case of periostitis elsewhere, nodes are the seat of characteristic nocturnal pain, which is extremely distressing and exhausting to the patient.

TREATMENT.—The treatment in any case is by the administration of iodide of potassium; the effect of which is most marked, however, in syphilitic cases, the pain being usually removed in two or three days. If suppuration occur, incision may be required.

6. **Rickets.**—In a rickety infant the skull looks large; though it may be questioned whether this appearance does not depend on a deficient development of the bones of the face. The frontal and parietal eminences appear too prominent; the fontanelles remain patent much longer than in a healthy infant; and in some cases the anterior fontanelle may be unclosed as late as the fourth or even sixth year. The skulls of rickety children have a peculiarly massive feel; they are sometimes long in proportion to their width, conforming to the shape known as dolicocephalic. (For a more detailed account of this and other conditions see a paper by S. J. Gee, M.D., in vol. vii. of the *St. Bartholomew's Hospital Reports*, on 'The Shape of the Head looked at from a Medical Point of View.') The head of an adult who has been the subject of rickets in his childhood has often a very characteristic appearance: an apparently large square skull, with a prominent forehead towering above a diminutive and pinched-up face, giving to the individual a decidedly intellectual aspect.

Craniotabes occurs occasionally in rickety skulls, but, as will be afterwards shown, we do not yet know how far, if at all, it depends upon the constitutional condition.

7. **Craniotabes.**—By this term is meant the occurrence of spots of remarkable thinness in the skull, such that an indentation may be produced by the pressure of the finger. True craniotabes, as opposed to the gelatiniform degeneration of the outer table (Parrot), attacks the inner aspect of the skull. For its production an undue softness of the bone appears to be necessary, together with the occurrence of pressure, either from within or from without. It is rarely found congenitally, and it then affects the anterior part of the skull. It is common in syphilitic infants under one year of age, and is then usually met with in the posterior parts of the parietal bones. These positions, it will be noticed, are those most subjected to pressure under the two conditions mentioned. Craniotabes has been, by some observers, associated with rickets, but the relation of the one to the other is at present doubtful. It disappears as age advances, and requires no special treatment. *See* M. Parrot, *Revue Mensuelle*, 1879, p. 769; and Dr. Barlow and Dr. Lees, *Path. Trans.*, 1880, p. 236, and 1881, p. 323.

8. **Syphilitic Affections.**—From the foregoing observations it will be seen that syphilis, congenital or acquired, has much to account for amongst diseases of the skull. It may cause periostitis, with consequent nodes; chronic osteitis, with consequent hypertrophy, local or general; caries; necrosis; and craniotabes. As a general rule, it may be stated that syphilitic affections of bone are amongst the later manifestations of this disease. The inflammatory forms are usually accompanied by severe nocturnal pains, and they may be expected in most cases to yield to the administration of iodide of potassium.

9. **Tumours.**—It is necessary to refer in the briefest possible way to the tumours of the skull. Primary growths may spring from the diploë, or from the inner and outer tables of the cranial bones. Perhaps the most common are exostoses and some of the various kinds of sarcoma, either of which may reach an enormous size. The former may assume various characters (*see* TUMOURS). A remarkable instance of one presenting the appearance of a horn will be found described in the *Transactions of the Pathological Society of London*, vol. iii. p. 149. These alone, and then only in certain cases, admit of removal by the surgeon. In connexion with the bones of the face, tumours of the antrum or of the upper jaw, of various kinds, and tumours of the lower jaw, are not uncommon. In the latter position the various forms of epulis—myeloid, fibrous or malig-

nant, and cystic tumours, are frequently met with. Exostoses often grow from the jaws and the orbit, and in connexion with the former the different kinds of odontoma must be mentioned. Secondary tumours of all kinds may affect the skull; thus more than one instance is on record of a pulsating growth, occurring secondarily to a similar growth in the thyroid gland; and scirrhus, following cancer of the breast, is by no means unknown. Of these secondary affections the commonest are those which affect the skull by the direct extension of tumours from within or without; for example, the epitheliomata of the scalp or mouth, or rodent ulcer of the face. R. J. GODLEE.

SLEEP, Disorders of.—SYNON.: Fr. *Troubles du Sommeil*; Ger. *Stöhrungen des Schlafes.*—A proper amount and kind of sleep is needful in order that the body may be maintained in a state of health. But the actual amount of sleep taken and necessary for persons in health varies, within wide limits, according to age, the soundness of the sleep itself, and individual idiosyncrasy.

Age is a very important modifying factor. Thus an infant may sleep for twenty hours out of the twenty-four, and young children up to the age of ten commonly sleep for fourteen or at least twelve hours. In children from ten to fifteen years old, the duration of sleep usually varies between twelve and ten hours. In persons from fifteen to twenty-five the period should not sink below eight hours; from the latter age on to fifty it may fall to seven hours; and after this age about the same amount of sleep is required by the majority of persons, though some find six hours sufficient, and a few can (without apparent injury) take habitually even as little as five hours' sleep. The instances in which a duration of sleep habitually less than this is needed are altogether rare and exceptional.

Soundness of sleep, too, is subject to much individual variation. In childhood and in early life, sleep is commonly more profound than it is in adults, and much sounder than in old age. But, over and above these variations incident to age, there are individual differences; some persons are naturally 'light' and others 'heavy' sleepers. As a rule, those who can do with a small amount of sleep belong to the latter category. And similarly in regard to amount there are individual differences: some persons are able to do with a comparatively small amount, while others seem to require to sleep decidedly beyond the average periods above stated.

The disorders of sleep—that is, the variations outside the above limits—belong to three principal categories, in the first of which may be ranged all those cases where sleep is *excessive* in amount; in the second those in which it is *defective* in soundness or in amount; and in the third those in which it is *unnatural in character*.

I. Amount of Sleep Excessive.—This occurs commonly in more or less demented persons or in idiots, whose brain-activity is below the usual level. Such persons, when their natural wants are satisfied, are apt, like many of the lower animals, to sleep away a large portion of their time.

But some individuals of notable intellectual power may occasionally, even in a state of health, though after greatly prolonged labours with previous deprivation of rest, continue to sleep soundly for twenty-four or even thirty-six hours.

In many brain-affections, and in some cases of blood-poisoning, a condition of unnatural sleep bordering upon stupor may be present for many days. Obscure cases in which sleep is prolonged for weeks, or even months, are occasionally met with in this country. This rare condition only supervenes in persons of an obviously 'nervous' temperament, and the state itself seems generally to be a kind of trance allied to catalepsy.

Occasionally an excessive tendency to sleep for the greater part of the day is set up in middle-aged persons without other very distinct accompaniments or apparent cause. Some years since the writer had such a case under his care for several months in University College Hospital. No cause could be ascertained, and this patient was almost constantly asleep, except when taking food, or when he was being engaged in conversation. His pupils were habitually contracted, and his memory was very defective, but there was no paralysis of any kind. Before death his temperature on several occasions sank for many hours as low as 92° F. At the necropsy, the brain, as a whole, was found to be distinctly wasted. There was no definite focal lesion, though the pons was thought to be more indurated than natural.

On the West Coast of Africa a curious endemic disease occurs, known as the *sleeping sickness* (*see* Gore, *Brit. Med. Journ.*, Jan. 2, 1875), the ætiology and pathology of which is altogether obscure. It begins with a swelling of the cervical glands, together with an increasing tendency to sleep. The somnolence becomes more and more constant, until at last the patient cannot even be aroused to take nourishment. The disease lasts from six to twelve months, and is generally fatal. *See* NEGRO LETHARGY; and TRANCE.

II. Amount of Sleep Defective.—Under this head we have to do with two kinds of failure—a defect of quality (*disturbed* or *restless sleep*); and a defect in quantity (*wakefulness*, *insomnia*, *pervigilium*). These two defects often co-exist, though in many cases we may have the former condition existing alone.

(*a*) *Disturbed* or *restless sleep.*—This is a very common complaint, apt to occur in persons of all ages, and under the influence of many different causes, some of the most frequent of which are these: Indigestible food, or food of excessive or unaccustomed quantity, taken not long before going to bed; painful conditions of any kind, whether due to mere neuralgia or to serious organic disease of this or that organ; discomfort induced by undue cold or excessive heat; mental excitement or worry; chronic alcoholism; the menopause; prolonged overwork (mental); over-fatigue (bodily); febrile conditions; inflammations; gouty states of the system; imperfect action of the liver and various forms of dyspepsia; excessive hæmorrhages; acute and chronic illnesses of various kinds, such as delirium tremens, bronchitis, polyuria, and different forms of heart-disease; the state of convalescence from many acute diseases; the taking of tea or coffee, either too strong or too late at night. Lastly, sleeping in a novel or uneasy condition, or in the midst of unaccustomed noises, may also be mentioned as a not infrequent cause. Under any of these various conditions sleep may be fitful and disturbed, the persons often starting or turning about uneasily, dreaming much, and from time to time waking under the influence of dreams of a distressing or oppressive character. In one of the most extreme of the latter conditions, especially when it has been evoked by indigestible food, the state known as *nightmare* is induced. *See* NIGHTMARE.

TREATMENT.—The treatment of disturbed sleep must of course vary widely according to the nature of the influences under which it has arisen. These may at times be easily corrected, but in other cases, where the disturbed rest is dependent upon pain difficult to annul, or upon some acute or chronic disease, it may be impossible or extremely difficult to ensure sound sleep, notwithstanding the best-directed efforts to correct or neutralise the disturbing causes in operation. It may then be necessary to have recourse to some of the measures recommended under the next heading.

(*b*) *Insomnia* or *wakefulness.*—Under this head we may have either complete or partial insomnia. The condition is complete when the person gets no sleep at all for night after night, as in acute mania, delirium tremens, in those suffering from some very severe pain, or in persons under the influence of profound grief or mental anxiety. On the other hand, we may have partial insomnia of different kinds. In the one set of cases the persons who suffer from it may lie awake for long periods (one to several hours) before being able to get to sleep at all, and then sleep may be more or less sound and continuous till morning. In other cases, patients do not experience so much difficulty in getting to sleep, though after they have slept for one, two, or more hours they awake and cannot again fall asleep; they lie awake often in a state of mental depression, or even actually tortured by gloomy or horrible forebodings.

Various cases are on record in which absolute insomnia has lasted not only for days but even for weeks, interrupted only by mere snatches of sleep during brief intervals.

In this whole class of cases, however, the sufferers themselves are apt to form exaggerated estimates of the amount of their wakefulness, and to become more or less hypochondriacal upon the subject.

TREATMENT.—In many of these cases the art of the physician is very severely taxed. Whenever it is possible, insomnia should be corrected by a studious attention to the general health and habits of the patient, and by endeavouring to ensure the presence, as far as possible, of the physiological conditions which favour sleep. Mental repose, bodily comfort, a sufficient degree of warmth, a certain amount of fatigue, combined with perfect quietude—one or more of these conditions will be found in different cases either important aids or essentials for the production of sleep. To ensure the first of these conditions, it may be needful to prohibit all study for some hours before retiring to rest. An evening walk, so as to induce a certain amount of bodily fatigue, is, where it can be had recourse to, often beneficial; whilst in other cases a warm bath at bedtime, followed by friction of the skin, may greatly facilitate sleep. Sometimes a mere hot foot-bath, with or without mustard, will prove beneficial. A cup of warm beef-tea, gruel, or some weak stimulant (such as hot whisky and water) just before going to bed may also have a salutary influence, and the former may be repeated, or taken preferentially, during the night. Monotonous sensorial impressions (sounds or gentle frictions); or a monotonous dwelling of the mind upon certain uninteresting imaginary sights or verbal repetitions are, again, sometimes found to act as provocatives of sleep, though in other cases they completely fail.

In debilitated or neurasthenic conditions of the system, a patient's ability to sleep may often be greatly improved by the administration of such nervine tonics as arsenic and strychnine in combination with digitalis or sumbul; and some patients suffering from worry or overwork have derived great benefit in the way of improved sleep by taking spirit of turpentine (♏30) in capsules at bedtime.

Where the preceding measures are unavailing, recourse must be had to hypnotics and sedatives, such as bromide of potassium, chloral hydrate, opium in one or other of its forms, morphine, Indian hemp, amorphous hyoscyamine, hyoscine, &c., in doses appropriate to the age and condition of the patient.

In the more urgent cases the doses of such hypnotics may have to be repeated till sleep is procured; but in many of these urgent conditions the sedative influence of packing in the wet sheet must not be forgotten.

Several other most useful remedies of this class have been in use during recent years, the most important of which are sulphonal, paraldehyde, chloralamid, and one which has been more recently introduced, namely, chloralose. Of these, sulphonal (gr. 15-30) is best given in the form of cachets or crushed tabloids about an hour and a half before bedtime. It often acts well, and produces less depressing effects than chloral hydrate. Paraldehyde (♏30-60) is a very safe hypnotic to give where such a drug is required in patients suffering from heart or lung disease, but the great objection to it is its very nauseous taste and odour. Chloralamid (gr. 20-45), given in an acidulated solution, is free from these objections, and is almost equally safe; and it would appear that the same may be said of chloralose, the dose of which (gr. 5-15 in hot water) is smaller than that of either of the other drugs just mentioned. It is said to produce prolonged and restful sleep, and not to lead to disagreeable after-effects on awaking. Such remedies, however, ought never to be taken except under the orders and directions of a medical man, who alone would be able to judge as to the most suitable drug, the proper dose, and the mode of its administration. With some of these drugs, a dose on alternate nights is found to be sufficient; and in all cases it is of the greatest importance to obtain the desired result with the minimum quantity that will prove effective. Again, wherever hypnotics are had recourse to, it is of great importance to see that their use is not continued after the need for them has passed. It not infrequently happens, for instance, that much of a patient's insomnia may be due to a bad habit of the system, which yields after it has been broken in upon by the use of hypnotics for a short period. Abrupt discontinuance is generally most inadvisable; there should rather be a gradual diminution of the dose, with or without the knowledge of the patient.

III. Sleep Unnatural in Character.—Under this head we have to do with various unnatural conditions, in which the abeyance of brain functions that exists during sleep is more partial than that which normally exists. In disturbed sleep the physiological condition pertaining to and provocative of sleep is generally less profound than it should be, just as in other cases of unusually deep sleep (akin to stupor) such a condition is generally more profound than natural. In the cases to which we now refer, however, sleep is partial in its area: portions of the brain that are usually involved in the physiological condition peculiar to sleep remain exempt, so that the sleeper exhibits powers which sleep usually annuls. Hence we may have *somniloquy* or *sleep-talking*; and *somnambulism* or *sleep-walking*.

In those who exhibit the former phenomena, dream-thoughts are capable of evoking correlative acts of speech, and such persons will sometimes allow a listener to hold a sort of conversation with them, of which in the waking state they recollect nothing. This dream-conversation may be more or less coherent. Dreams themselves, too, vary much in their coherency in different individuals. In some persons, whose sleep is to that extent unnatural, powers are displayed during this condition which even surpass those of the waking state. Mathematical problems have been solved during such sleep; poems and music have been composed and written out, which have altogether surprised the same person when awake. The writer has recently seen a young lady liable to what may be termed 'singing fits,' in which she would lie for hours incapable of being aroused by ordinary means, singing, without intermission, songs, hymns, and portions of operas in promiscuous succession, but in a manner decidedly excelling that of which she was capable when awake. In all these states we have to do with a morbid condition of sleep, partial in its area, and in which there is the further peculiarity that certain faculties are in a condition of exalted activity. The alliances here are intimate with the conditions that are now studied under the name of 'hypnotism,' but which were formerly included under the term 'animal magnetism.' *See* MAGNETISM, ANIMAL.

Many of the above remarks apply to somnambulism also. Here the morbid sleeper possesses an unwonted power of calling his muscles generally into activity in response to his dream-thoughts. Sight in relation to the dream may be good, though unrelated visual impressions are not taken cognisance of. Muscular sense-impressions also are freely acted upon; but the sleep-walker may be quite deaf to all ordinary auditory impressions.

TREATMENT.—These are to be regarded as distinctly morbid conditions, and the persons manifesting them may often be cured by attention to the general health, and the use of remedies calculated to give tone to, and allay the irritability of, the nervous system. A line of treatment, in fact, not very dissimilar from that to which one would have resort in convulsions or epilepsy will often suffice to cure these minor manifestations of nervous disorder.

Finally, sleep may be disturbed by certain phenomena occurring to the person whilst he is actually in this condition, which, though scarcely to be spoken of as disorders of sleep, ought at least to be mentioned in this article.

One of minor significance is snoring, which at times may be so loud as to awaken the sleeper; but another of far greater significance is the occurrence of convulsive or epileptic attacks, which in some patients occur only during sleep.

H. CHARLTON BASTIAN.

SLEEPING SICKNESS.—*See* NEGRO LETHARGY.

SLOUGH (Sax. *slog*, a foul hole or hollow).—The dead material resulting from gangrene, ulceration, or low forms of inflammation of soft tissues. A slough may be in the form of a mass, as in gangrene; or in shreds, as in ulcers and unhealthy wounds, which are then said to be *sloughing*. *See* GANGRENE; ULCER and ULCERATION.

SMALL-POX.—SYNON.: Variola; Fr. *La petite Vérole*; Ger. *Blattern*.

DEFINITION.—An acute infectious disease, characterised by an eruption of pimples on the forehead, face, and wrists, which in from ten to fourteen days passes through the stages of vesicle, pustule, and crust; it also appears on certain mucous membranes; and is sometimes complicated with hæmorrhage into the skin, and from the mucous surfaces.

ÆTIOLOGY.—When, where, or how small-pox arose is not known. It certainly appeared in Europe in the sixth century. It arises now from contagion and from inoculation. It affects all races of men, every age, and both sexes. No climate is free from its ravages. It rages with special virulence where it appears for the first time, and in such cases may carry off whole tribes. It is exceptionally severe among negroes and the inhabitants of warm climates generally. Its subjects are unvaccinated or badly vaccinated persons, extensive observation having shown that in proportion to the efficiency of vaccination are the rarity and mildness of small-pox. As a rule, it attacks the same person once only, but there are exceptions to this rule. Some few—of whom Morgagni, Boerhaave, and Diemerbroek are said to have been instances—are insusceptible of small-pox.

ANATOMICAL CHARACTERS.—Small-pox is the result of a specific morbid poison, which, after a period of incubation of about thirteen days, possibly sometimes less, manifests itself by high fever and an eruption on the skin. The eruption is sometimes preceded by rashes of an erysipelatous, scarlet, or measly character, chiefly seen on the lower abdomen, the groins, and the upper and inner part of the thighs, along the sides of the chest and about the axillæ. Sometimes they are seen upon the face and neck, and occasionally they cover the body. They are distinguished from the hæmorrhagic rashes by the absence of blue-black spots, and are usually associated with the milder cases. 'As regards the skin-eruption, the papules are due, in the first instance, partly to punctiform hyperæmia of the cutis, over which the epidermic cells, and more especially those of the superficial portion of the rete mucosum, become swollen. By degrees, serous fluid is poured out into the substance of the affected epidermis, raising the horny layer from the swollen group of cells below, but detaching it imperfectly, so that a number of small irregular intercommunicating serous cavities are produced. But soon suppuration occurs in the subjacent rete mucosum, and the pus-corpuscles then rapidly diffuse themselves, and the pock is converted into a pustule. The umbilicated character which is so common is due to the presence either of a hair or of a sudoriparous gland, the connexion of which with the subjacent true skin has not yet been destroyed. The suppurative process need not implicate the true skin below; but not infrequently it involves and destroys it to a greater or less depth, and is prolonged inwards along the hairs or glands. Under the former circumstances the pustule leaves no permanent trace; under the latter a depressed cicatrix results, presenting numerous pits upon its surface.' (Bristowe, *Theory and Practice of Medicine*.)

Post-mortem examination shows nothing, beyond external appearances, special to small-pox, except a trace of eruption on the larynx and vocal cords. The blood is in most cases imperfectly coagulated, and in black cases not at all. In the latter ecchymoses of the mucous and serous membranes will be found. Pleuritic effusions and pneumonic consolidations are sometimes found, but the most common lung-complication is broncho-pneumonia. In *variola hæmorrhagica pustulosa* hæmorrhage is generally found in the substance of the lungs, heart, kidneys, and liver.

SYMPTOMS.—Small-pox may be described under seven forms: (1) Discrete; (2) Confluent; (3) Hæmorrhagic; (4) Malignant (Pure Hæmorrhagic); (5) Inoculated; (6) Small-pox after vaccination and revaccination (Modified); (7) Small-pox after small-pox.

1. **Discrete.**—In the discrete form the disease begins with rigor, fever, lumbar pain, headache, and sickness, with copious perspirations; followed by an eruption on the forehead, face, and wrists. This is usually most abundant on these parts, next most abundant on the hands and feet, and least so on the limbs and trunk. The eruption is followed by a remission of the general symptoms, and a fall of temperature, which continues until about the eighth day. Between the third and the eighth days the pimples appear on the extremities and the trunk, and change into greyish-white vesicles, circular, flattened, depressed in the centre, and

surrounded by a red ring. During this time also vesicles may be seen in the mouth and the upper part of the pharynx and larynx, and there will be some soreness in these parts. On the eighth day some of the vesicles become pustular, lose their central depression, and become globular, whilst the redness which surrounds them becomes more marked. With this change the temperature rises, and the general symptoms return; but these are of short duration, for the pustules either dry up rapidly and form scales, or burst and form scabs; the temperature falls by about the tenth day; and the patient is then convalescent, fatal results being extremely rare, except in unvaccinated children under one year. When the crusts have fallen, and the desquamation which follows them is complete, there will often be pitting.

2. **Confluent.**—In this form the initial symptoms are essentially the same as the former, but more severe. The eruption appears about the same time, and in the milder varieties is discrete until the disease has reached the vesicular or the pustular stage; but in the more severe forms it is confluent from the first, and instead of showing distinct closely packed papules, the whole face is swollen, presenting the appearance of a tense elastic mass. When the eruption is well out the temperature falls, and the general symptoms remit, but to a less extent than in the discrete variety, and this remission continues until about the eighth day. Up to this time more or less delirium is present in many cases, and it is sometimes maniacal and suicidal in character; drowsiness and stupor sometimes take its place, and occasionally alternate with it. On this day, the eighth, the vesicles begin to become pustular, the areola to deepen, the temperature to rise, and the general symptoms to return. At the same time the face becomes extremely swollen; the eyelids close from œdematous swelling; saliva flows copiously from the mouth; the glands and the subcutaneous tissue of the neck and lower jaw enlarge; and the early delirium usually disappears. One of three things may now take place: (1) the disease may go on regularly to the eleventh day; (2) the development of the pustules may cease, the face remaining flat, of an opaque white colour; or (3) hæmorrhage may take place into the skin beneath the vesicles, and from the mucous membranes, that is, it may become hæmorrhagic-pustular. In either of the last two events death is almost invariable, and often rapid. In the first the swelling of the face increases for the next three days, during which time the vesicles become pustular, and the hands and feet swell. There will be increased sore-throat, increased salivation, great thirst, sleeplessness, delirium, rising temperature, and occasionally laryngitis. On or about the eleventh day the temperature and the general symptoms will have reached their height, the pustules will discharge their contents, and crusts will form. After this, in favourable cases the temperature will begin to fall, and the symptoms of the so-called 'secondary fever' to decline. By the fourteenth day crustation will be complete on the face, where it is most commonly found, the general symptoms will have disappeared, the temperature will have become normal, and convalescence established. In unfavourable cases it is about this time, the eleventh day, that death usually occurs. It is preceded by low delirium, variable temperature, subsultus, involuntary motions, and occasionally hæmorrhage into the skin and the pustules. When the crusts, which in this form are often retained many weeks, fall off, and when the desquamation is complete, there is pitting, which, at first of a reddish-brown colour, in process of time becomes white.

3. **Hæmorrhagic - Pustular, Vesicular, or Papular.**—This form of small-pox constitutes the connecting-link between the confluent and the malignant. With the latter it is often confounded, and hence true malignant has sometimes been said to end in recovery. It is characterised by hæmorrhage into the skin beneath the vesicles or the pustules. There are generally petechiæ, sometimes ink-spots, and often subcutaneous hæmorrhage. Recovery is very rare. Death may take place in the vesicular or the pustular stage.

4. **Malignant.**—SYNON.: *Variola Nigra*; *Variola Hæmorrhagica*; Black Small-pox; *Purpura Variolosa.*—This form is invariably fatal. Its distinguishing features are hæmorrhage into the *skin*, and irregularity in the form of the eruption. The illness commences with the ordinary symptoms, but accompanied by marked lumbar pain, præcordial anxiety, and coldness of the extremities. This is followed, about the third or fourth day, by ecchymosis into the conjunctivæ, and a purpuric or scarlatiniform rash, sometimes covering the whole body, but most marked over the lower abdominal region, and the upper and inner part of the thighs, in which rash large and small dark blue, deep violet, or black spots are seen. The ordinary eruption is almost entirely absent. In the majority of cases it is limited to a few scattered papules, more often found on the fingers and toes than elsewhere. With these appearances there will often be found on the skin hard tumours, of variable size, of the same colour as the spots; and from one or more of the mucous surfaces there will be bleeding. Death sometimes takes place as early as the third day, but most commonly on the fifth. The temperature usually fluctuates about 102° (F.), sometimes reaches 104°, and is sometimes nearly

normal during the whole course of the disease. The mind is almost always clear throughout. This form of small-pox occurs at all ages, and in both sexes. It is never found in well-vaccinated subjects under fifteen, nor in those who have been efficiently revaccinated about that age.

5. **Inoculated.**—On the second day of inoculation a pimple rises, which by the fourth has developed into a vesicle, and by the seventh or eighth into a pustule, when the patient has rigors, swelling and pain in the axillary glands, and more or less fever, followed on the eleventh day by the ordinary small-pox eruption (Bristowe), which passes through the usual stages. The inoculated pustule attains full development on or about the eleventh day, and by the fourteenth there will be a crust. The characteristic of the disease thus induced is its mildness. It protects from small-pox in the same degree as first attacks of that disease protect from second attacks. The objections to it are (1) that small-pox so induced is infectious; and (2) that it is sometimes fatal.

6. **Small-pox after Vaccination and Revaccination.**—(*a*) *After vaccination.*—Speaking generally, it may be said that *good* vaccination protects from small-pox, and that when it does not protect absolutely it renders the disease milder and the disfigurement less marked, and reduces the mortality directly as the efficiency of the vaccination and revaccination. Persons under fifteen years of age with two good cicatrices are very rarely the subjects of severe small-pox; and if they contract it, death is almost if not quite unknown. After this age, however, certain, chiefly inefficiently vaccinated, persons become again susceptible, and the disease in some of these is occasionally severe. Post-vaccinal small-pox may be described under the following three forms: (1) In one class of cases there is more or less feeling of illness, headache, slight fever, possibly some lumbar pain, followed on the third day by a sparse eruption of papules, which abort and soon disappear. (2) In another class there are severe initial symptoms, followed on the third day by an eruption of papules, and a remission of the fever. On the fifth day the papules will have become vesicles, which in a day or two dry up without any recurrence of fever, leaving the patient convalescent at the end of the week. (3) In a third class the initial symptoms are very severe, sometimes indistinguishable from those of confluent small-pox, and they last forty-eight hours, after which an abundant eruption comes out, the whole face swelling as in severe confluent. The temperature now falls, and the disease in some cases will abort at this stage; in others it will go on to the vesicular stage and then abort, the patient becoming convalescent about the end of a week, without any recurrence of fever. In the case of adults who have been vaccinated only in infancy, and in children who have been badly vaccinated, the disease may run an unmodified course and end fatally.

(*b*) *After revaccination* (successful).—Small-pox, after this, is practically unknown. During the epidemic of 1871, 110 persons were engaged in the Homerton Fever Hospital in attendance upon the small-pox sick; all these, with two exceptions, were revaccinated, and all but these exceptions escaped small-pox. The experience of the epidemic of 1876–77 was of the same kind, all revaccinated attendants having escaped, whilst the only one who had not been vaccinated took the disease and died of it. So, in the epidemic of 1881, of 90 nurses and other attendants of the Atlas Hospital Ship (small-pox) the only person who contracted small-pox was a housemaid who had not been revaccinated. At the same time a single efficient revaccination about puberty is not, in the writer's opinion, an effectual protection, even against death, for all time.

7. **Small-pox after Small-pox.**—Second attacks are occasionally met with among adults. In the writer's experience they have invariably been mild; but fatal cases are said to occur.

COURSE, TERMINATION, COMPLICATIONS, AND SEQUELÆ.—In the discrete form of small-pox the great majority of cases recover; half of the confluent cases die about the eleventh day, and the malignant cases invariably die. In small-pox modified by vaccination the course of the disease will depend upon the quantity and quality of this, as shown by the marks. If these be of the best kind, three or four in number, and in a patient under fifteen, the disease is invariably mild. In some, however, who have passed puberty, the best primary vaccination loses in power; but, nevertheless, it almost invariably modifies the disease, and when death occurs it is usually due to some accidental complication. Of complications, laryngitis, bronchitis, pneumonia, and in particular broncho-pneumonia, are the most common. Glossitis occurs occasionally. On two occasions the writer has met with cerebral symptoms, which were shown after death to depend upon cerebral hæmorrhage. Aphasia with right hemiplegia he has seen twice; and once a condition like dementia, shown after death to depend upon thrombosis of the basilar artery. In the cases of cerebral hæmorrhage the eruption was not fully developed, but at the time of death they did not seem likely to become cases of extreme confluence. One was in a girl twenty-one years of age, with two good vaccination marks; and the other in a boy of eight with four fair marks. In both cases the event occurred in patients who suddenly became dangerously ill, and the seriousness of whose illness could not be ascribed to a small-pox which was by itself mild. It may be that this would be found to be the *immediate* cause of death in other cases, if *post-mortem* examination were more frequent and complete. It has been said that small-pox is occasionally complicated with scarlatina or measles; and it is true that *eruptions* indistinguishable from those of scarlatina and measles appear in some cases of variola; but whether the presence of such eruptions, which are but *one* symptom, constitute evidence upon which to maintain the co-existence of two specifically distinct diseases may be doubted. Pregnancy has been said to be a grave complication of small-pox. It is certain, however, that many pregnant women recover without injury; but abortion in confluent cases is often fatal, on account of the attendant bleeding. Of sequelæ the most common is pitting. Mania and dementia are occasionally seen. Erysipelas, abscesses, gangrene of the extremities, particularly the tips of the hands and feet, enlargement of the glands of the neck, conjunctivitis, iritis, perforating ulcer of the cornea, are not uncommon, and then occasionally one or both eyes may be destroyed. The specific small-pox eruption, however, never appears on the corneal conjunctiva. The changes which take place in the eye are late in the disease, and in all probability due to defective nutrition. Otitis, parotitis, orchitis, and ovaritis occur sometimes; and pyæmia occasionally.

Diagnosis.—This cannot be made with certainty until the eruption appears. Fever, headache, lumbar pain, and vomiting during the time of an epidemic of small-pox, should arouse suspicion; and should these be followed after forty-eight hours by an eruption of papules on the forehead, face, and wrists, the diagnosis may be considered certain. The difficulty of exact diagnosis depends on the fact that in many cases all the main features are not present together, and that one begins to trust to the existence of some one prominent symptom. Fever with headache, backache, and vomiting *may* occur in continued fevers; but the later appearance of the eruption, and the fact that it is not found in the situations in which that of small-pox occurs, ought to negative the idea of small-pox. Small-pox is occasionally preceded by eruptions which simulate those of measles, scarlatina, or erysipelas, and these eruptions are associated with fever and other symptoms of constitutional disturbance. If the disease be small-pox, the eruption will change within twenty-four or thirty-six hours, or will show signs of malignancy. Pyæmia, glanders, and acute rheumatism with a pustular eruption, may also be mistaken for small-pox, but attention to the *history of the case* will be enough to enable one to form a correct opinion. So far as eruption alone may lead to error, the point for diagnosis turns on the query, Could the eruption have reached, or would it not have gone beyond its existing stage, if the disease on which it depended were small-pox? Of eruptions unattended by general symptoms, syphilides, acne, eczema, erythema, and urticaria are most frequently mistaken for small-pox; but mistakes of this kind may in most cases be avoided by a careful consideration of the history. Lumbar pain is found with fever in pneumonia, but physical examination of the chest ought to settle the question; moreover, there is no eruption beyond occasional herpes. In lumbago there is no fever. Labour-pains are unattended by fever; moreover, they usually come on gradually and in the belly first, and are not constant. It must be borne in mind, however, that pregnant women, when suffering from small-pox, may have labour-pains and the initial symptoms of small-pox concurrently. Cases of black or malignant small-pox will present little difficulty; but if scarlatina, measles, and typhus prevail at the same time, there will be great difficulty in arriving at an exact diagnosis as to which form of malignant fever exists in the case under observation. The diagnosis from chicken-pox has been treated of in that article. *See* Chicken-pox.

Prognosis.—This will have been gathered from what has preceded. Small-pox is most fatal in unvaccinated children under five, and in adults over thirty. At these periods of life half or more may die. The lowest mortality in the unvaccinated occurs from ten to fifteen. The discrete form is rarely fatal in adults, but it is so occasionally when it occurs in unvaccinated children. Half of the confluent cases will die, and of the malignant all, and nearly all children under one year, whatever form the disease may assume. As regards vaccination in prognosis, it may be stated generally that the unvaccinated will die at the rate of about 50 per cent., the badly vaccinated at the rate of about 26 per cent., and the well vaccinated at the rate of about 2·3 per cent. *See* Vaccination.

Treatment.—There is no specific for small-pox, its complications or sequelæ, and the treatment is therefore to be conducted on general principles. The following are points of importance: (1) The patient should be placed in a large, well-ventilated room. He should be fed at intervals on easily digestible food, such as milk, beef-tea, chicken broth, and eggs beaten up; and occasionally, according to habit, a little wine or spirit may be given. He should be permitted to drink iced water or iced lemonade as he pleases. He should have a feather-bed, the sheets ought to be of the softest material, and the coverings light; and there should be two beds in the room, in order that the patient may be changed daily. (2) Two competent nurses should be obtained, one to attend the patient by day, the other by night, and these should never *for a moment* lose sight of him. (3) The hair should be cut short. (4) Heat of skin may be relieved by cold-water sponging, and the swelling of the eyelids and other painful parts by the constant application of cold compresses. (5) To relieve itching olive oil may be used, or, what is better, lanolin, or vaseline, which applied as a dressing to the face will facilitate the removal of scabs; and to destroy the disagreeable odour, some kind of deodorant, such as Sanitas powder, should be sprinkled about and over the patient's face and bed. (6) To procure sleep, opium, or some form of alcohol diluted with warm water, may be given. (7) Salivation should not be interfered with, but the mouth should be kept clean, and sedatives avoided during its continuance. (8) When delirium is marked, in addition to the nurse there should be an attendant, one accustomed to deal with lunatics if possible. Mechanical restraint should be avoided, and the 'strait jacket' and 'tying down' strictly forbidden. The patient ought not to be left for one moment alone, otherwise he may have to be looked for wandering along some street, or drowned in the nearest watercourse. He should not be argued with, nor flatly contradicted. If he should imagine his attendants are bent upon injuring or killing him, they should be changed. If he be excited by the mere presence of others, as may happen in hospital wards, he should be treated by himself in a dark room. Should he persist in getting out of bed and putting on his clothes, in walking about his room, or in sitting over the fire, he should be permitted to do so, for to the fretted and fevered patient moving about is a relief. In maniacal delirium chloroform may be administered. (9) The eyes should be carefully watched, and in severe cases an ophthalmic surgeon should be consulted. (10) About the eleventh day laryngitis often supervenes, and for this tracheotomy should be performed when there arises distinct difficulty of breathing. Although in the majority of such cases the patient dies, the relief from suffering is so great that the operation should be performed. (11) When crusts begin to form about the nostrils they should be removed, and generally the patient should be kept in bed until suppuration under the crusts has ceased and the skin is healed. (12) Abscesses should be opened when they appear, and a water-bed should be ordered at the same time. (13) The patient may be discharged safely when the crusts and scales have disappeared, and not less than six baths have been given at intervals of two days. Such is the general treatment of confluent small-pox; in the discrete kind little is needed; in the malignant none is of any avail.

The prophylaxis of small-pox is discussed under VACCINATION.

ALEX. COLLIE.

SMELL, Disorders of.—*See* NOSE, Diseases of; and OLFACTORY NERVE, Morbid Conditions of.

SNAKE-POISONS.—*See* VENOM, Effects of; VENOMOUS ANIMALS.

SNEEZING, Excessive.—SYNON.: Fr. *Coryza Spasmodique*; Ger. *Niesekrampf.*

DEFINITION.—An affection characterised by frequent and uncontrollable attacks of sneezing, out of all proportion to the nasal secretion.

ÆTIOLOGY.—The causes of excessive sneezing may be broadly classified as *extrinsic* and *intrinsic*. *Extrinsic* causes include especially various vegetable substances in the form of powder, of which tobacco-snuff is the type, and the pollen of certain plants (*see* HAY FEVER). The *intrinsic* conditions in connexion with which the affection occurs vary considerably. In some cases it is associated with whooping-cough or asthma, and it is not uncommon in gouty persons. It is sometimes a symptom of the hysterical condition, and not infrequently associated with disordered menstruation, or some other derangement of the sexual functions. It has been met with in pregnancy, and even during more than one pregnancy in the same person, ceasing in the intervals, and has been supposed to replace morning-sickness (Barnes). In some persons a bright light or intense colour is sufficient to determine an attack of sneezing.

SYMPTOMS.—The morbid sneezing has no special characters. It is distinctly a reflex act, being excited usually by some slight impression on the fifth nerve. A slight catarrhal condition of the nasal mucous membrane is common. The secretion has been thought to be, in some cases, of a specific character, analogous to that of hay fever.

TREATMENT.—The attack itself may be usually cut short by a strong impression on some branch of the fifth nerve; when this fails, a mustard poultice to the back of the neck, or an emetic, may be employed. Atomised astringent nasal inhalations, or the vapours of creasote or iodine, are useful, but the most effectual agent is the cautious application to the nasal mucous membrane of a solution of hydrochlorate of cocaine. This is best effected by a fine spray-apparatus, by which at each jet about a drop of a 3 per cent. solution is injected, the patient sniffing at the time. One or two drops may be thus applied to each nostril twice daily, and the treatment is usually most effective. The immersion of the head in cold water has also been recommended. Any irregularity in the functions of the genital or other organs must be attended to; and iron, quinine, and arsenic, if not otherwise objectionable, are useful in removing the liability to the complaint. *See* CATARRH; and HAY FEVER.

W. R. GOWERS.

SNUFFLES.—A popular term for the condition in which a nasal discharge exists in children suffering from congenital syphilis. *See* Syphilis.

SODEN, in Taunus, Germany.—Common salt waters. *See* Mineral Waters.

SOFTENING.—Synon.: Fr. *Ramollissement*; Ger. *Erweichung*. A term of pathological significance, implying that an organ or tissue has a degree of consistence less than that which is natural to it. This is a condition which occurs in various organs or parts (1) as a result of pathological changes *during life*; and (2) as a consequence of different *post-mortem* influences.

(1) **Intra-vitam Softening.**—With regard to the first order of changes, the brain and the spinal cord are the organs in which softening is most common, and in which it is apt to assume its most typical characters (*see* Brain, Softening of; and Spinal Cord, Softening of). It occurs also in the osseous system (*see* Bone, Diseases of). The liver and spleen may likewise be softer than natural, and so may the mucous membrane of the stomach or intestines, or the tissue of the heart. In nearly all such cases the principal cause of this diminished consistence is a fatty degeneration or infiltration, associated with more or less of serous infiltration (*see* Fatty Degeneration). This pathological condition is the reverse of those conditions of induration known by the name of *sclerosis* in some organs, and *cirrhosis* in others. *See* Sclerosis.

(2) **Post-mortem Softening.**—The softening due to the definite pathological processes just referred to must be clearly discriminated from certain softenings which may supervene after death as a result of traumatisms or mere *post-mortem* changes. Thus the tissue of the brain or of the spinal cord, in some parts, may be diminished in consistence, and rendered more or less pulpy, owing to its having been bruised during the operations necessary for exposing these organs to view. The same organs likewise diminish in consistence by mere lapse of time after death, and the more quickly in proportion to the heat of the weather. In the stomach also *post-mortem* softenings are most prone to show themselves, should the organ contain gastric juice at the time of death. Here we get softening first, and afterwards solution of the mucous membrane and other tissues of the organ by a kind of digestive process. *See* Stomach, Diseases of; 19. Softening of.

H. Charlton Bastian.

SOLIS ICTUS (Lat.)—A synonym for sunstroke. *See* Sunstroke.

SOMNAMBULISM. — Sleep-walking. *See* Sleep, Disorders of.

SOMNILOQUY.—Sleep-talking. *See* Sleep, Disorders of.

SOMNOLENCE. — An unnatural drowsiness or disposition to sleep. *See* Sleep, Disorders of.

SONOROUS RALE.—A variety of dry *râle* or rhonchus, of a low-pitched character, resembling snoring and similar sounds, and produced in the larger air-tubes. *See* Physical Examination; and Rhonchus.

SOPOR (Lat.) — An unnatural deep sleep, from which the patient can only be roused with difficulty. *See* Consciousness, Disorders of.

SOPORIFICS (*sopor*, heavy sleep).—Synon.: Fr. *Soporifiques*; *Soporatives*; Ger. *Einschläfernde Mittel.*—Agents that promote sleep. *See* Narcotics.

SORDES (Lat. filth). — Definition.—Crusts which form upon the lips and teeth of persons suffering from extreme exhaustion.

Description.—Sordes occur commonly in what is called the typhoid state, whether this be due to typhoid or puerperal fever, pneumonia, or any like disease. They appear first as thin, light-yellowish crusts upon the prolabia, generally in close proximity to the teeth; gradually increase in thickness and in area; and, changing their colour to brown, or even black, at length extend to the adjacent surfaces of the teeth. They seldom or never cover those portions of the teeth which are hidden by the lips, but spread over their exposed surfaces; so that, as the patient lies with slightly parted lips, they bridge over the interval in the form of a narrow band upon the middle of the incisors of the upper jaw. When the lips are more widely separated, the sordes do not extend, unless in conditions of extreme exhaustion, over the whole of the exposed surfaces of the teeth, but form two ridges, corresponding with the margins of the upper and lower lips.

Sordes are composed of various schizomycetes, mingled with *débris* of food and epithelium. Micrococcus occurs almost constantly; bacillus subtilis frequently; and the writer has found, each in a single instance, sarcina ventriculi and spirochæta plicatilis.

Pathology and Treatment.—These organisms, which are of constant occurrence on the papillary surface of the healthy tongue, are easily dislodged from the smooth lips and teeth. But in conditions of great prostration, especially when the prostration is associated with delirium, the slight frictions necessary for their removal are not made, and they obtain so firm a hold that they can only be removed by careful and repeated cleansing. Such cleansing may with advantage be performed with a piece of soft rag, or a brush dipped in a weak solution of Condy's fluid.

Henry T. Butlin.

SORE-THROAT. — A popular name for various affections of the pharynx, larynx, and tonsils. *See* Larynx, Diseases of; Pharynx, Diseases of; Throat, Diseases of; and Tonsils, Diseases of.

SOUFFLE (Fr.) — A soft, blowing sound. The term is applied either to the respiratory murmur heard over the lungs; or to certain murmurs heard in connexion with the heart or blood-vessels. *See* Physical Examination.

SOULZMATT, in Alsatia.—Alkaline table-waters. *See* Mineral Waters.

SPA, in Belgium.—Iron or Chalybeate waters. *See* Mineral Waters.

SPAIN, Southern.—*See* Malaga; and Climate, Treatment of Disease by.

SPANÆMIA (σπανός, rare; and αἷμα, blood).—A condition of blood, in which the amount of its solid constituents is below the normal, the blood then appearing thin. *See* Anæmia; and Blood, Morbid Conditions of.

SPAS.—*See* Mineral Waters.

SPASM.—Synon.: Fr. *Spasme*; Ger. *Krampf.*

Definition.—A name given to abnormal contraction, occurring either in muscular organs, in single muscles, or in groups of muscles.

1. *Spasm of muscular organs.*—Concerning spasms of organs not much requires to be said here. We may cite as instances those spasms which occur in the pharynx in hydrophobia; the contractions of the œsophagus in œsophagismus and in some cases of hysteria; the painful contractions of the intestine which are presumed to occur in certain cases of colic; of the lower end of the rectum in tenesmus; of the bladder or of the urethra in certain cases of inflammation with irritability; of the vagina in vaginismus; of the uterus in rare cases of sudden abortion resulting from shock; possibly of the heart in certain diseases of that organ; of the vessels in various regions of the body, and on various occasions, from overaction of vaso-motor nerves; of the bronchial tubes in certain cases of asthma and hay fever; of the glottis in laryngismus stridulus, and in pertussis; as well as of the gall-ducts or ureter under conditions of irritation, either direct or reflex. In reference to many of these conditions the reader may refer to special articles in which they are considered. All are due to excessive nervous stimuli, maintaining conditions of muscular contraction which are unusual both in degree and in duration. These spasms are, therefore, tonic in type, and in almost all the cases cited it is involuntary muscular fibres that are involved.

2. *Spasm of single muscles or of groups of muscles.*—The next class of spasm is that which affects the striped or voluntary muscles. They are divisible into two main categories, that is, into *tonic spasms*, in which the contractions are continuous, and *clonic spasms*, in which contractions and relaxations occur in quick succession; the former being typified by cramps, and the latter by convulsions.

Under *tonic* spasms, we may have cramps of brief duration, affecting a single muscle, such as the diaphragm in hiccough; or of prolonged duration, as in the sternomastoid in certain cases of wry-neck. The tonic contraction may affect several muscles at the same time, as in lock-jaw, or the painful cramps which occasionally occur in the calves of the legs, or in other parts of the body. Such local spasms occur also in the condition known as tetany, in conjugated deviation of the eyes, and in writer's cramp; likewise in spasmodic spinal paralysis, in hysterical paralysis, and under various conditions of irritative organic disease implicating motor nerves, or motor centres or tracts either in the spinal cord or in the brain. More general tonic spasms occur in catalepsy, in tetanus, and in strychnine poisoning.

This whole class of tonic spasms is supposed to be due to irritation, mechanical or chemical (nutritive), operating *directly*, either upon motor centres or upon the fibres conveying motor incitations in some part of their course between the brain and the muscles. In other cases, however, tonic spasms are of *reflex* origin, and the cause of irritation operates in or upon sensory surfaces, nerves, or centres.

Clonic spasms are also of various kinds. They may be limited to single muscles, such as the orbicularis palpebrarum; or they may affect particular groups of muscles, such as those of one side of the face, or the muscles of the lower jaw on both sides, or certain of the abdominal muscles, or some of the foot muscles, as in ankle-clonus. In other cases clonic spasms may be more general, taking the form of unilateral or of bilateral convulsions. The latter also may be irregular or of coördinated type. *See* Convulsions.

Where clonic spasms are much slighter in degree and in range, affecting some muscular fibres and that to a small extent, rather than entire muscles in a more marked manner, we have the production of *tremors*, which may be either fine or coarse, local or general.

Transitional conditions exist, connecting all these various manifestations more or less closely with one another. They constitute, indeed, one great assemblage of related though apparently heterogeneous phenomena, which have mostly received separate consideration under their respective names. Though it is desirable that their fundamental relationship should have been thus briefly pointed out, no practical end would be achieved by dwelling further upon the group as a group, upon the physiological meaning or origin of the several forms of spasm, or on their therapeutic treatment, which will be found described under separate articles. *See* MOTILITY, Disorders of; STRYCHNINE, Poisoning by; TETANY; WRITER'S CRAMP.

H. CHARLTON BASTIAN.

SPASMODIC.—SYNON.: Fr. *Spasmodique*; Ger. *Krampfhaft.*—A descriptive epithet applied or applicable to conditions or diseases in which spasms, and mostly those of the tonic class, are met with as prominent or essential constituents; for example, *spasmodic croup*, *spasmodic asthma*, *spasmodic stricture*. *See* SPASM.

SPECIFIC.—When applied to a disease, the word 'specific' signifies that such disease is produced by a special cause, and has special characters, for example, syphilis and the eruptive fevers. When applied to a remedy, it implies that the substance has a distinct and definite effect in the cure of a certain disease, such as mercury in syphilis, or quinine in ague; or that it acts upon a particular organ, as ergot upon the uterus.

SPECTACLES, Uses of.—*See* STRABISMUS; and VISION, Disorders of.

SPECTROSCOPE IN MEDICINE.

INTRODUCTION.—Defining a prism in optics, as a solid angle bounded by two planes, it may be stated, generally, that a spectroscope consists essentially of a prism and a slit. A diffraction-grating may replace the prism, but for medical purposes no advantage is gained by its use.

According to the kind of spectroscope, other accessories are required; thus, there are two kinds of spectroscope used for medical purposes—*chemical spectroscopes* and *micro-spectroscopes*. In the former the slit is set at one end of a tube, known technically as the collimator, at the other end of which, and having the slit in its focus, is a lens which makes the rays admitted through the slit parallel before entering the prism. The prism refracts and disperses (when they can be dispersed) the rays passing through it, and, if they be rays of white light, they emerge from the second face of the prism as a coloured image of the slit, red at one end, violet at the other, passing from red into orange, yellow, green, blue, and violet. This rainbow band is the continuous spectrum of the light-source. If, on the other hand, a light-source be used containing not compound rays, but those of one colour only—for example, such as are yielded by a colourless flame into which a salt of sodium is introduced, then the rays emerge from the prism as a yellow line, a yellow image of the slit. The prism should be set at the minimum angle of deviation for the sodium line. (For the meaning of this term, and the method of setting the prism, the reader may consult Glazebrook's *Physical Optics.*) The spectrum is then magnified in a telescope, which is a small astronomical refractor, moving round the table of the spectroscope, and capable of being focussed.

In *direct-vision* spectroscopes, to which the micro-spectroscope belongs, a compound prism is used; by this means the slit and the prism can be placed in the same straight tube.

In the *micro-spectroscope*, which is a combination of a microscopic eye-piece and a direct-vision spectroscope, a lens collects the rays. Passing up in the optic axis of the tube of the microscope, they then fall on the slit and are made parallel by another lens placed between the slit and the compound prism. This compound prism is composed generally of three prisms of crown glass and two of flint glass, united to each other by Canada balsam. By such a combination deviation is eliminated, while sufficient dispersion is retained to make the spectrum long enough. A right-angled reflecting prism covers half the slit, so that a second spectrum can be compared with that of the substance beneath the objective of the microscope; a side-stage being adapted to the side of the micro-spectroscope, perforated with a square hole, and provided with spring clips to hold tubes, &c., the light being reflected into the hole by means of a plane mirror suitably mounted. The slit can be widened and narrowed by means of a screw and springs bearing on the jaws of the slit, which should be made to move away from each other equally, as this prevents displacement of the centre of a band or line when the slit is widened.

It is advisable to work with both these instruments; but if one only is desired, then the micro-spectroscope is to be recommended. Useful observations may be made, however, with a pocket spectroscope, procurable at a trifling cost.

DIFFERENT KINDS OF SPECTRA.—When light from various sources is examined with the spectroscope, the appearances observed may be classed under three heads: (1) Spectra consisting of bright lines or striæ; (2) Continuous spectra; (3) Absorption spectra.

(1) *Bright-line spectra* consist of bright lines on a dark background, occurring singly or in groups, placed in the same or different parts of the spectrum. Glowing gases or glowing vapours yield such. Metals of the alkalis and alkaline earths yield such spectra when their combinations are heated in the Bunsen flame; the heavy metals require to be

volatilised at a much higher temperature by means of the electric spark.

Metallic poisons may be detected by their bright-line spectra; and the elements, sodium, potassium, calcium, and others, can be similarly detected in the ashes of calculi, and elsewhere. The late Dr. Bence-Jones, in his study of the 'chemical circulation,' used the spectroscope to determine the rapidity of the distribution of lithium salts to distant parts of the body, such as the crystalline lens and the hip-joint.

(2) *Continuous spectra* are yielded by incandescent solids and fluids. Gas-light, candle-light, the electric and lime lights, incandescent platinum, &c., yield a continuous spectrum—the band of colour referred to above, red, orange, yellow, green, blue, and violet—one colour passing gradually into the next without break.

(3) *Absorption spectra* are of two kinds: (*a*) those consisting of black lines occurring in a continuous spectrum; and (*b*) those consisting of broad black spaces, or shadings of varying degrees of darkness, in a continuous spectrum. The spectrum of the sun, and of of many of the stars, are examples of the former, and the latter are those with which medical spectroscopy has to do. These black lines, bands, or shadings are spaces of darkness in the spectrum due to the absence certain rays. Those in the solar spectrum, which were discovered by, and named after, Fraunhofer, are caused by the presence of vapour in the sun's atmosphere. Every gas and every vapour when in a comparatively cool state absorbs the same rays that it emits in the incandescent state. If no vapour existed around the sun, then we should have thousands of bright lines belonging to the elements burning in the sun. Some of the solar lines are, however, telluric, *i.e.* of earthly origin, and are due to absorption in the earth's atmosphere. The most prominent Fraunhofer lines, beginning from the red end of the spectrum, have been called A, a, B, C, D, E, b, F, G, and H.

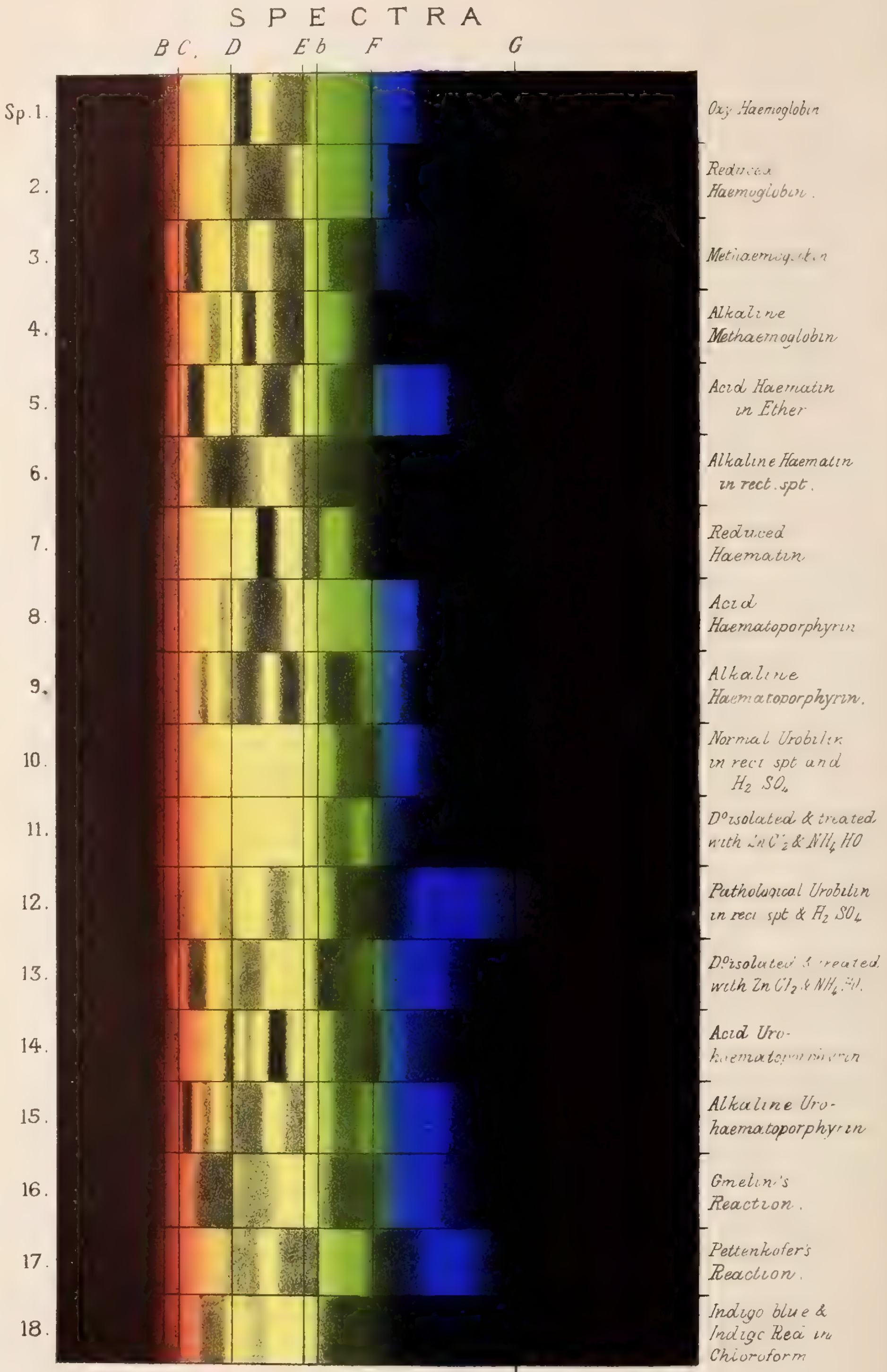
Solutions of animal and vegetable colouring-matters have the property of arresting certain rays of light passing through them; and corresponding to the rays stopped, or enfeebled, we have spaces of darkness in the spectrum—the *absorption bands.* Solid pigments may do the same, even when the light analysed (by the prism) is reflected from their surface. Absorption may, however, be general, that is, one or the other end of the spectrum may be absorbed.

THE STUDY OF ABSORPTION SPECTRA.—Two pigments may give the same spectrum, and yet not be identical; to prove identity, their respective spectra must be changed in the same way by reagents. In studying such spectra, the first thing to be done is to map the principal lines in the solar spectrum. By consulting a map of the solar spectrum, and then examining the spectrum of diffused daylight, concentrated, if necessary, by a condenser on the slit, it is easy to identify the most prominent Fraunhofer lines referred to above. Of these A, a, and H are not easy to see. Next they should be mapped on a piece of smooth drawing-paper. Both the chemical spectroscope and the micro-spectroscope should be provided with *photographed scales*; angular measurements for the former are only indispensable for certain measurements, such as the calculation of refractive indices. These scales can in both instruments be illuminated by a mirror at the end of the scale-tube. By means of a millimetre scale a map is easily made from the readings obtained from the Fraunhofer lines. The scale of this instrument is to be set so that D shall stand at a convenient number; for the chemical spectroscope it is generally set at 50.

In mapping an absorption spectrum we begin by setting the scale. A flame coloured by a sodium salt is brought before the slit of the chemical spectroscope, or reflected up by means of the microscope mirror on to the slit of the micro-spectroscope; then the scale is adjusted until the sodium line stands at the same number on the scale that the D line stood at. The slit is then illuminated by means of artificial light, say an Argand gas-burner, the light being condensed on the slit by a bull's-eye condenser in the case of the chemical spectroscope. The fluid to be examined is then placed in a vessel, such as a test-tube, held in a suitable holder, before the slit of the chemical spectroscope, or in a small flat-bottomed tube let into a thin slab of wood, for the micro-spectroscope. If the solution be too darkly coloured to transmit the spectrum, either a thinner layer or a more dilute solution must be used. Hermann's hæmatoscope is frequently used for this purpose, as by means of a screw-adjustment any depth of fluid can be examined; it is only applicable to the chemical spectroscope. The slit must not be too wide, and the focus should not be altered after the sodium line has once been focussed. A black cloth, to exclude extraneous light, should be used to cover the chemical spectroscope. Bands in the red end of the spectrum are best seen by artificial light, in the violet by daylight. For examining portions of organs or tissues a compressorium is very useful, as various degrees of thickness can then be examined.

When publishing results, it is necessary to give the measurements of absorption bands in terms of a universal scale. Now, no two arbitrary scales agree, so that all measurements should be reduced to wave-lengths, denoted by the sign λλ. Zeiss's micro-spectroscope is provided with a wave-length scale, but the readings of any spectroscope may be reduced to wave-lengths by means of an *interpolation curve.* A sheet of logarithm paper has the arbitrary number of the scale

SPECTROSCOPE IN MEDICINE.


SPECTRA
B
C
D
E
b
F
G
Sp. 1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
Oxy Haemoglobin
Reduced Haemoglobin.
Methaemoglobin
Alkaline Methaemoglobin
Acid Haematin in Ether
Alkaline Haematin in rect. spt.
Reduced Haematin
Acid Haematoporphyrin
Alkaline Haematoporphyrin.
Normal Urobilin in rect spt and H_2SO_4
D^o isolated & treated with $ZnCl_2$ & NH_4HO
Pathological Urobilin in rect spt & H_2SO_4
D^o isolated & treated with $ZnCl_2$ & NH_4HO.
Acid Urohaematoporphyrin
Alkaline Urohaematoporphyrin
Gmelin's Reaction.
Pettenkofer's Reaction.
Indigo blue & Indigo Red in Chloroform

J.A. MacMunn. del.　　M & N. Hanhart lith.

Fig. 138. Diagram representing the most important Spectra of Pigments.

of the spectroscope written out along the top line, each tenth of an inch corresponding to one division of the scale. Along the side-line, at right angles to this, the wave-lengths are written, each tenth of an inch here being made to correspond to two millionths of a millimetre. It is convenient to begin at the top of this line with 410 millionths of a millimetre, then the next *inch* division has 430 placed opposite to it, and so on down to 730. On referring to Angström's numbers, the wave-lengths of the principal Fraunhofer lines are found to be as follows in millionths of a millimetre: A = 760, **a** = 718, B = 686, C = 656, D = 589, E = 526, b = 516, F = 486, G = 430. Their value on the arbitrary scale of our spectroscope has been determined by actual measurement. By means of these data their positions on the paper are denoted by small crosses; through the centres of these crosses a curve is drawn. When now we want to know the value in λλ of any number of the scale of the spectroscope, we can find it by running the eye along the perpendicular line joining the top line with the curve, thence to the right-hand side line, where its wave-length is given. In other words, the abscissæ are the arbitrary numbers of the scale, the ordinates the wave-lengths.[1]

Uses of the Spectroscope in Medicine. It is not necessary to describe in detail the various pigments and their spectra which have been discovered in the animal body. It will suffice to point out briefly some of the applications of the spectroscope to medicine, especially as a full account of most of these pigments is given in Professor McKendrick's *Text-book of Physiology*, vol. i., and in Professor Halliburton's *Text-book of Chemical Physiology and Pathology*.

In medical jurisprudence the spectroscope is indispensable for the detection of blood-stains on clothing, knife-blades, &c. In poisoning by carbonic oxide from the inhalation of coal gas, charcoal fumes, &c., the spectrum of the blood is peculiar, and reduction, by means of sulphide of ammonium, cannot be brought about. Other poisonous gases have been found to enter into peculiar combinations with hæmoglobin, such as nitric oxide, &c.; doubtless research will reveal the existence of many such combinations.

To the physician the instrument is useful in enabling him to detect blood and its decomposition-products, and also bile-pigments and their decomposition-products, in urine and various pathological fluids, under diseased conditions, and from the administration of drugs. In the detection of various pigments, which cannot be recognised by other methods, microscopic or chemical, as well as in enabling us to form an idea as to the extent and nature of the metabolic changes taking place under the influence of disease, the spectroscope promises to be a helpful guide. In fact, pigments have already been found in the urine which can be produced artificially from hæmoglobin and hæmatin, &c., by certain chemical methods, by means of which we have found out how they are produced in the body. These pigments serve as finger-posts to point out the various steps of the abnormal processes by which not only they, but the substances with which they are associated, are originated. The pigment known as urohæmatoporphyrin may be given as an example. This can only be produced in the laboratory by the action of very energetic *reducing* agents on hæmoglobin or hæmatin, yet it occurs in many diseased conditions, in which, until recently, it was supposed increased oxidation took place; but we now know that exactly the opposite occurs, and the spectroscope confirms this. Again, the rapidity of the reduction of oxyhæmoglobin to reduced hæmoglobin may be measured by the spectroscope, as Hénocque has shown. Observing the ungual phalanx of the thumb, at the root of the nail, by means of a direct-vision spectroscope, he finds, if a ligature be quickly applied, that in health reduction takes place in seventy seconds, whereas in anæmic states it may happen in from thirty to forty seconds, being dependent on the amount of hæmoglobin, the amount of hæmoglobin reduced in one second being 0·2 per cent. under normal conditions.

Wertheimer has also made use of the spectroscope in a novel and ingenious manner. He injected sheep-bile into the femoral and mesenteric veins of dogs, and detected the presence of the writer's cholohæmatin in the bile of the dog within ten minutes after its injection into the femoral, and five after its injection into a mesenteric vein, showing, as he remarks, that the liver has the power of picking the constituents of bile out of the circulating blood.

Instead of repeating what is already known about the pigments and their spectra, attention is called to the accompanying chart (fig. 138), where the most important spectra are figured. In this, sp. 1 represents the spectrum of oxyhæmoglobin. That of the compounds of carbonic oxide and of nitric oxide, respectively, with hæmoglobin resembles this, except that the bands are nearer the violet. 2 is the spectrum of reduced hæmoglobin, got by adding sulphide of ammonium to a solution of oxyhæmoglobin. 3 is the spectrum of methæmoglobin, a substance intermediate between hæmoglobin and hæmatin, in which the oxygen is more firmly combined than in oxyhæmoglobin. It occurs on the edges of healing wounds, in old blood-stains, in various exudations, &c., and may be produced artificially by treating a solution of blood with a great number of reagents, which are not energetic enough to split the hæmoglobin into hæmatin and a proteid. 4 is the spectrum of alkaline methæmoglobin, *which is very often mistaken for oxyhæmoglobin in alkaline urine.* It may be obtained by adding a little ammonia to a solution of methæmoglobin. 5 is the spectrum of acid hæmatin in ether; and 6, that of alkaline hæmatin in rectified spirit. 7 is that of reduced hæmatin, got by adding a reducing agent, such as ammonium sulphide, to a solution of alkaline hæmatin. Hæmochromogen is another name for this pigment. This is a very important spectrum, as by its means blood can be detected with great certainty when present in minute traces. Sometimes blood may be present in urine, adhering to the sediment; if this be filtered off, digested in rectified spirit containing ammonia, filtered, and the filtrate treated with ammonium sulphide, this spectrum is obtained. Again, in detecting blood-stains on clothing, knife-blades, &c., the bit of cloth, or blade, is treated with the same reagents, with a similar result. 8 is the spectrum of acid hæmatoporphyrin, got by dissolving hæmoglobin in strong sulphuric acid and filtering through asbestos; and 9, that of alkaline hæmatoporphyrin, obtained by dissolving hæmatoporphyrin in alcohol and ammonia. These two spectra, and 14 and 15, should be carefully studied, as a condition known as hæmatoporphyrinuria has lately been described, first by the writer, since then by others. In many of these cases it seems to have been caused by the administration of sulphonal, but not in all. The urine is a deep Burgundy-red colour, and decomposes very slowly; a specimen obtained in May 1890 still remains unchanged. 10 is the spectrum of normal, and 12 that of pathological, urobilin, in rectified spirit and sulphuric acid; that of stercobilin is almost identical with the latter. 11 and 13 are the spectra of normal and pathological urobilin respectively, treated in a spirit solution with zinc chloride and ammonia, which develops a green fluorescence. 14 and 15 are the spectra of acid and alkaline urohæmatoporphyrin. This pigment can be obtained by treating hæmatin with energetic reducing agents, aided by heat, such as sodium amalgam, zinc and sulphuric acid, &c.; at an early stage hæmatoporphyrin is produced, then this pigment. It occurs as such, as the writer has discovered, in the urine of acute rheumatism, and of many other diseases, including Addison's disease. Dr. A. E. Garrod finds that its presence is independent of blood-destruction in rheumatism, and must probably depend upon a failure of those organs, in which it should be metabolised to other pigments, to effect such change.

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[1] By using the *reciprocals* of the numbers expressing the wave-lengths, the curve becomes nearly a straight line. The reciprocal of a fraction is obtained by making the numerator and the denominator change places. Thus, the reciprocal of $\frac{1}{2}$ is $\frac{2}{1}$, the reciprocal of 5 is $\frac{1}{5}$, and of $\frac{1}{5}$ is $\frac{5}{1}$, *i.e.* 5.

Bilirubin[1] and biliverdin, the colouring-matters of human bile, give only a *general* absorption of the spectrum; but either of them when treated with nitric acid gives 16, that of Gmelin's reaction, when the spectrum of the violet stage is examined. 17 is the spectrum of Pettenkofer's reaction; and 18, that of indigo-blue and indigo-red from *normal* urine, by heating with hydrochloric acid to which a little nitric acid has been added, then, when cold, agitating with chloroform This test succeeds when Jaffe's fails.

The above are the most important spectra from a purely medical point of view. There are, of course, other pigments in the human body present under normal conditions, such as myohæmatin and the histohæmatins (discovered by the writer), the lipochromes or fat-pigments, formerly known as luteins, and the black pigments included under the name of melanines. The last show no absorption bands, and probably arise somehow in connexion with the lipochromes, although in cases of melanuria associated with melanotic sarcomata a chromogen, or colourless mother-substance, is present which on oxidation changes into melanin. At all events, the origin of a melanin from hæmoglobin seems doubtful.

Many attempts have been made to explain the bronzing of the skin in Addison's disease, but as yet physiologists are not disposed to accept any of the hypotheses offered. The writer finds, however, that the suprarenal bodies of many mammals contain hæmochromogen, pointing to the indisputable fact that these organs are concerned in the downward metabolism of effete hæmoglobin; this, taken in connexion with the presence of urohæmatoporphyrin in the urine, would seem to point out that, if the suprarenal bodies are diseased, then effete blood-colouring matter must be present in excess in the blood, and produce staining of skin and mucous membranes.

CHARLES A. MAC MUNN.

SPECULUM (Lat.)—SYNON.: Fr. *Speculum*; *Miroir*; Ger. *Speculum*; *Spiegel.*

DEFINITION.—An instrument adapted for exploring the several channels and deeper-seated parts of the human body. The chief of these are the ear, the eye, the nose, the mouth, the throat, the rectum, and the vagina. For each of these there are specially adapted instruments.

DESCRIPTION.—Specula are made of various materials, and in a variety of shapes. The speculum is intended not only to permit and facilitate inspection, but also to dilate the canals and to expose parts, in order that they may be treated surgically, or have medicaments applied to them. For this reason a cylindrical speculum will not always answer the purpose; we have, therefore, bivalve and trivalve specula, and many other forms. On account of the friability of glass, other material has not infrequently to be used, such as white polished metal, celluloid, or wood; the latter is objectionable, as it has no reflecting power; but when it becomes necessary to apply the actual cautery through a speculum, a substance must be employed that is a non-conductor of heat and non-friable, such as wood.

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[1] Which is identical with hæmatoidin

VARIETIES.—**Aural specula.**—Of these there are several forms, and some are known under the name of 'auriscopes.' Some have a trumpet-shaped opening, which facilitates the introduction of light, and greatly increases the illuminating and reflecting power. There are also bivalve aural specula with a screw lever, and others with handles attached so as to separate the blades.

Eye specula.—These are known by the name of *eyelid retractors* and *ophthalmoscopes*, both of which are really specula for examining the eye, though not generally classified as such. *See* OPHTHALMOSCOPE.

Nasal specula.—There are several forms of these, the great purpose they have to serve being that of dilating. One, known as Elsberg's, is three-bladed.

Throat specula.—Specula for examination of the throat are generally called *laryngoscopes*. *See* LARYNGOSCOPE.

Rectal specula.—These are cylindrical, bivalve, or trivalve. The cylindrical are made on the principle of Fergusson's vaginal speculum, but with an opening so as to expose the wall of the rectum at the part to which it is adapted. The valvular forms are made of white metal.

Vaginal specula.—Of these there are many kinds. Perhaps the most useful is that known as Fergusson's, which is cylindrical and made of glass, with a coating of mercury behind it, so as to give it reflecting power, and backed by vulcanised indiarubber. An improved variety of this is of a tapering form, so as to admit more light. *See* WOMB, Diseases of.

Sims's duckbill speculum is of great use in retracting the perinæum and dilating the vagina, when space is required for operation, as in vesico-vaginal fistula. Then there are bivalve and trivalve metallic specula. Wooden cylindrical specula are always used when the actual cautery is applied, for reasons already mentioned. For the ordinary purposes glass is the preferable material, as it is unaffected by caustics.

The uses of specula will be found described in connexion with the diseases of the several organs to which they have reference.

It is worthy of record that many varieties of specula have been discovered among the ruins of Pompeii, and that recently a quadrivalve vaginal speculum has been unearthed there. CLEMENT GODSON.

SPEECH, Disorders of.—SYNON.: *Troubles du Langage*; Ger. *Störungen der Sprache.*—Defects of speech are very various in their nature, degree, and mode of causation. They are capable of being classified from several different points of view. The writer will not attempt to do more in the present article than point out the nature and relations of the several kinds of defects, which will, in almost all cases, be found to have received consideration under their own proper headings.

ÆTIOLOGY AND PATHOLOGY.—Disorders of speech may depend upon (1) *congenital*, or (2) *acquired* defects of the brain, or of certain of its nerves and sense-organs.

1. *Congenital defects.*—The most frequent and important of these defects is *deafness*, which entails mutism, so that the individuals thus afflicted are known as 'deaf-mutes.' It must, however, be borne in mind that this condition of mutism or dumbness may also be brought about by absolute deafness occurring from any cause after birth, but before the child begins to talk; or even after it has learned to talk, up to the fifth or seventh year. In cases of the latter type, the child, when without the accustomed guidance derived through the sense of hearing, soon forgets how to speak and becomes dumb. In addition to this class of cases, there are those of congenital idiocy without deafness, but in which the child never learns to talk or articulate in the proper sense of the term (*see* IDIOCY). There are also other cases allied to the last, in which, owing to some intracranial lesion occurring either before, during, or soon after birth, the child's subsequent mental condition is greatly impaired, as well as its motor power. In these most deplorable cases the child may never be able to speak in any distinct or articulate fashion, it may not be able to walk or even stand, or it may only be able to accomplish these latter acts imperfectly. In some of these children there is evidence of the existence of a hemiplegic condition, with arrest of growth of the paralysed limbs. Such patients are also frequently subject to one-sided fits; but it is not certain whether in these cases the inability to speak is especially prone to occur in those who are congenitally paralysed on the right side. In some of the less severe examples of this latter type which have come under the writer's observation, speech has been merely deferred—the child has not commenced to speak till the fourth, fifth, or even the sixth year. *See* DUMBNESS.

During the last two or three years the late Dr. Hadden has described several curious cases of speech-defect met with in children, to which the term 'idioglossia' has been applied. These persons have to a certain extent a language of their own; so that when asked to repeat phrases, they make use of sounds of their own instead of those proper to the words that should be employed. The sounds which they substitute are said to be always the same for the same words, though some of these patients at least seem to be capable of writing correctly from dictation. They may also show a fair amount of intelligence generally.

2. *Acquired defects.*—Among acquired defects of speech we have troubles of various degrees and kinds, which may come on at any period between infancy and old age, and which, as regards duration, may be temporary or permanent. The great variation in the extent and nature of these defects is due to the fact that the impeding condition or lesion may act (1) upon parts of the brain concerned with the genesis of thought, and of the will to speak; (2) upon some part of the nervous channels or centres concerned with the actuation of speech; or (3) upon the peripheral nerves and organs concerned with articulation and vocalisation. Thus it happens that acquired defects of speech may, in one set of cases, be associated with the most marked alterations in the intelligence or previous mental condition of the patient, whilst in others they may be represented by mere defective articulation or vocalisation. In briefly referring to the principal varieties, it will be convenient to pass from the simple to the more complex types.

Proper vocalisation is essential for the production of normal speech; where it alone is defective we have to do with various kinds of aphonia, which may be due to very different causes (*see* Voice, Disorders of). Again, articulation as a mere motor act may be interfered with or perverted in diverse modes. Where speech-movements are incoördinate, we have such common defects as stuttering or stammering (*see* Stammering); or else those less marked perversions of speech-movements which are met with in some cases of chorea. Again, where the movements concerned in speech are more simply defective, we have that indistinctness of articulation and blurred utterance which, in various degrees, is so commonly associated with different forms of paralysis due to cerebral disease. To this kind of defect the name 'Aphemia' is now commonly applied. It presents itself under many various conditions, and with different degrees of completeness. It may show itself in its most extreme form in 'labio-glosso-laryngeal paralysis,' or in other forms of bulbar disease. This blurred or difficult articulation is also one of the signs met with in general paralysis of the insane, and in disseminated cerebro-spinal sclerosis. Again, it occurs in association with hemiplegia caused by different lesions in various parts of the brain, between the bulb below and the cerebral cortex above. As a rule, it is most marked and most persistent in hemiplegia due to disease of the pons Varolii, while in lesions higher up it is apt to be slight and more transitory, especially where such lesions exist on the right side of the brain. It is evident, indeed, that this kind of defect is specially prone to occur where there is damage to the first parts of the outgoing tract leading from the kinæsthetic centres in the left third frontal convolution, or in any lower parts of the same tract, or when there is damage to the actual motor centres for articulation situated in the bulb. Damage to the third left frontal convolution itself gives rise to a form of speech-defect which is commonly known as *aphasia* (*see* Aphasia). The writer has shown, however, that this condition may, in reality, and in full accordance with modern doctrines as to the strict localisation of cerebral functions, be induced by damage in parts of the cortex comparatively remote from the 'third frontal convolution.' Such forms of speech-defect may exist without any very obvious mental impairment, and it is worthy of note that they may sometimes be induced, without coincident hemiplegia, as a result of over-work, either literary or clerical, or under the influence of great excitement. Related to speech-disorders of this type are the other more complex and extremely varied defects of speech classed under the head of *amnesia.* These are often associated with grave mental and volitional defects. The writer long ago pointed out that they are especially apt to occur in association with lesions involving the convolutions which bound the posterior extremity of the 'Sylvian fissure.' These are parts of the cortex which both clinical and experimental investigations have shown to have much to do with visual and auditory impressions. They would accordingly be concerned with the appreciation, on the one hand, of printed and written characters, and, on the other, of spoken words; and seeing that such parts of the cortex must also afford the starting-points for volitional incitations to acts of writing, reading, and speaking, it can easily be understood how much damage to the brain in these regions may interfere with intellectual 'appreciation,' as well as with intellectual 'expression.'

Finally, in this relation, reference should be made to certain forms of speechlessness occasionally met with in hysterical females, or in the insane of both sexes, in which there may be a deficiency of will to speak, dependent upon perverted cerebral action, either without or with a discoverable basis of actual morbid changes. In such cases patients may remain dumb for months or for years; there may be no apparent motive, or the speechless condition may, in the insane, stand in direct or indirect relation to certain delusions.

Prognosis and Treatment.—The treatment of these various defects of speech will, of course, depend upon their nature, causes, and associated conditions. Reference must, therefore, be made to the several special articles in which the different forms of such defects are considered. It may be said here, however, that most of the forms of speech-disorder dependent upon congenital defects are comparatively little amenable to treatment. Those due to brain-lesions occurring later in life are oftener mere temporary defects, diminishing after longer or shorter periods, as the effects of the original lesions become lessened by time and treatment. Some of the marked cases of aphemia, moreover, are capable of being cured or greatly improved by careful daily drilling in the articulation of vowel-sounds and short words, provided this exercise be persistently and methodically carried out.

H. Charlton Bastian.

SPERMATORRHŒA (σπέρμα, seed; and ῥέω, I flow).—Synon.: Fr. *Spermatorrhée*; Ger. *Samenfluss*.

Definition.—A real or apparent discharge of seminal fluid, occurring without voluntary sexual excitement.

Two varieties may be recognised: (1) *True spermatorrhœa* is the discharge of spermatozoa from the urethra, or in the urine, at periods other than during sexual excitement. (2) *False spermatorrhœa* or *prostatorrhœa*, is the discharge of a seminal-like fluid, destitute of spermatozoa.

Ætiology.—Local irritation, whether from masturbation or from some diseased or disordered condition of the genital organs, is the cause of spermatorrhœa in the first instance. General or local morbid conditions, such as balanitis, phimosis, a long prepuce, urethral catarrh, irritability of the prostate, a tender spot in the urethra, varicocele, spasmodic contraction of the levator ani from rectal irritation, worms in the intestinal canal, constipation, and changes in the nerves or nerve-centres supplying the genito-urinary tract, inducing either hyperæsthesia or anæsthesia, serve as excitants. Any of these states may give rise to masturbation, or masturbation may in turn cause most of them. Should the conditions that determine the irritation persist, the very smallest mental or local stimulus is sufficient to continue the disease indefinitely.

Symptoms.—The first symptom that alarms the subject of spermatorrhœa is the occurrence of frequent nocturnal emissions, at first with, and afterwards without, erotic sensation. These reduce his strength, render him weak and irritable, and gradually prey upon his mind; and if, as frequently happens, masturbation be practised, they induce a condition of extreme mental depression. When the patient reaches this state, the mere reference to sexual matters, the sight of anything lewd, the act of defæcation, or a chance irritation of the penis during walking, riding, or driving, is often sufficient to cause an abortive or, it may be, a complete emission. The discharge may, in advanced cases, find its way into the bladder and be passed with the urine; a condition which is regarded by the patient as the most serious of all. The discharge may be the ordinary seminal fluid; or it may be less in quantity, clearer, tenacious, more like synovial fluid in appearance and consistence. In the latter case it seldom contains spermatozoa, but it is usually only the forerunner of the other more serious state, or it may intermit with it. These conditions combine to render the patient for the time being physically and mentally a wreck, sleepless, listless, nervous, anæmic, and with an old and insipidly anxious look upon his muddy or pimpled face. Intercourse becomes well-nigh impracticable, the discharge of semen occurring before the introduction of the organ; or erection may be impossible or imperfect.

Diagnosis.—In the diagnosis of the cause of spermatorrhœa, the condition of the external genitals must first be determined. The presence of a tender spot in the urethra, or the existence of hyperæsthesia or anæsthesia or stricture, can be made out by passing a catheter. The acorn-pointed bougie is the best for diagnosing the exact seat of such troubles. The discharge itself must be found and examined microscopically, the presence of spermatozoa establishing true spermatorrhœa. Glairy fluids, like that of prostatorrhœa, occur in the urethra during the last stages of a gleet, or in straining at stool, and also in stricture. The history of the case, and catheterism, readily clear up the cause of the discharge.

Prognosis.—In the generality of instances the patient gets quite well, either by ordinary care on his own part, or by medical treatment. In other cases, however, the development of some inherited disease manifests itself simply from the weak condition to which the patient is reduced. In some instances dementia or melancholia is induced, and the patient continues his impure habits even whilst under watch and ward in a lunatic asylum.

Treatment.—Should any local irritation appear sufficient to cause spermatorrhœa, it ought to be treated and removed if possible. A long prepuce should be cut off, balanitis cured, a varicocele relieved, or rectal irritation removed. To prevent masturbation many plans have been tried, such as the application of iodine to the penis, or touching the parts with caustics, which, by the pain they cause, prevent the patient meddling with the organ. These measures, or such as these, combined with encouragement from the medical attendant, and resolution on the part of the patient, will help towards a cure. The situation of a tender spot in the urethra can be made out by a bougie—the acorn-pointed bougie being the best, or by pressure on the perinæum; or it may be possible to see a local change by the urethroscope. When discovered, the tenderness may be relieved by counter-irritation to the perinæum, or by applying caustics directly to the tender surface, either in substance or in solution. The solution chiefly used is one of nitrate of silver, varying in strength from five to sixty grains to the ounce, and it is best applied by the silver syringe-catheter, the flexible tube, or through the urethroscope. The patient's digestion and impaired physical and mental condition must be looked after. Stomachic and nervine tonics, such as gentian, strychnine, phosphates, and iron, are the most useful, and must be given for some time. To allay irritability of the genital organs, the bromides and belladonna may be given, separately or in combination. For hyperæsthesia the extract of belladonna, in half-grain doses morning and evening, is especially useful; it may be given with the tonics recommended above. Should anæsthesia of the urethra and genitals exist, galvanism has been tried and has proved successful. The patient should sleep on a hard bed, and get up the moment he wakes. A separate bedroom should be disallowed. Cold hip-baths morning and evening, rectal injections of cold water, walking exercise, and mixing in company as much as possible, are useful adjuvants to treatment. Various mechanical contrivances have been suggested, but attention to the moral and physical health will do much to allay nocturnal emissions. *See* Masturbation.

James Cantlie.

SPEZIA, Bay of, in Central Italy. A calm, moist, moderately warm, equable winter climate. Mean winter temperature, 50° F. *See* Climate, Treatment of Disease by.

SPHACELUS (*σφάζω*, I destroy).—The process of mortification; or, more correctly, the dead mass resulting from this process. *See* Gangrene.

SPHINCTERS, Disorders of.—Synon.: Fr. *Troubles des Sphincters*; Ger. *Stöhrungen der Schliessmuskeln.*

From a practical point of view, it is here only needful to refer to disordered actions of the sphincters of the bladder and of the rectum. The disorders themselves are in each case of two kinds. We may have to do with *spasm* of the sphincter vesicæ or of the sphincter ani, leading to or, at least, aiding in bringing about, retention of urine and retention of fæces respectively; or, on the other hand, there may be *paralysis* of these sphincters, leading to incontinence of urine, and favouring incontinence of fæces.

Ætiology and Pathology.—These opposite modes of disordered function of the sphincters of the bladder and the rectum may be variously induced; but the causes may be ranged in three principal categories, according as they are—(1) of *peripheral* or *reflex*, (2) of *spinal*, or (3) of *cerebral* origin.

1. *Peripheral causes.*—These are not always distinct from those of the next category, and they more frequently reveal themselves as spasms than as paralyses, except when the cause is some actual inflammatory disease (peripheral neuritis) involving the nerves which supply the sphincters. Retention of urine due to reflex spasm of the sphincter of the bladder is frequent enough, especially in stricture of the urethra or stone in the bladder. On the other hand, a weak action of the sphincter, with undue irritability of the bladder, may lead to nocturnal incontinence of urine in children. Temporary paralysis of both sphincters may occasionally be induced by a kind of cerebral reflex, under the influence of fright. Spasmodic conditions of the sphincter ani may be induced by the irritation of fissures or small ulcers just within the anus, and may tend greatly to increase the suffering of the patient during or after defæcation.

2. *Spinal causes.*—The majority of the cases of disordered action of the sphincters will be due to this class of causes. They are incidents of functional or of structural diseases of the spinal cord, acting upon the nerves by which such sphincters are supplied. Here, too, we may have irritation of the spinal centres, causing spasms and corresponding retention of urine or of fæces; or we may have pressure upon or destructive lesions of the same parts, in the lower lumbar region of the cord, leading to paralysis of the sphincters, and a corresponding incontinence of urine or of fæces. Irritation or destruction of the channels in the cord, by which voluntary incitations are conducted to these lumbar centres, may also lead to spasm or paralysis of either of the sphincters (*see* Spinal Cord, Diseases of). In many structural diseases of the cord entailing paraplegia, paralysis of the sphincters (owing to its different sequelæ) becomes an important condition, which notably influences the gravity of the disease, and demands the exercise of great care in counteracting its effects, as far as this may be possible. *See* Spinal Cord, Special Diseases of: 9. Softening of.

3. *Cerebral causes.*—In cerebral disease, where the mind or consciousness is profoundly affected, there may be incontinence of fæces or of urine. Yet such events can scarcely be said to be due to a disordered action of the sphincters. If no restraining or inhibitive power be exercised by the cerebral hemispheres, then the spinal reflex mechanisms regulating the action of the detrusor muscles and of their related sphincters are called into play from time to time. The latter become relaxed coincidently with the contrac-

tion of the expulsor muscles of the bladder or rectum, when, from either viscus, a sufficiently powerful set of afferent impressions passes to the related spinal centre. So that in hemiplegia with mental impairment, in dementia, or in stupor or coma, we commonly meet with incontinence of urine and of fæces. Over-action or spasm of these sphincter muscles may also occur under various perverted cerebral conditions, especially in hysteria; thus occasioning an undue retention of the contents of the bladder or of the rectum, as the case may be.

The sphincter of the vagina is also liable to be affected by spasm, but this subject is considered in another part of this work. *See* VAGINA, Diseases of.

TREATMENT.—The treatment of disorders of the sphincters must of course depend upon the nature of the cause, and upon the nature of the particular defect existing in each individual case. When the exciting cause is local, it must be remedied if possible. Where due to structural disease in the spinal cord or in the brain, the above disorders present themselves among many other morbid signs and symptoms; and in these cases we must always strive to correct, as far as it may be possible, the original and common cause of the morbid symptoms in question.

H. CHARLTON BASTIAN.

SPHYGMOGRAPH, The (*σφυγμός*, the pulse; and *γράφω*, I write).

DEFINITION.—The pulse-writer; an instrument devised to record the form of the movements of the arterial pulse.

HISTORY.—The idea of this instrument is as old as Galileo, but it is only in recent years that it has assumed a practical form. The first registering instrument, for recording the movements of an artery, was used by Ludwig in 1847, ten years after Hérisson had devised his sphygmometer, by which he showed in a column of fluid the movements of the pulse. It was with this instrument that Chelius demonstrated the second wave, or dicrotism, of the normal pulse.

Vierordt was the first to construct a sphygmograph which could be applied on man, utilising an idea of King's, who had previously demonstrated the pulsation of the veins in the neck by attaching to them a delicate lever. The instrument of Vierordt, however, did not record the form of the pulse-movements accurately, and for the most part registered only a series of uniform curves. This physiologist remarked that the problem was to place on the pulse a very delicate elastic spring, and by means of it to transmit the movements of the pulse to the writing lever. Marey succeeded in doing this by the invention of his sphygmograph, which became, after the publication of his work in 1863, forthwith applicable for clinical, as well as physiological, research. Its introduction gave the study of the pulse a scientific basis, by causing the arteries to write their autographs, and thereby restored to its first importance the neglected art of reading the pulse.

DESCRIPTION.—Although there are now several sphygmographs at work in the field of clinical inquiry (Marey's, Pond's, Dudgeon's), it will be necessary to describe only that of Marey, which is most commonly in use.

The essential part of the instrument is a delicate spring, armed at its free end with an ivory pad which rests upon the artery. The spring is fixed by its other extremity to the frame-work, and receives the pulse-movements, which are transmitted, amplified, and recorded by an arrangement of two levers. The lower lever is hinged to the steel spring, so that it can move up and down at its free end, which terminates in a vertical knife-edge considerably above the ivory pad which rests on the artery. This knife-edge can be raised or lowered by means of a screw, and so adjusted and maintained in contact with the upper lever, near its centre of motion. This second or upper lever, which points in the opposite direction to the lower one, is very light, and carries at its free end a pen, which records, on a plate moved by clockwork, the vertical movements transmitted to it through the first lever, from the spring resting on the artery. By this arrangement of levers the movements originally received by the spring from the artery are amplified some fifty times in the record.

The tracing is called a *pulse-trace* or *sphygmogram*, and consists of a series of pulsations, varying in number and form according to the frequency and the characters of the pulse. *See* PULSE.

The frame of the instrument, to which the spring is fixed, holds the clockwork by means of which the recording plate is made to travel.

The framework is also made so as to fit easily on the arm, and is retained in position by straps, the arm resting on a suitable pad or cushion.

The regulation of the pressure of the spring on the artery is one of the most important points in the application of the instrument. It requires to be accurately regulated and measured, in order to estimate the character of the pulse, and render a comparison of traces trustworthy, as was first pointed out by the writer. This is effected by a regulator screw connected with the steel spring, and furnished with a registering dial, which records the pressure at which the maximum rendering of the pulse is obtained. By this arrangement, or by a somewhat similar one devised by the late Dr. Mahomed, the tension of the pulse can be fairly estimated by the sphygmograph.

APPLICATION.—In the application of the instrument, the first important point to observe is accuracy of adjustment of the ivory pad of the spring over the radial artery. This can be best done by marking the position of the artery with ink, and then carefully adjusting the spring. Secondly, the pressure on the artery must be regulated by means of the pressure screw, so as to obtain the greatest amplitude of movement by the lever, and the record of all the waves of the pulse. Thirdly, the friction between the recording pen and the receiving plate, on which the trace is recorded, must be reduced to a minimum. Smoked glass and paper are the best receivers; pens that write with ink are apt to blur the finer features of the trace. The tracings on smoked glass or paper are fixed and rendered permanent by varnish; the tracing papers, which should be well enamelled, may be smoked by being held over burning paraffin or camphor, or even over an ordinary vesta match. When the traces are recorded, they may be fixed by varnish made of gum benzoin, or Burgundy pitch in methylated spirit (1 in 8), or ordinary tincture of tolu.

Uses.—The applications of the sphygmograph to clinical inquiry are numerous and important. Precision is given to the study of the pulse, and by the aid of a graphic representation of its form the finger is taught what to feel. A pulse-trace (*see* Pulse, *which should be read with this article*) shows at a glance the rate, regularity, and equality of the heart-beats. Irregularities, and especially inequalities, that escape the finger, are registered; and indications as to pulse-tension and heart-strength, most important for prognosis and treatment, are obtained. In acute visceral inflammations, for instance, slight inequalities in the pulsations otherwise unrecognisable may be recorded, and the first signs of heart-failure, and the necessity for stimulants, thus suggested. Again, the undulatory pulse of a ventricle, too weak to resist respiratory influences, is disclosed in the tracing; and prognosis and treatment may be correspondingly modified.

Indications.—The evidence yielded by the sphygmograph mainly concerns: (1) The mode of the heart's contraction. (2) The condition of the peripheral circulation. (3) The state of the arteries and their coats. (4) Valvular diseases of the heart.

1. The Mode of the Heart's Contraction.—The sphygmographic tracing shows this by the line of ascent. When the heart-muscle acts suddenly and vigorously, the line is vertical and lofty, and terminates in a pointed summit-wave. Unless the vessels are over-full of blood, there follow well marked tidal and dicrotic waves. On the other hand, when the heart's contraction is feeble, the line of ascent is less vertical and lofty; the summit wave is less distinct; and the tidal and dicrotic waves are less, or the former is blended with the summit wave. The pulse, moreover, unlike the pulse of a vigorous ventricle, is easily obliterated by pressure. A note of the pressure at which the most perfect trace is collected should always be made, as it enables the observer to compare results at different times.

2. The Condition of the Peripheral Circulation.—The easy or difficult passage of the blood through the arterioles and capillaries, causing low or high pulse-tension, is estimated by the pressure required to develop or to obliterate the three waves, but more especially the tidal and dicrotic waves. Obstructed peripheral circulation is manifested by increase of the tidal wave, diminution of dicrotism, and lessened height of line of ascent and summit wave (fig. 139). The heart, apart from febrile or nervous excitement, contracts less suddenly under these conditions. On the other hand, in easy and quick capillary circulation, such as occurs in fevers, the sudden heart-contraction causes a more vertical and higher line of ascent, exaggerates the summit wave, lessens the tidal wave, and fully develops the dicrotic wave (fig. 140). In such conditions the fully dicrotous and hyperdicrotous traces are recorded (fig. 141). The rapid onflow of blood is, moreover, shown by the more sudden fall of the line of descent. It is by the comparative study of the three waves, and the pressure required to record them fully, that we obtain valuable indications as to heart-strength and pulse-tension in acute diseases, and in the earliest stages of some chronic affections.

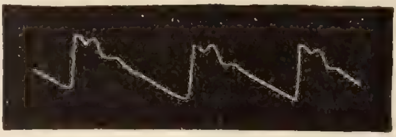
Fig. 139.

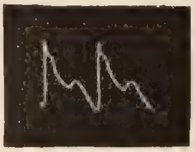
Fig. 140.

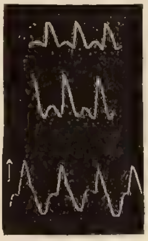
Fig. 141.

3. The State of the Arteries.—There are three chief conditions of the arteries that modify the pulse: (*a*) The state of the *muscular* coat; (*b*) *degenerative* conditions of the arterial walls; and (*c*) the presence of *aneurysm*.

(*a*) When the *muscular* coat is contracted, the artery imparts to the finger a hard, wiry sensation, which shows in the trace by a short line of ascent, and the blending of the summit and tidal waves in an oblique line of descent, scarcely broken by dicrotism (fig. 142). In the opposite condition of relaxed arterial coats, the dicrotic and summit waves are enlarged, and the tidal waves lessened. These changes can be experimentally illustrated by the application of cold and heat to the surface of the body. The cold and hot stages of ague also show the two states.

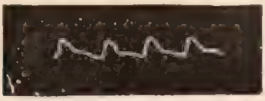

Fig. 142.

(*b*) *Inflammatory* and *degenerative* processes lead to rigidity of the arteries, whereby the modifying influence of their elasticity on the blood-movement is lost. The blood-wave in the radial artery consequently approaches more to that imparted by the heart's systole. In these conditions the pulse often beats visibly, so that we are prepared for the amplitude of the trace. The tidal wave is large, nearer to, and often blended with the summit wave, while the dicrotism which occurs early in the line of descent is badly marked. The presence of these peculiarities often leads to the early diagnosis of unsuspected atheroma of the great vessels (fig. 143).

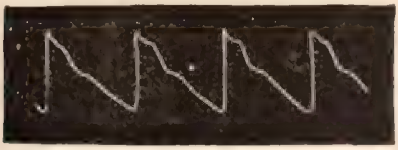

Fig. 143.

(*c*) When the sac of an *aneurysm* is seated on a main trunk after its origin from the aorta, it acts as an elastic bag, and so modifies the pulse-form by rendering the line of ascent oblique, diminishing or abolishing the summit wave, modifying the dicrotism, and more or less converting the three waves into a simple curve. To the finger these changes mean retardation (oblique line of ascent) and diminution of force (loss of summit wave). Such peculiarities in the left radial artery are produced by an aneurysm of the left subclavian, or in the right radial by innominate aneurysm. When the aneurysm is connected with the thoracic aorta in its ascending portion, there is frequently a dissimilarity between the two radial pulse-traces, which is persistent, one being smaller than the other, more vibratory, or more easily obliterated by increased pressure. The pulse usually more affected is the right, as the aneurysm tends to implicate the innominate artery. In aneurysm of the transverse portion of the arch, the left pulse is more commonly diminished in force and amplitude (figs. 144 and 145). In aneurysms of the descending thoracic and abdominal aorta, the dicrotic wave is often much increased in both pulses, while the right radial yields usually the more normally developed trace.

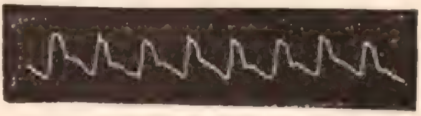

Fig. 144.—Right Radial Tracing.

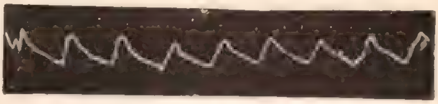

Fig. 145.—Left Radial Tracing.

These signs may be more or less simulated by pressure of tumours on the arterial trunks, or by their partial obstruction by clots. The sphygmographic signs of aneurysm, therefore, require to be confirmed by the use of the ordinary means of diagnosis. In some cases, however, the pulse-traces alone suffice to indicate the lesion and its seat.

4. Valvular Diseases of the Heart.—Valvular diseases of the heart generally influence the pulse-trace. In *aortic regurgitation* this is strikingly seen (fig. 146). The strong, dilated ventricle contracts suddenly on a large charge of blood, and consequently there is a lofty line of ascent, ending in a pointed summit wave. The tidal wave is small in proportion to the trace; and the dicrotism, which occurs later than normal in the line of descent, is generally much diminished, on account of the leakage into the ventricle interfering with the rebound of the blood-column from the closed valves. The dicrotic wave, thus starved, is followed by a rapid fall in the tracing, showing the quick emptying of the artery. It is this contrast between the height of the summit wave and the rapid fall of the trace, unbroken by any *sustaining* wave, that gives the pulse its splashing and collapsing character. These features, the small dicrotism and the rapid fall, indicate the amount of regurgitation. In some cases of this valve-lesion the tracing shows a well-marked tidal wave and a fairly developed dicrotic wave; and increased pressure by the spring of the

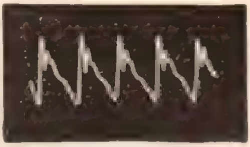

Fig. 146.

sphygmograph, instead of obliterating the trace as usual, shows that there is a fair amount of tension. Such features commonly occur in older persons, in whom the valve-defect is small and due to atheroma, and not to rheumatism, and the pulse-form is modified by the addition of the characters of the pulse of degenerated arteries. When such features are observed in rheumatic cases, and the trace more resembles the normal form, they point to perfect compensation and small valve-defect

In *aortic stenosis* the trace testifies to the amount of the lesion. When the narrowing is extreme the summit wave is lost, the line of ascent becomes oblique and gradual, and the pulse is felt to be retarded. More commonly a break in the line of ascent marks the position of the summit wave, while above it rises the large tidal wave, due to the strong systole (fig. 147). Such pulse traces are called *anacrotic*, to distinguish them from the *katacrotic* traces with all their waves in the line of descent. In cases in which the obstruction is less in degree, the summit of the tracing may be forked by a sharp division between the summit and tidal waves. The dicrotic wave is lessened. The loss or checked development of the summit wave, followed by an exaggerated tidal wave, arising from a strong and often dilated ventricle, pushing a large blood-wave *gradually* into the arteries through the narrowed aortic orifice, are the characteristics of this lesion when pure. When it is associated with aortic regurgitation, the large tidal wave is still pronounced.

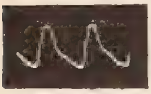

FIG. 147.

Mitral valve lesions, which are less immediately connected with the arterial blood-movement, present less decided characteristics.

In *mitral regurgitation* the tracing is often of the normal outline, and in such cases the compensation is fairly perfect. In some cases, in addition to great rapidity, the pulse is small and shabby, in striking contrast to the vigour of the impulse (fig. 148). The line of ascent is sloping, and the tidal and dicrotic waves poorly defined. In other cases great irregularity is the chief feature of the trace, a series of small, ill-developed pulse-waves being succeeded by large and well-formed pulsations. On analysis, the series of small, ineffectual heart-contractions correspond to inspiration, and the fuller and more vigorous ones to the respiratory pause. In other conditions similar irregularities are caused by the same influences. Dr. Burdon Sanderson, who first referred these irregularities to their cause, says: 'The mechanical effect of inspiration is to augment the quantity of blood contained in the pulmonary circulation, and hence to increase the frequency of the contractions of the heart. This increased frequency depends on the distended state of the auricles, in consequence of which the ventricles fill more rapidly during their period of relaxation. In this way the length of the diastolic pause is diminished, and the hurried action of the heart satisfactorily accounted for; but the question still arises, Why are the rapid beats which occur in inspiration also ineffectual? Very probably because the mitral valve does not close; the heart being distended with blood, its walls are kept apart to such an extent that the curtains do not meet. The ventricle contracts, but much of its blood is discharged into the auricle, to be returned to the ventricle as soon as its contraction is over. It is not until the effect of inspiration in keeping the auricles full ceases, that the curtains get near enough to allow the heart to make an effort sufficiently effectual to send a full tide of blood into the aorta, and thus relieve the distended pulmonary circulation.'

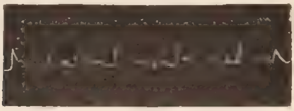

FIG. 148.

Similar peculiarities are occasioned by the same mechanism in tricuspid regurgitation and dilated heart.

In *mitral stenosis* the sphygmographic evidence is very important. The pulse-tracing shows irregularity in the line of descent, which often is greatly prolonged through a missed pulsation—a true intermission in the beat, and sometimes broken by the interpolation of a small, abortive pulsation (fig. 149). These abortive pulsations are due to over-distension of the auricle, causing premature auricular contractions, which propagate themselves to the ventricle, and so produce a ventricular contraction on a small charge of blood. They mostly occur during inspiration, from the causes above mentioned. The rhythmical relations between the contractions of the auricle and the ventricle are thus disturbed, and hence the features just described.

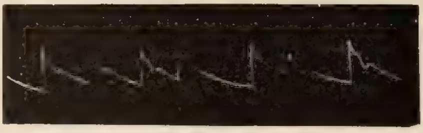

FIG. 149.

These are the special characters of the pulse of mitral stenosis. In some cases, where the stenosis is not great and the compensation perfect, the pulse is regular in time and form, or nearly so; but in these cases characteristic irregularities can often be produced by vigorous exertion.

Finally, in therapeutical investigations the sphygmograph is indispensable as a means of discovering the influence exerted by a drug on the state of the vessels, on the condition of the peripheral circulation, and on the vigour of the heart. The modifications in the form of the pulse-trace above described enable the investigator to estimate these effects. B. Walter Foster.

SPINA BIFIDA (*spina*, the spine; and *bifida*, cleft).—Synon.: Fr. *Hydrorhachis Congénitale*; Ger. *Rückenspalte*.

Definition.—A congenital malformation, with arrest of development, of the laminæ and spinous processes of some portion of the spinal column.

Generally there is a deficiency of two or three spinous processes and the laminæ; the rudimentary portions of the arches of the vertebræ being spread out and irregularly expanded. The spinal cord being thus left unprotected, its membranes protrude through the aperture posteriorly, forming a kind of hernial tumour.

Anatomical and Clinical Characters.—At birth the tumour in spina bifida is generally about as large as a walnut, and either spherical or ovoid in form. It may be met with in any part of the spinal column, but with rare exceptions it occurs in the lumbar or lumbo-sacral region. The tumour is filled with cerebro-spinal fluid, and is therefore always tense, with distinct fluctuation; its tension increases when the child cries, and may be diminished by pressure. The cutaneous covering of the tumour is generally very thin and attenuated, sometimes having the appearance of a transparent membrane, of a bluish or congested colour. In other cases the skin is of its normal thickness and colour. The nerve-trunks, forming the cauda equina, frequently traverse the interior of the sac in the median line, and after being reflected from the posterior wall of the sac, recross its cavity towards their normal distribution. The tumour is nearly always solitary, but cases in which a second enlargement existed have been recorded.

Diagnosis.—Difficulty in the diagnosis of spina bifida can hardly ever occur, and the characters above described will readily distinguish it from the congenital tumours of a fatty, fibrous, or cystic character occasionally met with in the same situation.

Complications.—Spina bifida is sometimes associated with hydrocephalus, with club-foot, or, it is said, with some paralytic symptoms; the latter complication probably occurring only in those cases in which the nerves of the cauda equina traverse the sac of the tumour.

Course and Terminations.—The majority of cases of spina bifida terminate fatally, often within a few days or weeks of birth; the children dying from convulsions, frequently preceded by rupture of the sac, and the escape of its contents. When the fluid only oozes gradually, relief follows; and sometimes spontaneous and complete cure thus occurs, the tumour contracting to a small nodule, and the aperture in the canal closing more or less completely. In some cases, when the cutaneous covering is thick and normal, the tumour may gradually increase in size without material inconvenience, up to the adult period of life, attaining the size of a child's head, or even larger dimensions.

Prognosis.—This must generally be unfavourable, especially when the tumour is of large size at birth, and its covering only thin, membranous, and vascular, with a broad base. When the base of the tumour is narrow, and its cutaneous covering thick and normal, the prognosis may be more favourable, especially if the malformation be situated on the sacrum.

Treatment.—The result of any treatment of spina bifida must be extremely doubtful, but in many cases the process of spontaneous cure has been successfully imitated by small tappings frequently repeated, and followed by light compression, covering the tumour with cotton wool or lint, and strips of plaster Only a portion of the fluid should be allowed to escape at the time of operation; and the puncture should always be made at the side of the tumour, so as to avoid any possible injury to the nerve-trunks which may traverse the sac. Cases have been successfully treated by the injection of small quantities of iodine. Dr. J. Morton of Glasgow has used a solution made by dissolving 10 grains of iodine and 30 grains of iodide of potassium in an ounce of glycerine—half a drachm of which solution may be injected, without allowing the fluid contents of the tumour to escape, at intervals of a week or ten days. The writer has seen a case successfully treated in this way by the late Dr. Murray at the Great Northern Hospital; and he has also employed it successfully himself. Other operative measures, such as compression of the neck of the tumour by means of a clamp or ligature, and also excision, have been employed, occasionally with success; but no such attempt should be made except under the most favourable circumstances, when the tumour has a very narrow base—more or less pedunculated, and is situated over the sacrum; otherwise death from convulsions or meningitis would probably follow.

W. Adams.

SPINAL ACCESSORY NERVE, Diseases of.—The upper fibres of the spinal accessory nerve emerge from the surface of the medulla oblongata, below the pneumogastric. They arise from a column of nerve-cells adjacent to the nucleus of the hypoglossal, and continuous with the nucleus of the pneumogastric. The fibres join the latter nerve and innervate the movements of the larynx. Their share in the nerve-supply to the pharynx is undecided, but it is certain that the levator palati is supplied by them. Paralysis of the vocal cord, tongue, and palate is occasionally due to disease at the surface of the medulla in this region, and the fact that stimulation of the roots of this nerve causes movement of the palate has been proved experimentally by Horsley and Beevor. The lower, spinal, fibres of the nerve emerge from the side of the cord as low as the sixth or seventh cervical nerves, and pass through the substance of the lateral columns, arising from the anterior cornua, in common with the motor fibres of the upper cervical nerves. This spinal part of the nerve ascends through the foramen magnum, and is connected with the bulbar portion for a short distance; the two parts then separate, the latter joining the pneumogastric, the former passing to the neck, and supplying the sternomastoid and the upper part of the trapezius. The double relation of the nerve is thus correctly expressed in its name. The bulbar fibres alone are 'accessory' to the pneumogastric; the 'spinal' fibres are strictly part of the motor cervical roots.

1. **Paralysis.**—Ætiology.—The nucleus of origin of the nerve may be diseased by slow degeneration of the motor cells, as in progressive muscular atrophy and chronic bulbar paralysis, and also in syringomyelia and central growths that spread from the cervical region to the medulla. In chronic spinal muscular atrophy the upper part of the trapezius, supplied by this nerve, is often affected later than any other muscle; it is the *ultimum moriens*, as Duchenne called it. The nucleus of origin of the bulbar portion may be damaged by acute processes—softening or hæmorrhage (acute bulbar paralysis); and the grey substance from which the spinal fibres arise may be affected in acute poliomyelitis. The roots of the nerve are sometimes damaged by injuries, such as fracture or dislocation of the upper cervical vertebræ; by narrowing of the foramen magnum; by tumours external to the cord; and especially by meningitis, syphilitic or simple, in this region. The spinal part of the nerve, from its long course, is especially liable to suffer. The nerve is rarely injured in fractures of the skull. The causes of paralysis of the vagal portion, after its junction with the pneumogastric, have been considered in the article on diseases of that nerve. The spinal part, in its course to the muscles, may suffer in rare cases from rheumatic inflammation, or from injury; may be compressed by enlarged glands; or implicated in abscesses in its neighbourhood.

Symptoms.—Paralysis of the spinal accessory may be complete, when the disease involves the nerve where both parts are united, but is much more commonly partial, on account of the extensive origin of the spinal portion, and the early separation of the two divisions. The symptoms indicating disease of the accessory part of the nerve, as loss of movement of the vocal cords, are described in the article on the pneumogastric nerve. The paralysis of the palate, which is so often associated, is best recognised by the defective movement in phonation. *See* Palate, Paralysis of.

The loss of function of the spinal portion of the nerve is shown by paralysis of the muscles which it supplies—the sternomastoid and trapezius. Unilateral palsy of these muscles does not affect the posture of the head; but the head, when behind the vertical position, cannot be rotated to the opposite side. Paralysis of the trapezius, which may occur alone if the disease of the nerve is behind the sternomastoid, is almost confined to the upper part of the muscle, that proceeding from the occipital bone to the clavicle. The middle part of the muscle receives a sufficient nerve-supply from the cervical nerves to prevent conspicuous paralysis or wasting, although the fibres of the spinal accessory can be traced almost to its lower border. The loss of the upper part alters the contour of the neck, and the shoulder is not raised in deep inspiration. The shoulder can, however, still be elevated voluntarily, this movement being effected by the middle part of the muscle. Abduction of the arm by the deltoid is interfered with, on account of the loss of the support afforded by the upper part of the trapezius; and the supplemental action of other muscles causes a slight rotation of the scapula. If the nerve or its origin is damaged by an acute process, the paralysed muscles undergo wasting, which is usually rapid, and is accompanied by the reactions which characterise nerve-degeneration.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the spinal accessory nerve are those of the morbid process causing the paralysis (*see* especially Progressive Muscular Dystrophy; Labio-Glosso-Laryngeal Paralysis; and Pneumogastric Nerve, Diseases of). In all cases, if the muscles waste and present loss of irritability, electricity should be applied, the voltaic current being in most cases required.

2. **Spasm.**—The muscles supplied by the spinal accessory nerve are frequently the seat of spasm, causing 'torticollis,' or 'wry-neck.' The spasm is due to an affection of the centres, probably in some cases those in the medulla, in others those in the cortex of the brain. This affection is described in a special article. *See* Wry-Neck.

W. R. Gowers.

SPINAL CORD, Diseases of.—Synon.: Fr. *Maladies de la Moelle Épinière*; Ger. *Krankheiten des Rückenmarkes.*—Though the spinal cord is commonly regarded as a single organ, yet it is one which is very composite in structure, and still more so in function. It is in part (1) a mere aggregate of connecting fibres between the body generally and the brain—that is, an accumulation of channels of conduction for sensory impressions of all kinds, both superficial and deep, on their way to the brain; and also for outgoing motor incitations from the brain to all the voluntary muscles of the body, as well as to those pertaining to the viscera and their ducts, and to blood-vessels. In part, however, the cord also consists (2) of a serial aggregation of more or less fused ganglia having to do with the execution of voluntary and all sorts of reflex actions; with the functional activity of organs; and with the nutrition of tissues.

The structural bases for these two principal sets of functions are most intimately knit together; those of the second set are not wholly distinct from those of the first—to a considerable extent they are the same elements, capable of being called into play voluntarily, as well as in a reflex manner.

In order to facilitate references in the special articles on diseases of the spinal cord to the details set forth in this *Introduction*, it will be divided into a series of numbered sections.

§ 1. General Relations and Structure of the Spinal Cord.

—Continuous with the bulb or medulla oblongata above, the spinal cord begins at the level of the upper border of the body of the first cervical vertebra, whilst it ends in a narrow pointed extremity opposite the upper part of the body of the second lumbar vertebra, or perhaps a trifle higher. Throughout the whole of this extent it is enclosed within the narrow spinal canal, and is invested by two membranes, the *pia mater* and the *arachnoid*. Beneath the latter and in the meshes of the looser pia mater there is situated (as around the cerebrum) a certain amount of cerebro-spinal or subarachnoid fluid. Enveloping the cord much more loosely, outside the arachnoid, is the firm spinal *dura mater*.

The arrangement of the several anatomical components of the spinal cord is essentially similar throughout its extent. Its two halves are marked off from one another in front by the deep 'anterior longitudinal fissure' (fig. 150 A), and posteriorly by a median septum of connective tissue rather than by an actual fissure. Each half contains a central mass or core of grey matter, shaped something like a comma. The grey masses in the two halves of the cord are turned back to back, and are connected with one another by means of an intervening bridge of matter, answering to the 'grey commissure.' In front of this bridge of grey matter lie some white fibres, constituting the 'white commissure.' Through the centre of the grey commissure there runs a fine canal—the *central canal* of the cord—which is lined with a layer of epithelium-like cells.

The thick anterior extremity of the grey matter in each half of the cord is known as the *anterior cornu*, and the much thinner posterior extremity as the *posterior cornu.* This latter approaches near to the surface of the cord in its postero-lateral region, and is here joined by the *posterior roots* of the spinal nerves. Their point of entry on each side divides the white substance of the corresponding half of the cord into posterior and antero-lateral columns. The portions of the white substance of the cord lying behind and between the posterior roots constitute the two *posterior columns*, each of which is again subdivided by a slight superficial fissure into a postero-external tract or *root-zone* ('*column of Burdach*'), and a postero-internal wedge-shaped portion, or '*column of Goll.*' The portions of the white substance which on each side lie in front of the posterior roots constitute the *antero-lateral columns.* The inner portions of the anterior columns border upon the anterior fissure, but there is no real line of demarcation to define the bounds of the anterior and of the lateral columns respectively, because the anterior roots are connected with the anterior cornua in a diffuse or scattered manner, and not in a compact bundle like that formed by the fibres of each posterior root.

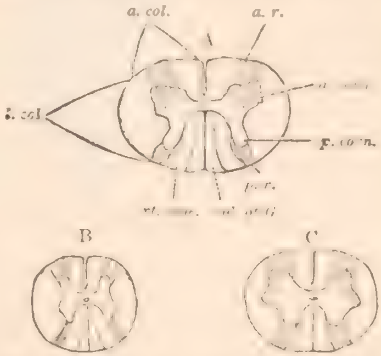

Fig. 150.—Diagrammatic representations of transverse sections of Spinal Cord. 1½ natural size. A. Through middle of cervical swelling; *a. col.*, anterior column; *l. col.*, lateral column; *rt. zone*, root zone; *col. of G.*, column of Goll; *a. r.*, anterior roots; *p. r.*, posterior roots; *a. corn.*, anterior cornu; *p. corn.*, posterior cornu. B. Section through mid-dorsal region. C. Section through middle of lumbar region.

These figures show, pretty accurately, the relative proportions of the different component parts of the cord in the three situations named.

For some particulars concerning the *blood-vessels* of the spinal cord, see §§ 5, [illegible] and [illegible].

§ 2. **In-going Channels of Conduction to the Brain.**—The paths for these impressions soon after their entry into the spinal cord by the posterior roots were formerly supposed to cross to the opposite half of the cord, decussating with their fellows of the other side. But, according to the more recent researches of Mott, this is not the case. He concludes that painful impressions, and those of temperature (heat and cold), are conducted up both sides of the cord; but that touch and pressure sensations associated with localisation, and likewise muscular-sense impressions, are chiefly conducted up the same side.

Impressions of pain, as well as those of heat and cold, after passing with the nerve-roots through portions of the posterior columns, principally traverse the central regions of the grey matter of the cord. Disease or damage of these posterior columns, as well as of the grey matter, often causes a more or less marked retardation in the transmission of such impressions.

Impressions of touch and pressure are supposed to travel in the main by the *posterior columns*, though possibly some of them ascend in portions of the lateral columns. But Tooth has brought forward reasons for doubting this (*Journ. of Physiol.* 1892), and inclines to the view that they may travel upwards through the substantia gelatinosa of the posterior horns, mainly on the same side, though to some extent on the side opposite to that at which they enter the spinal cord.

The paths traversed by impressions from muscles to the encephalon (so important for the regulation of movements) are not distinctly known; but they are probably double, and to be found in the posterior as well as in the lateral columns. Those in the posterior columns may go to the cerebrum, and those in the lateral columns to the cerebellum ('direct cerebellar tract'). These channels—that is, those going to the cerebrum—were long ago said by Brown-Séquard to decussate in the pons Varolii, rather than soon after their entry into the spinal cord.

The path for the transmission of impressions from the 'genital centres' in the lumbar region of the cord to the brain is probably situated in the posterior columns.

§ 3. **Out-going Channels of Conduction from the Brain.**—All that is certainly known concerning the spinal paths for voluntary motor incitations is that, below the decussation of the pyramids, they are to be found mainly in the posterior part of the lateral column ('crossed pyramidal tract'). The fibres descend through these columns to different levels, according as their stimuli are destined to evoke the activity of different nerves and muscles; thus, if a movement of the arms is to be excited, they go only as low as to some part of the cervical enlargement; but if the movement is of the legs, as far as to the lumbar swelling. In each case such motor fibres then penetrate the grey matter (anterior horns), and come into relation with some of the great nerve-cells contained therein, whence outgoing fibres arise, which cluster together outside the cord, and constitute the fibres of the anterior roots. The motor paths for the foot and leg, in the lumbar lateral column, are said to lie more towards the circumference of the cord than those for the thigh-muscles.

On the other hand, some (see p. 803) of the pyramidal fibres of the medulla pass into and through the spinal cord on the same side, that is without decussating, and constitute the inner part of the anterior columns ('direct pyramidal tract'). It seems probable that these fibres of the direct pyramidal tract gradually decussate along their whole course through the cord, their fibres passing through the anterior commissure and through the grey matter to reach the lateral pyramidal tract of the opposite side of the cord.

It is probably an error to suppose, as some have imagined, that there are any special routes for the conduction of reflex motor impulses from the brain, apart from those concerned with the excitation of voluntary movements.

During recent years additional information concerning the composition and functions of the different columns of the spinal cord has been obtained by the study of so-called 'secondary degenerations' (*see* § 5 (13)), by developmental investigations (Flechsig), as well as by clinico-pathological research, and experiments upon animals. In this way we have come to recognise the existence of 'tracts' in the spinal cord other than those to which reference has already been made, and to learn that, though each tract is for the most part composed of fibres of the same order, it is not wholly so. In some regions, as we shall see, there are even in the same tract or part of a tract both afferent and efferent fibres.

A better understanding of the exact situation and relative size of the several tracts already referred to, as well as of those about to be described, may be gathered from a study of fig. 151, after Schäfer.

Of the tracts already mentioned, the columns of Goll and the columns of Burdach, which together constitute the whole of the posterior columns of the cord, are composed almost wholly of direct continuations of the posterior nerve-roots. This has been proved by cutting these nerve-roots in the sacro-lumbar and in the dorso-cervical regions respectively, and subsequently studying the secondary degenerations thus occasioned. The lower the root the more mesial is the resulting long degeneration in the higher parts of the cord

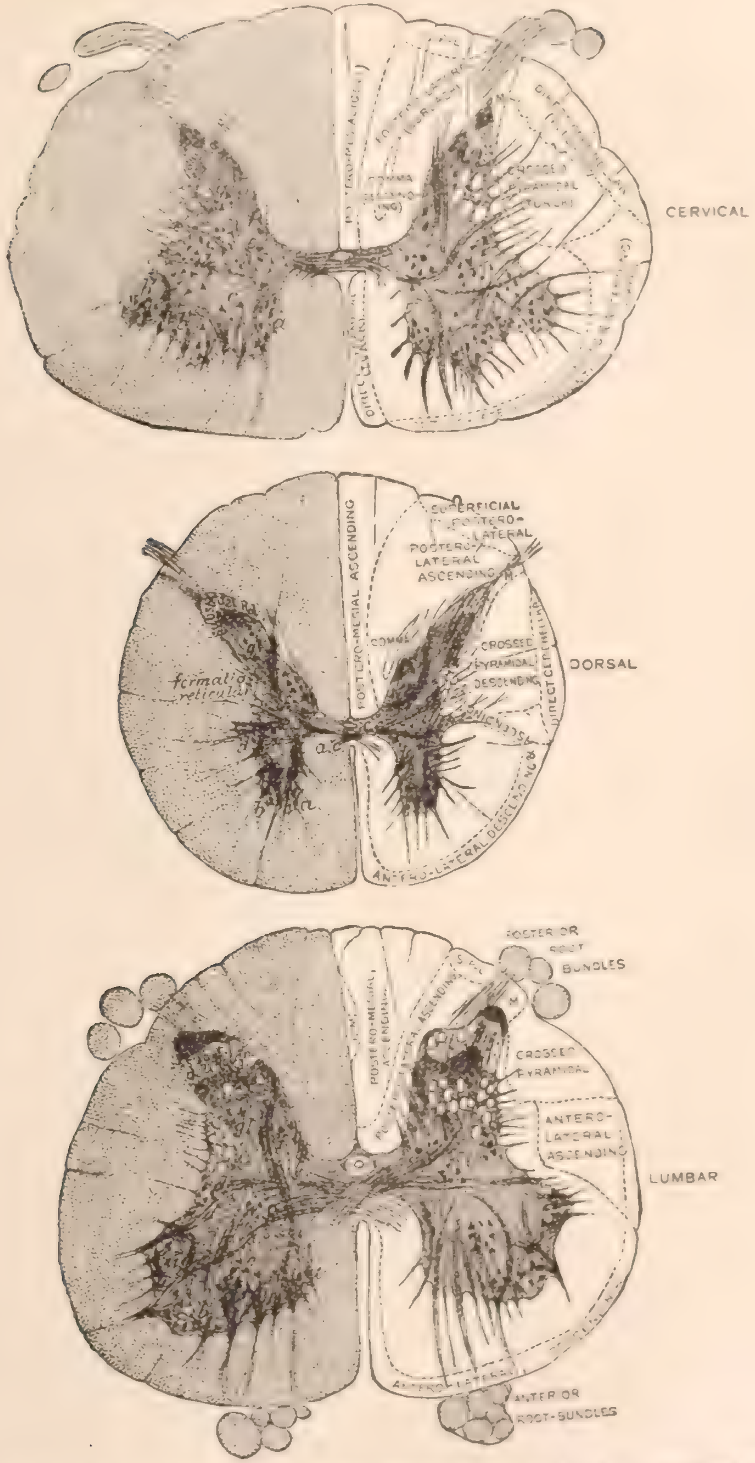

Fig. 151.—Sections of Spinal Cord in lower cervical, mid-dorsal, and mid-lumbar regions. [illegible]
On the right side of each section the conducting tracts are delineated

and in the medulla oblongata. Thus Schäfer says (*Quain's Anatomy*, 10th ed. vol. iii. p. 28): 'With regard to this degeneration in the posterior mesial column, it is to be noted that, while that which results from section of the lower (lumbo-sacral) roots occupies in the higher parts of the cord the postero-median angle as above described, the degeneration resulting from section of the dorsal roots lies next to this; that resulting from section of lower cervical roots passes up Goll's column in its lateral part next to the column of Burdach; and finally that resulting from section of upper cervical roots is confined to Burdach's column, and ends in the nucleus cuneatus of the medulla oblongata. . . . The fibres, as they enter the cord with the posterior nerve-roots, form in fact a succession of lamellar tracts, which lie in each case at first next to the posterior cornu, and become gradually shifted medianwards by those which enter the cord with the higher nerve-roots.' These degenerations from sections of the nerve-roots diminish markedly in amount as they are traced up the cord, and that which remains is eventually confined to a part of the posterior column which contains normally fine or medium-sized fibres only. 'From this it may be inferred,' Schäfer says, 'that the larger fibres of the posterior roots—which in fact form the bulk of these roots—have a relatively limited course after entering the cord. They probably end by their collateral branches, and ultimately by their main ascending branches, turning into the grey matter and breaking up into terminal ramifications in the fine interlacements of nerve-fibrils which occur in the neighbourhood of the nerve-cells and cell-groups.'

Of late years a small area of descending degeneration has been recognised in Burdach's column, in the cervical and dorsal regions of the cord more especially, and to this, on account of its shape, the name 'comma tract' has been given. According to Dr. Mott, this degeneration occurs not only in sections of the cord, but also from section of posterior nerve-roots. It is remarkable from the fact that it extends only for a very short distance below the lesion; and it has been suggested, with much probability, that this area may represent the descending branches of the cut posterior roots. It has, of course, long been known that, on their entrance into the spinal cord, the posterior roots divide into descending as well as into ascending bundles.

Afferent impressions are conveyed, however, to the cerebrum, not only by the different tracts entering into the composition of the posterior columns, but also, as we have seen, through the grey matter; whilst they are conveyed to the cerebellum along two tracts forming part of the lateral columns. One of these, known as the 'direct cerebellar tract' (Flechsig), begins to appear in the upper part of the lumbar enlargement, as a compact bundle of fibres at the periphery of the posterior half of the lateral column, just outside the crossed pyramidal tract. This fasciculus increases in size by the constant accession of new fibres as it passes upwards through the dorsal and cervical regions of the cord. It is generally supposed that these fibres emanate from the cells of Clarke's column (situated at the inner and central part of the posterior cornu), and that they pass upwards by way of the restiform body to the cerebellum. The other afferent cerebellar tract is known as the 'antero-lateral ascending tract' (Gowers). It was formerly confounded with the direct cerebellar, and supposed to be its anterior prolongation; but it was shown by Gowers to be a distinct fasciculus, the fibres of which come from the lumbar region of the cord below the commencement of the direct cerebellar tract. It is often wedge-shaped or rounded, lying in front of the 'crossed pyramidal tract.' It can be traced upwards into the bulb and pons Varolii, and then enters the cerebellum with the superior peduncle, passing mainly to the vermis. Its fibres are intermingled with those of the 'descending cerebellar tract,' to which reference will presently be made.

All the paths for afferent impressions to the cerebrum, with the exception of those for muscular sense, were, as before stated, formerly supposed, soon after their entry into the spinal cord by the posterior roots, to decussate with their fellows of the opposite side (Brown-Séquard). But according to the recent researches of Dr. Mott this is not the case. He comes to the conclusion that painful and thermal impressions may be conducted through either or both sides of the grey matter; but that tactile and pressure sensations are chiefly conducted up the same side of the cord, and that the same holds good for muscular-sense impressions. Mott's view is borne out by the fact that the secondary degenerations, resulting from sections of the posterior roots, are always limited to the same side of the cord; and likewise by the fact that hemisections of the cord when they are quite unilateral show no degeneration in the posterior column of the opposite side.

If we sum up, then, all that is known or legitimately surmised concerning the paths for afferent sensations through the cord, it comes to this: Both the direct cerebellar and the antero-lateral ascending tract convey impressions to the cerebellum; the former has been supposed to convey impressions of the muscular-sense order, and the latter, if it does not convey impressions of the same kind, may give passage to impressions of common sensibility serving as additional incitations to some of the complex reflex actions regulated by the cerebellum. On the other hand, the columns of Goll are also commonly supposed to transmit muscular-sense impressions, though the ultimate destination of these may be to the cortex in the Rolandic areas of the cerebrum. The evidence derived from syringomyelia make it highly probable that painful and thermal impressions reach the cerebrum by way of the central grey matter, in accordance with the views of Schiff. As to impressions of touch and pressure nothing definite is known; the paths for these impressions may lie partly through the columns of Burdach, and partly through the grey matter of the posterior horns (Tooth), as the only other ascending tracts seem to be a series of short commissural fibres running through the lateral columns, and serving to connect the nerve-cells at various levels of the posterior cornua with one another.

In addition to the crossed and the direct pyramidal tracts, there are two other columns seeming to contain outgoing fibres in each half of the spinal cord. The most important is known as the '*antero-lateral descending cerebellar tract*,' which consists of fibres that are connected with cells in the cerebellar cortex of the same side, and which undergo degeneration on removal of the corresponding half of the cerebellum (Marchi). These fibres form an extensive circumferential tract in the anterior three-fourths of the antero-lateral column, spreading inwards in front of the crossed pyramidal tract to reach the intermedio-lateral tract of the grey matter. The tract which is thus marked out is most extensive in the upper regions, and gradually lessens in the lower part of the cord, but can be traced almost to its termination. It embraces in the dog the part of the anterior column which in man is occupied by the direct pyramidal tract, and also the whole region of the tract of Gowers, the fibres of these two tracts being intermingled. Some of the fibres of the anterior roots also exhibit degeneration after removal of the cerebellar hemisphere, and are therefore probably directly continued from fibres of this tract.

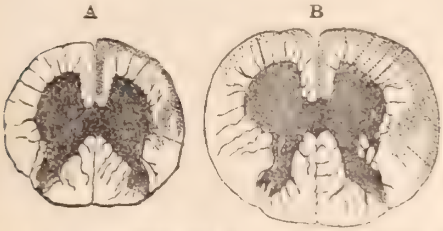

Fig. 152.—Sections show the 'Descending Cerebellar Tract' in the spinal cord of the Dog, following upon extirpation of the left half of the cerebellum. (Schäfer after Marchi); A, Lumbar Cord; B, Cervical Cord.

The degeneration is in the antero-lateral column of the same side as the lesion, except in B, where there is a little degeneration on the opposite side.

The same holds good for nearly all the efferent cranial nerves (Marchi). These degenerated fibres are numerous on the same side as the lesion, but a few occur in the opposite nerves.

The other tract formerly thought to contain outgoing fibres is now believed, with more probability, to belong really to the afferent system of fibres. It is known that the posterior roots of the spinal nerves divide on their entrance into the cord into two main longitudinal branches, ascending and descending. Of these the ascending branch has been hitherto principally referred to, but the descending branch ought also to undergo degeneration. But the only descending degeneration in the posterior columns occurs in a small tract which is known (from its shape) as the 'comma tract.' As already stated, Dr. Mott has found that this degeneration occurs not only in sections of the cord, but also after section of the posterior nerve-roots, and that on each occasion it extends downwards for a limited distance only (half to three-quarters of an inch). It seems, therefore, most probable that this degeneration of the comma-tract represents the degeneration of the fibres belonging to the descending branches of the posterior roots.

§ 4. **Spinal Reflexes.**—The reflexes of purely spinal mechanism which are of importance (by their presence, absence, or variation) as indications of disease of the spinal cord in different longitudinal regions have been divided into (*a*) the superficial or *skin* reflexes, and (*b*) the deep or so-called '*tendon* reflexes.'

(*a*) *Skin reflexes.*—The most important of these are tabulated on page 800. The designation of the parts of the cord upon which they severally depend is based upon a very useful table published by Dr. Gowers.

These skin-reflexes vary much in different individuals, as regards the facility with which they may be obtained. They are often more marked in children and in women than in men; though when the latter are of an irritable or nervous temperament, some or all of the skin-reflexes may in them be well-marked even in conditions of health. It must be borne in mind, also, that the superficial reflexes are always distinctly exaggerated, when the corresponding skin regions are tender in association with related visceral disease (Head).

In cases where extensive transverse lesions exist, situated higher up in the cord than the nerves upon which any of these reflexes depend, such reflexes are commonly supposed to be exaggerated in intensity. This, however, is not the case where we have to do with total transverse lesions. The fact that this or that reflex exists, shows not only that the afferent and efferent nerves, but

Name of Reflex	Mode of Excitation	Nature of Result	Level of Cord upon which Reflex depends
Plantar reflex .	Tickling sole of foot .	Movements of toes; of these and foot; or of these and leg	1st, 2nd, and 3rd sacral nerves (lower part of lumbar enlargement)
Gluteal reflex . .	Irritation of skin of buttock .	Contraction of glutæi . .	4th and 5th lumbar nerves
Cremasteric reflex .	Irritation of skin of upper and inner part of thigh	Drawing up of testicle . .	1st and 2nd lumbar nerves
Abdominal reflex .	Irritation of skin of abdomen along edge of ribs, and above Poupart's ligament	Contraction of upper or of lower part of abdominal muscles	8th to 12th dorsal nerves
Epigastric reflex .	Stroking side of chest over 6th and 5th intercostal spaces	A dimpling of corresponding side of epigastric region (contraction of highest fibres of rectus abdominis)	4th to 6th or 7th dorsal nerves
Scapular reflex .	Irritation of skin in interscapular region	Contraction of posterior axillary fold (teres), or of several of scapular muscles	6th or 7th cervical to 2nd or 3rd dorsal nerves

that the path through the spinal cord at the corresponding level, is practically undamaged. It is not, however, necessarily true that absence of any of the reflexes is an indication of disease at the corresponding level in the spinal cord. It may be so; but it may also be that the disappearance of the reflex is dependent upon disease in some part of the afferent or of the efferent nerves, leaving the cord itself intact. Or it may also happen that the particular reflex is simply not to be obtained in the individual under examination. Or, again, with a complete transverse lesion in the lower cervical or in the upper or mid dorsal regions of the spinal cord in man all reflexes dependent upon lower portions of the cord, excepting perhaps the plantar, will (though this is contrary to usual belief) be found to be abolished. *See* Spinal Cord, Special Diseases of: 9. Softening of.

Further, it must be borne in mind that in certain cases of hemiplegia (even where hemianæsthesia does not co-exist) these skin-reflexes are often notably diminished or even abolished on the paralysed side of the body; though the reverse condition of things will probably obtain in regard to the deep or 'tendon reflexes' next to be considered. It will probably be found, hereafter, that this repressing effect upon the skin-reflexes is associated with the existence of lesions in special parts of the brain, and not with lesions in other localities, though such several sites are at present very imperfectly known.

(*b*) '*Tendon reflexes.*'—Much discussion has taken place as to whether these are 'reflexes' at all, in the proper sense of the term. Into this question we do not propose to enter. The phenomena themselves, to which alone reference will be made, are chiefly two in number, namely, *ankle-clonus*, and that variously known as the *knee phenomenon*, *patellar tendon-reflex*, *knee-reflex*, or *knee-jerk*. Corresponding phenomena are met with in the upper extremities in the form of 'wrist-jerk' (produced by a slight blow over the radial side of the wrist), and 'elbow-jerk' (from a blow upon the triceps tendon). These phenomena are increased or diminished under the influence of the same kind of conditions that cause increase or diminution of the 'knee-jerk,' so that no further special reference will be made to them.

There is a distinct difference in regard to the importance of the presence of the 'knee-jerk' and 'ankle-clonus' respectively. The 'knee-jerk' occurs in health, so that it is its absence, as well as its increase, which is of principal significance in certain diseases. 'Ankle-clonus,' on the contrary, is a phenomenon not to be obtained in a state of health, so that its presence was formerly

Name of Reflex	Mode of Excitation	Nature of Result	Level of Cord upon which Reflex depends
Knee-jerk . .	By striking patellar tendon with edge of hand or with percussion hammer, whilst leg hangs loosely over fellow, or over forearm of operator. Also by striking quadriceps tendon, above patella	A single upward jerk of the leg and foot, slight or distinct	2nd and 3rd lumbar nerves
Ankle-clonus . .	With knee extended or very slightly flexed, by pressing quickly and firmly against anterior part of sole of foot (so as to stretch calf-muscles) and then keeping up the pressure	A series of clonic contractions at the ankle-joint, continuing as long as the pressure is maintained, and instantly ceasing when it is relaxed If the condition is very highly marked it may spread to the whole limb, or even to that of the opposite side	1st to 3rd sacral nerves (lower part of lumbar enlargement)

thought by some to be a positive sign of disease of the spinal cord. But this is a view which requires limitations and limitations of such a kind as to deprive the manifestation of ankle-clonus of much of its diagnostic significance. It may exist, for instance, after one-sided fits dependent upon disease of the cerebral cortex; and, again, it may exist to a well-marked extent where the antero-lateral columns of the cord are pressed upon at a certain level, even though (as in the condition above referred to) no lateral sclerosis of the cord has been developed.

Both these physical signs have during recent years attracted much attention. Ankle-clonus was originally described by Brown-Séquard in 1858; it was more particularly defined in the human subject by MM. Charcot and Vulpian in 1866; and its diagnostic importance has since been repeatedly enforced by these observers. In 1874 the mechanism of the knee-jerk, and the fact of its absence in certain spinal diseases, especially locomotor ataxy, began almost simultaneously to engage the independent attention of Erb and of Westphal, and subsequently of many other observers. The latest information concerning its mechanism and many of the conditions which modify it may be found in an important memoir by Dr. Sherrington in the *Journal of Physiology*, vol. xiii., No. 6, 1892, pp. 666-672, and in another by Dr. Risien Russell in the *Proceedings of the Royal Society* (vol. liii. p. 430).

For a brief reference to the functional activity of the *vaso-motor centres*, and of their nerves emanating from the spinal cord, *see* § 7, (4) and (5).

§ 5. **Pathological Data concerning the Spinal Cord.**—GENERAL ÆTIOLOGY AND PATHOLOGY.—The spinal cord itself may be damaged by disease invading it *from without*—that is, taking origin either in the bony canal or in the enveloping membranes; or it may be the seat of *intrinsic* pathological changes. As the former conditions may and do constantly produce functional derangements or actual structural changes of a secondary order in the cord itself, we must take cognisance of them here, so that the various peculiarities as to their occurrence may be made known and considered side by side with those pertaining to the different causes of disease of intrinsic origin, from which they have to be distinguished at the bedside.

(*a*) *Extrinsic Causes.*

(1) *Stabs or bullet-wounds* may involve limited regions and parts of the spinal cord.

(2) *Fracture with dislocation of some of the vertebræ* (as results of severe falls or other mechanical violence) exists as an occasional cause of an associated paraplegia, produced by the crushing of, or pressure upon, the spinal cord. This is most apt to occur in the cervical region, though the dorsal and lumbar regions are, to a less extent, liable to similar accidents.

(3) *Scrofulous caries of the vertebræ* may exist in any of the regions, and may or may not be associated with *angular curvature* in a corresponding portion of the spine. The paraplegia, or other result of interference with the functions of the cord, in the majority of cases of this disease, is not due so much to its compression by diseased bone, as to the irritation and subsequent compression of the cord by inflammatory products.

(4) *Cancer of the vertebræ* occurs either as a primary or as a secondary affection. Such a new-growth may involve the dura mater or not, and as it grows it may at first irritate and subsequently compress the spinal cord itself.

Other diseases of the spine are rare as causes of disease of the spinal cord. Still aneurysmal erosion of vertebræ with subsequent pressure upon the cord must not be forgotten, and very rarely an aneurysm bursts into the spinal canal. Exostoses and enchondromatous growths from the bones may also quite rarely compress the cord.

(5) *Cancer of the spinal meninges, or new-growths of other kinds* (*see* MENINGES, SPINAL, Diseases of), may also involve irritation, and subsequently compression, of the anterior or posterior nerve-roots or of the spinal cord itself in one or other region. *Hydatids*, again, should be remembered as possible causes of spinal disease, especially where their existence has already been detected in the body in other situations.

(6) *Hæmorrhage into or upon the meninges.*—*See* MENINGES, SPINAL, Diseases of.

The foregoing groups of causes of disease of the spinal cord give rise to sets of symptoms having a generic resemblance, because in each case *compression* acts upon the cord, or upon the spinal roots and cord, from without, in one or other direction.

(*b*) *Intrinsic Causes.*

(7) *Hæmorrhage* occurs with extreme rarity in the spinal cord. This is due, in the main, to the firmer texture of the cord, and to the greater abundance of supporting connective tissue around its blood-vessels, as compared with that surrounding the vessels of the brain. When hæmorrhage, of idiopathic origin, does take place into the spinal cord, it almost invariably occurs in the softest portion of the organ, namely, its central core of grey matter—and in this region it may extend for some distance upwards and downwards. As a result of falls or blows, also, hæmorrhage into the substance of the cord is a rare event; still, under these conditions, it occurs occasionally—mostly in association with laceration of the substance of the cord. Of this latter kind of lesion, resulting from a fall

from a height of about twenty-five feet, the writer has recorded a remarkable instance (*Med.-Chir. Trans.*, vol. l., 1867), in which, although the cord was severely lacerated, there was no external wound and no fracture or dislocation of vertebræ.

(8) *Embolism* occurs with great rarity in the spinal cord, and is still more seldom recognised when it does occur. This is due to the fact of the small size of the arteries of the cord, and, as compared with the frequency of embolism in the brain, to the absence among them of any large trunk, like the middle cerebral, coming off more or less directly from one of the great vessels arising from the arch of the aorta. Emboli are known to reach the brain much more rarely by way of the vertebrals than by way of the carotids; and the principal arteries of the spinal cord are either direct offsets from the vertebral (anterior spinal), or indirect branches from the same (posterior spinal)—the latter arising from the inferior cerebellar, which are twigs from the termination of the basilar artery. Apart from these vessels, the blood-supply of the cord comes from still smaller twigs, derived from the intercostal and lumbar arteries, which anastomose with and reinforce the anterior and posterior vessels, at intervals, along the whole length of the cord. All the principal vessels, small though they are, seem to anastomose freely with one another. Thus, even if embolism of spinal arteries should occur, as it probably does very rarely, its effects would be diminished in importance, and obscured clinically as well as *post mortem*, by reason of the very small size of the vessels, and also by the fact of their not being 'end' arteries.

(9) *Thrombosis* would, however, be capable of occurring in diseased spinal *arteries*, as well as in those of other parts of the body. Subsequent observations may perhaps show that degenerative changes or endarteritis are particularly common in the spinal arteries, so that the occurrence of thrombosis in them would thereby be rendered all the more easy and likely to occur. Once set up, the process of thrombosis might easily spread in this network of small spinal vessels, and yet be very difficult to be recognised in them except by the effects that would be produced upon the tissue of the spinal cord—namely, the production of softening. A similar process may also take place in the peculiarly tortuous network of *veins* which surrounds the spinal cord on all sides—perhaps even with more facility than in the veins of other parts—when general and other local conditions favour its occurrence. Ollivier, in fact, called attention to the probably natural slowness of the blood-current through the spinal veins, and to the multiplicity of causes which (owing to their influence upon respiration and cardiac action) tend still further to retard it—such as violent emotions or efforts, and all such diseases as greatly interfere with respiration or with the force and regularity of the heart's action. Ollivier adds that he has often seen in elderly persons fibrinous clots filling the veins of the cord, as well as those which are to be found on its nerve-roots.

Thus one of the common causes of ordinary degenerative softening, as it occurs in the encephalon, would also be operative in the cord.

(10) *White softening* of the spinal cord is, in fact, very common; often implicating its whole transverse area for a variable extent. It differs in no respect in its naked-eye or microscopical appearances from the process as it is met with in the encephalon. It is altogether unreasonable to assume, in accordance with current nomenclature, that this condition is mostly a result of inflammation, and therefore to be spoken of as a *myelitis*, when the pathologists of our time have declared that the similar process in the cerebrum and cerebellum is mostly of degenerative origin.

(11) *Myelitis.*—The writer is, of course, far from denying that primary *inflammation* may involve areas of the cord, and entail 'softening' of its substance. He believes, however, that 'acute myelitis' is far more likely to occur as a secondary process, in connexion with pressure upon and consequent irritation of some part of the cord, encroached upon by fractures or dislocations of the vertebræ, or otherwise wounded; also as an occasional sequela of scrofulous vertebral caries, of the direct pressure made upon the cord by some meningeal tumour, or of hæmorrhage into its substance. The question rather is as to the causation of primary or idiopathic softening—whether this is, in accordance with common phraseology, to be ascribed to inflammation, or whether it is non-inflammatory and of thrombotic origin, as the writer believes. Yet he is also far from believing that *all* the secondary softenings met with in the spinal cord are necessarily of inflammatory origin. Many of these also are probably due to degenerative changes from pressure and thrombosis, rather than to inflammatory causes.

Processes of degenerative 'softening' are mostly brought about quickly, so that they would from a clinical point of view, in the main, correspond with what is commonly spoken of as 'acute myelitis.' As for 'chronic myelitis' (in the commonly understood sense of chronic softening), the writer believes that no such disease should be any longer described. Many 'softenings' are in a certain sense chronic, as, though they may be more or less abrupt in their onset, they tend to last long rather than to kill quickly. Again, other maladies which the older physicians would have ascribed to 'chronic myelitis' or 'chronic softening,' are now known to partake more of the nature of chronic indurations, and to have as their bases various processes of sclerosis.

(12) Processes of *sclerosis* are extremely common in the spinal cord. In nature they are overgrowths of the connective tissue of this organ, altogether similar to those occurring in other organs and tissues, under the name of 'fibroid substitutions' or 'non-inflammatory hyperplasias of connective tissue.' Yet here, again, certain pathologists would have us see results of inflammation, and they accordingly speak of such changes as examples of 'chronic myelitis.' Sclerosis occurs under various forms, and constitutes the basis of several distinct diseases, which are in all cases gradual and more or less slow in their onset, as well as in their progress. It may occur (*a*) as a *diffuse* general overgrowth (after the manner of a cirrhosis in other organs); (*b*) in the form of *fasciculi* or bands limited to particular columns of the cord (especially the posterior and the lateral); or (*c*) in an *insular* manner, so as to form islets of sclerosis, scattered altogether irregularly through the cord at different levels, as in 'disseminated sclerosis.'

(13) Tissue-changes allied to these in their results or later stages, though they have a peculiar history and course of their own at the commencement, are the so-called '*secondary degenerations*' which occur in certain regions of the cord, as a result either of some previous damage or injury to this organ itself, or as a sequence of brain-disease.

These 'secondary degenerations' illustrate facts originally made known by Waller, but which were confirmed and extended by Phillipeaux and Vulpian, to the effect that when nerve-fibres are severed from the ganglion-cells from which they are outgrowths, the white substance of Schwann gradually breaks up in the course of seven to fourteen days, and undergoes a process of fatty degeneration, by which it is ultimately resolved into a multitude of mere molecules and fat-particles. The white columns of the cord are composed of aggregations of nerve-fibres running parallel with one another, so that when one of these columns is cut across, or when the continuity of its fibres is interrupted by some severe lesion occurring in their midst, a process of 'secondary degeneration' manifests itself simultaneously in all the fibres thus damaged, extending upwards or downwards from the lesion according as the fibres cut across have afferent or efferent functions. Thus the result appears as one or more band-like tracts of degeneration, running upwards or downwards according to the extent and situation of the transverse area of the cord affected.

In order to deal as briefly with this subject as possible, it may be said that experience has hitherto shown that such band-like tracts of 'secondary degeneration' occur especially in each lateral half of the cord, in three situations, namely, (1) in the lateral columns; (2) in the inner portions of the anterior columns; and (3) in the posterior columns. The degenerations in the anterior and in the posterior and median portions of the lateral columns take place in a direction downwards from the site of section or lesion of the fibres, at whatever level the damage may chance to exist; whilst those in the posterior columns and in the superficial portions of the lateral columns take place in an upward direction, starting from the section or seat of destructive lesion by which these columns may be invaded.

The fibres that undergo the *descending degeneration* in the lateral columns (constituting the 'crossed pyramidal tract') are generally believed to be those which transmit volitional stimuli to the various voluntary muscles of the body, and which have been previously alluded to as coming into relation with motor cells in the anterior cornua at different levels. These different fibres are supposed to enter the lateral columns at the commencement of the spinal cord, passing into them, in fact, as a result of the 'decussation of the pyramids.' Thus, the motor tract continued downwards through the 'internal capsule' from one Rolandic area of the cortex, let us say the *left*, continues along the crus and through the pons on the same side; thence passing into the bulb a considerable proportion of its fibres decussate with their fellows, and thereby reach the right lateral column of the cord, down which they proceed as a compact group in the manner indicated. The remainder of the fibres of the left motor tract (those which do not decussate) pass down also in a compact body (the 'direct pyramidal tract') and occupy most of the inner half of the left anterior column.[1] Thus, if the whole of the left motor tract be seriously damaged or cut across in the internal capsule or at any point above the 'decussation of the pyramids,' we should have a small band of degeneration in the anterior column on the same side, and also a larger band of degeneration in the opposite (or right) lateral column (fig. 153, H)—that is, we should have the form of secondary degeneration associated with many cases of hemiplegia. But if there be complete section of or destructive disease involving the antero-lateral columns of one side of the cord itself, then we should have a band of degeneration in the anterior, as well as in the lateral, column of the same half of the cord. Or if either column be cut or damaged singly, then in such column a band of degeneration would be found extending downwards from the seat of lesion

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[1] Though this is the rule, yet it would appear from the observations of Flechsig that developmental anomalies are apt to occur, and that the relative proportion between the decussating and the non-decussating fibres is subject to great variation in different individuals.

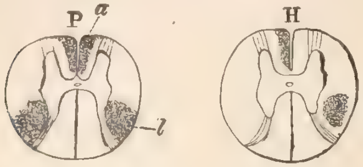

Fig. 153.—*P.* Showing descending areas of degeneration: *a.* in inner part of anterior columns; *l.* in lateral columns (mid-dorsal region). Case of *paraplegia,* from complete transverse softening in upper dorsal region.
H. Showing descending degenerations in case of *right hemiplegia,* from extensive softening of left 'internal capsule.' (Twice natural size.)

Or if, as so frequently happens, we have to do with a total transverse lesion, represented, for instance, by a focus of softening extending through the whole thickness of the cord in the upper dorsal or in some other region (so that the patient suffers from complete paraplegia), we should then find large areas of secondary degeneration in each lateral column below, as well as smaller areas in the inner part of each anterior column (fig. 153, P). The areas in both situations become less extensive as they descend, and gradually wear themselves out in the lower part of the lumbar swelling (see *Med.-Chir. Trans.* vol. l. pl. x.) It was stated by Bouchard, and has been commonly repeated by succeeding writers, that the areas in the anterior columns do not appear beyond the mid-dorsal region; but this mode of termination, as the writer pointed out in 1867, is certainly not invariable.

In such a case as that last cited, namely, one of paraplegia due to a total transverse lesion in the upper dorsal region, there would be found above the seat of lesion certain *ascending degenerations*—the principal of which would be situated in the posterior columns, though others, smaller and more recently defined, are to be met with in the outer part of the lateral columns (fig. 154).

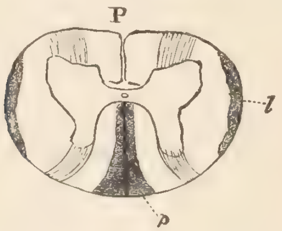

Fig. 154.—*P.* Showing ascending areas of degeneration; *p,* in columns of Goll; and *l,* along outer border of lateral columns, in middle of cervical swelling (corresponding with 'direct cerebellar tract' and the 'tract of Gowers'). Case of *paraplegia,* from complete transverse softening in upper dorsal region.

The ascending degenerations in the posterior columns are often strictly limited to the so-called 'columns of Goll.' Situated on each side of the posterior median fissure, they together constitute a median wedge-shaped patch, whose apex extends forwards to the commissure, and whose base is at the posterior surface of the cord. This band of degeneration reaches upwards to the bulb, where its fibres seem to terminate in the nucleus gracilis.

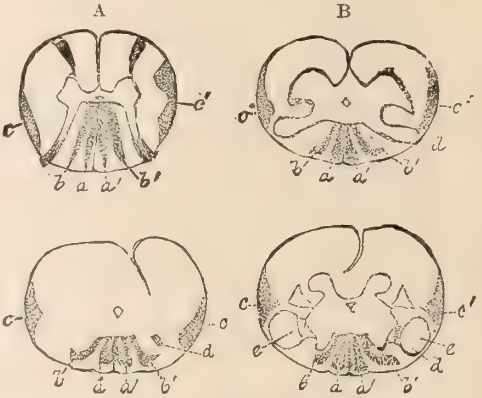

Fig. 155.—Peculiar areas of ascending degeneration, met with in a concussion-lesion of the Spinal Cord.
A, transverse section of the Spinal Cord, near the middle of the cervical region; B, transverse section through the cervical region of the cord, near lower border of medulla; C, section through lower part of medulla oblongata; D, section through Medulla about ¼″ below the *Calamus Scriptorius.*
The areas in the posterior columns (a, a', b, b') have a very peculiar disposition. The areas in the lateral columns in A are very unsymmetrical, that of the right side, anterior to c', represents the lateral sensory tract. Higher sections through the Medulla are represented in *Med.-Chir. Trans.*, 1867, pl. ix.

It seems clear, however, that, under certain conditions, the areas of ascending degeneration in the posterior columns may be differently arranged, and not completely limited to the 'columns of Goll,' since in a case with a lesion of some kind in the mid-cervical region (whose nature is not known, because, unfortunately, this part of the cord was not preserved) the writer long ago found such areas as are represented in fig. 155, in the upper cervical region and in the medulla. The ascending areas of degeneration occupying the superficial portions of the lateral columns were traced by the writer upwards into the restiform bodies. These are areas which we now know to correspond with the subsequently described 'direct cerebellar tract'; whilst the 'tract of Gowers'—corresponding with the part of the areas anterior to c' in fig. 155, A and B—which has still more recently been described, also contains afferent fibres for the cerebellum, though they reach it by a different route. According to Schafer, they can be traced upwards into the bulb and pons Varolii, while they eventually enter the cerebellum as part of the superior peduncle, passing mainly to the vermis. The fibres of this latter tract are intermingled with those of a part of the descending cerebellar tract (fig. 152), which is the only other long tract of degeneration existing in the spinal cord that has not hitherto been mentioned.

In these areas of degeneration, in addition to the changes already mentioned as occurring in the nerves themselves, other processes take place. There is, for instance, a very distinct but secondary overgrowth of the connective tissue throughout the diseased area, as well as an abundant development of large granulation-corpuscles, precisely similar to those met with in ordinary foci of softened nerve-tissue. The granulation-corpuscles are closely packed amongst the meshes of the connective-tissue overgrowth and the atrophied nerve-fibres (*see* fig. 156).

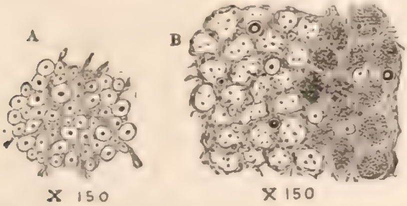

Fig. 156.—A, section of part of lateral column of a healthy Spinal Cord (× 150).

A, appearance of healthy lateral column. B, section through a patch of secondary degeneration in the lateral column of the Spinal Cord, on the right side of which there is shown the appearance of a section mounted in glycerine, and on the left side the appearance of a section mounted in Canada balsam (× 150).

In preparations which have been immersed in bichromates or in chromic acid, these corpuscles do not become stained to anything like the same extent as the healthy nerve tissues; hence the areas containing them remain pale, and are consequently to be traced with the greatest ease in spinal cords which have been immersed for a week or two in these fluids, though when they were in the fresh state no such areas may have been detectable, even on the most careful examination, by the naked eye. On the other hand, when sections through such degenerated areas of spinal cord are mounted in the ordinary way in Canada balsam, the granulation-corpuscles become invisible, so that Dr. Tooth and other recent writers make no mention of the existence of granulation-corpuscles in the areas of degeneration—the most obvious change then being the overgrowth of connective tissue, leaving, as Dr. Tooth says, 'loculi filled with homogeneous material not staining by Weigert hæmatoxylin.' (*See* his work '*Secondary Degeneration of the Spinal Cord*,' 1889, fig. 6). This 'homogeneous material' in the loculi represents, as the writer believes, granulation-corpuscles altered by the mounting in balsam.

(14) *New-growths* in the substance of the spinal cord itself are not very common, nor, on account of the limitations of space within the spinal canal, do they ever attain a very large size, so long as they take the form of circumscribed growths. For this situation a growth equalling a hazel-nut in bulk would be esteemed large. In regard to the nature of the growth, this is, of course, a matter of purely pathological interest, since the clinical signs and symptoms which a growth in the spinal cord is capable of causing would not vary with its nature, but would be wholly dependent upon its situation, and its rate and manner of increase. *Cancer* occurs within the spinal cord almost solely as a secondary extension from a similar growth pre-existing in the dura mater or in the vertebræ, or possibly in more distant parts. In altogether exceptional cases it may occur primarily in the spinal cord. *Gliomata*, *sarcomata*, and *myxomata* may also occasionally be met with, either in pure or in blended types; and in the case of the former we may have infiltrating growths occupying a wide area in the central and posterior regions of the cord more especially, through a considerable portion of its length, such as occurs in 'syringomyelia.' *Tubercular* or *scrofulous* nodules are also apt to occur, either alone or in combination with a tubercular meningitis. *Syphilitic gummata* may likewise be found in the substance of the cord, though their presence in this situation is not so frequent as it is in association with the spinal meninges.

(15) *Atrophy with degeneration of ganglion-cells* is apt to occur as a secondary process with extreme frequency in portions of the grey matter of the cord which happen to be more or less implicated by other contiguous pathological changes. But in two or three distinct diseases the ganglion-cells of the anterior cornua in different parts of the cord are prone to be suddenly overtaken by an ætiologically obscure and very inexplicable failure of nutrition, commonly supposed to be of an inflammatory nature, which speedily entails an atrophy of the particular cells affected. This, for instance, occurs as the anatomical basis of 'infantile paralysis,' and of the similar form of paralysis now known to occur (though more rarely) in adults. In these diseases whole groups of contiguous and functionally related cells are affected simultaneously, and as the atrophy of the ganglion-cells progresses there is generally evidence of a secondary overgrowth of the surrounding neuroglia in the anterior cornua. To assume that this process is inflammatory in type, as the terms 'cornual

myelitis' or 'acute anterior polio-myelitis' imply, seems to the writer somewhat questionable. Inflammation does not commonly limit itself to individual tissue-elements, and the slight overgrowth of the contiguous neuroglia may well be a secondary process of simple hyperplasia. This latter process is indeed less evident where, as in 'progressive muscular atrophy,' the initial and mysterious atrophy of individual ganglion-cells occurs more slowly and more sparsely. Cells, here and there, in particular anatomical groups, undergo in this affection the atrophic process, leaving others around them for a time as healthy as ever. Yet, as the disease progresses, the ranks of the healthy cells become gradually thinned in an altogether irregular manner; and this atrophy of nerve-cells, as it occurs, speedily entails, for reasons to be set forth in the next section, a corresponding atrophy of functionally related muscular fibres.

§ 6. **Trophic Relations between different Tissues and different Parts of the Spinal Cord.**—Irritation of the posterior cornua, or of the posterior roots of the spinal nerves, may give rise to various pustular or vesicular eruptions in related portions of the skin, often associated with neuralgic pains in these same regions. In other cases, with lesions in some parts of the grey matter, ulceration or actual sloughing of certain related tracts of skin are easily determined—especially under the combined influence of continued external pressure and frequent irritation from urine or fæces, as in some cases of paraplegia.

Degeneration or destruction in any way of the great ganglion-cells of the anterior cornua, or of the anterior roots of the spinal nerves (either within or outside the cord), gives rise, in the course of two or three weeks, to atrophy of the muscle-fibres with which such atrophied cells or nerve-roots are in relation. We thus get an atrophic paralysis, associated with the electrical 'reaction of degeneration.'

Certain diseases affecting the grey matter of the cord (in ways and sites which cannot be precisely defined) are also commonly supposed to be associated with chronic diseases of the joints; it seems, however, to the writer that these articular changes may be due rather to a co-existing peripheral neuritis involving certain nerves proceeding to the joints. Sometimes comparatively unimportant, these joint-changes lead in other instances to great atrophy of the articular ends of the bones, and possibly to dislocation with utter destruction of the joint, as in some cases of locomotor ataxy. Atrophy, with brittleness of bones, may also be met with in the same or in allied cases.

The fact of the existence of these trophic troubles in association with such lesions may be admitted wholly irrespective of the explanation of their pathogenesis. Whether they are due to defective or altered influences transmitted by ordinary motor and sensory nerves in relation with such tissues, or to altered influences through certain purely hypothetical 'trophic nerves,' lies altogether outside the fact of the mere co-existence of the several trophic troubles with the several lesions—which is the point of more immediate interest for the practitioner of medicine.

§ 7. **General Symptomatology, and General and Regional Diagnosis.**—Taking them in conjunction with some of the simpler principles of nerve-physiology, the practitioner has to make use of the various kinds of data above enumerated in the investigation of the precise nature of every case of disease of the spinal cord which comes before him. Under the word 'nature' we include, of course, both sides of the diagnosis that has to be made, namely, the *regional* and the *pathological*.

The practitioner is compelled to interpret the patient's symptoms, and the various signs he is able to recognise for himself, by the aid of such data when he attempts, for instance, to ascertain what parts of the cord are damaged, and in what order they have been implicated. He may wish to know whether the posterior or the lateral columns are specially involved; whether the grey matter is much damaged; and, if so, whether the damage more particularly affects the anterior cornua or other parts. Again, he may wish to know whether the anterior or the posterior spinal nerve-roots are specially involved; and, if so, whether they are merely irritated or more severely damaged, and whether they have been simultaneously or successively affected. For the present we shall concern ourselves with this aspect of the problem only, though it will subsequently be shown in our account of the several diseases of the spinal cord what light the co-existence of certain groups of these facts throws upon the other aspect of the problem, namely, upon the question of the pathological nature of the lesion.

Some of the facts already cited have, however, to be translated into their clinical equivalents, and to be supplemented by others derived more exclusively from the clinico-pathological study of spinal diseases, in order to form a series of data more immediately useful in the interpretation of the phenomena of diseases of the spinal cord in their regional relations.

Regional Diagnosis.—We already possess a number of valuable clinical data available for throwing light upon the regional side of the problem of diagnosis. It must be borne in mind, however, that the regional diagnosis of diseases of the spinal cord is itself a twofold problem. It involves a consideration: (*a*) of the *transverse area* involved; and (*b*) of the *longitudinal situation and extent* of the disease in such areas.

(*a*) DIAGNOSIS OF THE TRANSVERSE AREA INVOLVED.—The facts to be tabulated under this head may be set down in the order of their relation to different component parts or regions of the spinal cord.

(1) *Anterior roots of spinal nerves.*—Irritation of these may give rise to various forms of twitching or to tonic spasms in related muscles. Great pressure upon or destruction of the anterior roots will give rise to local complete or partial paralysis in the related muscles, followed in the course of a week or two by marked atrophy, and the establishment of the electrical 'reaction of degeneration' (*see* PARALYSIS). There will also be an abolition of reflex excitability of these muscles in response to skin-irritation, or from blows upon or stretchings of their tendons.

(2) *Antero-lateral columns.*—Increasing pressure upon or disease of these columns gives rise to paresis, gradually deepening into motor paralysis of parts deriving their nerve-supply at or below the seat of lesion.

When the disease occurs in the lateral column more especially, there may be twitchings or startings in the muscles below, or well-marked spasms, and possibly painful cramps. There may also be great exaltation of the superficial and deep reflexes, if the manifestation of the latter is not hindered by pre-existing spasms. Motor paralysis exists to some extent, but without any appreciable impairment of sensibility. No marked wasting of muscles, or diminution in electrical reactions, usually occurs.

(3) *Grey matter.*—(*a*) *Of anterior cornua.* Disease of these parts causes motor paralysis, with atrophy, loss of faradic excitability and of reflex excitability in related muscles—as in cases of disease of the anterior roots of spinal nerves.

(*β*) *Of posterior cornua and central parts.* Damage of these regions of grey matter will, according to its completeness in transverse extent, cause more or less delay or defect in the transmission of painful and thermic impressions, and perhaps interfere also with other modes of sensibility.

Some trophic lesions in skin and joints may also be met with (*see* § 6).

⁂ At different levels in the cord special centres (represented in both anterior and posterior regions of grey matter) in connexion with definite functions, may be interfered with by morbid conditions implicating the grey matter (*see below*, (*b*) [1–10]).

(4) *Posterior columns.*—The results of disease confined to this situation (more especially to the 'root-zones') will be—ataxy or signs of incoördination of movements; interference with impressions of touch, pressure, temperature, and of 'muscular sense'; abolition of knee-reflex; and diminution or loss of sexual desire.

(5) *Posterior roots of spinal nerves.*—From irritating lesions there will arise lancinating or other pains in the skin and deeper textures of related portions of the limbs, and possibly trophic skin-lesions. Pressure or destructive lesions will give rise to loss, in various degrees, of different modes of sensibility, superficial and deep; and diminution or abolition of the superficial and deep reflexes in related regions of the body.

It has been shown by Sherrington and others that there is considerable overlapping of the skin-areas supplied by contiguous posterior roots, and this has recently been well exemplified in one of the writer's cases of spinal caries operated upon by V. Horsley. In the course of the operation a single posterior nerve-root in the mid-dorsal region was divided on the right side, whilst two nerve-roots were divided on the left side. Around this latter half of the body a narrow band of anæsthesia was produced, only one inch wide; whilst on the right side there was no anæsthesia, this being obviated apparently by the overlapping above referred to. No such overlapping exists, however, in connexion with the territories of the nerves concerned with the appreciation of heat or cold, or of painful impressions (Head).

(*b*) DIAGNOSIS OF THE LONGITUDINAL SITUATION AND EXTENT OF THE LESION.—This is a consideration distinctly secondary to the other, since, at whatever longitudinal level the disease may be situated, its clinical characters will always be qualified by the part or parts of the transverse extent of the cord that may be involved. Here we are accustomed to obtain information of a general kind from the fact (1) that *special centres* in connexion with different viscera and functions, situated at different longitudinal levels in the cord, may be more or less deranged. But we have to depend in the main (2) upon the signs indicative of the *implication of particular sensory and motor nerves*, whose exact relations with different portions of the spinal cord are known. Such signs may consist of some excess or defect of *sensibility*, of *motility*, or of *reflex action.* Again, where disease or injury of the vertebræ exists in association with disease of the spinal cord, we may be guided by the known relations of the different vertebral spines to the different nerve-roots and segments of the cord.

Evidence from perverted activity of Spinal Centres.

(1) The lateral columns in the upper cervical region contain the motor paths for the muscles of respiration, so that section or disease of these columns at a lower level may interfere with the movements of respiration on the same side of the chest (thoracic muscles); whilst, if the lesion reaches as high as the fourth and third cervical nerves

(the origin of the phrenic) the diaphragm itself also becomes paralysed, and the movements of respiration must therefore almost cease.

(2) Again, the upper cervical region of the cord, though it does not contain actual centres connected with the excitation of the heart's action, is traversed by the augmentor and accelerator nerves, whose point of exit from the cord, as white *rami viscerales*, is with the second, third, and other upper dorsal anterior roots. These nerves ascend to the stellate ganglion, and thence proceed to the heart.

Thus different lesions in this upper cervical region of the cord may, according to their nature and extent, greatly interfere with the heart's action, as well as with the respiratory movements. The frequency of the pulse may be either notably accelerated or retarded; whilst the respiratory movements may be slower or much quicker than natural, and also extremely irregular and perverted in rhythm.

(3) The lower cervical and upper dorsal regions of the cord also contain the so-called 'cilio-spinal centre.' The fibres emanating from it pass outwards with the fibres of the anterior roots in the first, second, and third dorsal nerves (but especially in the second), and thence into the cervical sympathetic. Irritation of them causes dilatation of the pupil on the same side, together with widening of the palpebral fissure, whilst section or other destructive lesion of these parts causes contraction of the pupil.

(4) The vaso-motor nerves for the side of the head and neck, the pinna of the ear, together with the lateral lobe and half the isthmus of the thyroid body arise in similar regions of the cord, and also leave it similarly. Irritation of them produces contraction of the blood-vessels, and a lowering of temperature of the side of the face and head, together with diminution of sensibility, an absence of perspiration, and (should the irritation continue) a tendency to slight atrophy of the corresponding side of the face. Destructive lesions, on the other hand, operating upon these vaso-motor fibres, tend to produce a reverse set of conditions. *See* SYMPATHETIC SYSTEM, Disorders of.

Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ*.

(5) Gaskell has shown (*Journ. of Physiol.* vol. vii.) that all the *vaso-motor nerves* of the body leave the spinal cord in the anterior roots of the spinal nerves, from the second dorsal to the second lumbar inclusive, passing thence into the lateral ganglia of the sympathetic, in which these vaso-motor fibres lose their medullary sheaths. He adds (*loc. cit.* p. 15): 'This chain might, therefore, most appropriately be called the chain of vaso-motor ganglia instead of its present meaningless title of main sympathetic chain.' Gaskell also thinks, and in this he is supported by Sherrington, that the vaso-motor nerves, as well as certain visceral motor nerves, are connected with ganglion cells in the lateral regions of the grey matter (fig. 86).

Generally it may be said that section of one half of the cord or destruction of it for any extent longitudinally, causes at first paralysis of blood-vessels in the lower parts of the body on the same side—this vaso-motor paralysis carrying with it in the same parts an increase of temperature and an exaltation of sensibility. In a short time, however, the vaso-motor paralysis (and with it the increase of heat and sensibility) passes away, owing to the vaso-motor centres in parts of the spinal cord below, and to the peripheral vaso-motor centres, adapting themselves to act independently of those in higher parts of the cord, and of the supreme regulating centre in the medulla oblongata. (As a rule, the higher vaso-motor centres control those lower down, but after temporary paralysis even the peripheral vaso-motor centres seem to resume control over related blood-vessels.)

(6) The movements and secretions of the stomach and intestines generally are certainly influenced by the cord in different regions, so that in various cases, under perversions of this normal spinal influence, we may get vomiting, diarrhœa, or obstinate constipation—as direct results, that is, of morbid changes in certain parts of the cord in which intestinal sympathetic fibres have their roots. It seems, however, that through the greater portion of the alimentary canal the circular muscles are innervated by motor fibres distributed with the vagus. Thus peristaltic contractions of the œsophagus, stomach, and intestines can be excited by vagus stimulation, whether the stimulus be applied to the roots of the nerves as they leave the bulb, or to the main trunk of the vagus in any part of its cervical or thoracic course. On the other hand, the circular fibres of the rectum and of the descending colon are supplied by the lower abdominal splanchnic nerves, which leave the cord with the thoracic and not with the sacral outflow of visceral nerves (Gaskell).

In the grey matter of the lumbar swelling of the cord there are aggregated a number of *centres* having to do with important functions, which may be variously interfered with by disease. These centres are those which regulate—(7) the evacuation of the rectum; (8) the evacuation of the bladder; (9) erection, and ejaculatio seminis; and (10) the contractions of the uterus.

In each case the spinal centre constitutes an independent reflex centre, provided with its afferent and efferent nerves, but in each case also there is more or less of connexion between the spinal centre and others in the cerebral hemispheres. There must therefore be double sets of fibres for each centre traversing the whole length of the spinal cord and medulla; partly (commissural) for the transference of afferent impressions from each spinal centre to the brain, and partly (internuncial) for the conduction of efferent impressions from cerebral kinæsthetic to spinal motor centres.

In the case of the uterine centre these cerebral connexions are of comparatively slight importance; since, with a complete transverse lesion in the cervical or even in the upper dorsal region, the process of parturition may still be successfully accomplished. So long as the spinal mechanism is complete and perfect, parturition may take place without the need of cerebral co-operation. Our subsequent remarks will, therefore, refer principally to the other three lumbar centres.

Complete transverse lesions occurring in any part of the dorsal or cervical regions will, of course, entirely cut off all the above-mentioned lumbar spinal centres from connexion with, and therefore from any voluntary control by, the cerebral hemispheres. But various limited local lesions in particular transverse areas of the cord (though such areas cannot at present be definitely specified) may produce similar results, so far as the cerebral control of any one or two of the lumbar centres is concerned. According as the severance of these lumbar spinal centres from cerebral correlation and control is complete or partial, one or other of the following results would be produced:—

Name of Centre	Complete Severance from Cerebrum	Incomplete Severance from Cerebrum	
	Afferent and Efferent Fibres	Afferent Commissural Fibres only	Efferent Internuncial Fibres only
Rectal centre . .	Unconsciousness of need, and inability to prevent evacuation *Result.* Constipation, with incontinence of fæces after an aperient	Unconsciousness of need, and therefore no attempt to restrain evacuation	Consciousness of need to evacuate, with no ability to restrain the act
Vesical centre . .	Unconsciousness of need, and inability to prevent micturition *Result* Reflex evacuation in gushes at intervals	Unconsciousness of need, and therefore no attempt to restrain micturition	Consciousness of need, but inability to restrain micturition
Sexual centre . .	Diminution or absence of sexual desire. Erections and emissions, if they occur, wholly dependent upon the spinal reflex mechanism	With simple destruction of fibres, nearly same results as set down in previous column; but with *irritation* of afferent fibres there might be great increase of desire (satyriasis or nymphomania)	Feelings of desire, but no erection in response Erection and emissions, if present, purely through spinal reflex But with *irritation* of efferent fibres there may be persistent erections, mostly without desire

The *rectal* and the *vesical spinal centres* are each composed of two parts, with their separate afferent and efferent nerves – one set in relation with a sphincter muscle, and the other in relation with detrusor or expulsive muscles in functional opposition with the former. The several nerve-fibres, both afferent and efferent, in connexion with these centres have been shown by Sherrington (*loc. cit.* sec. iii., p. 672) to be contained in the first four sacral nerves, and in the case of the bladder also in the third, fourth, and fifth lumbar nerves (though none are contained in the intervening sixth and seventh lumbar). Thus, as Sherrington says (p. 683): 'If, as one may suppose, the position of the outflow of the efferents fairly indicates the position of the nucleus whence they come, then we may suppose that a long nucleus for the bladder exists in the lumbo-sacral region, which has, however, a gap in its continuity. . . . The outflow from the anterior roots above the gap is into the sympathetic system; from the anterior roots below the gap is direct by the sacral nerves.' Destruction or irritation of either of these sets of fibres, or of one of the centres, will necessarily interfere to some extent with the working of this particular centre, so that its functions may be interfered with in several different ways. There may be various degrees of irritability of the bladder or rectum, or various degrees of paralysis of these organs.

In cases of paralysis of the bladder, especially when owing to lesions implicating its spinal centre, the urine is apt soon to become fœtid and alkaline, and inflammation (alone or with ulceration) is most prone to be set up in its mucous membrane.

The details as to the modes of disturbance of the *genital* function, where disease implicates its lumbar centre or the afferent and efferent nerves in connexion therewith, are less known than where it involves the communicating fibres between this centre and the cerebrum. The *nervi erigentes* have been shown to pass out with the second and third sacral nerves, so that the sexual like the rectal centre is contained in the posterior part of the lumbar swelling. In the female the uterine centre has been shown to be similarly situated.

Evidence from implication of particular Sensory or Motor Nerves.

The more precise indications concerning the longitudinal implication of the spinal cord are, as already stated, derivable from the level at which alterations in sensibility or in motility (either voluntary or reflex) are to be detected. The more closely the lesion approaches to what is called a 'total transverse lesion,' the more distinctly will signs of this order reveal themselves. It is important, too, to recollect that the fibres of different sensory roots are to some extent dispersed through cutaneous surfaces overlying the muscles supplied by the corresponding motor roots. There are, however, many exceptions to this.

In regard to *sensibility*, the upper limit at which the trunk is affected is often sharply defined by the presence of a feeling of constriction, of pain, or of numbness ('girdle sensation') encircling the body. This sensation is generally supposed to be due to irritation of the roots of the nerves as they traverse the posterior columns (or perhaps outside them) at the upper level of the lesion. This symptom may of course be absent, but in some cases of paraplegia it is well-marked, especially where the upper level of the lesion lies anywhere between the third and the twelfth dorsal nerve-roots.

Our knowledge has of late been greatly increased concerning the extent and distribution of the cutaneous areas ('segmental skin-fields') pertaining to each sensory spinal nerve, owing to the labours of Ross, Allen Starr, James Mackenzie, Head, and Sherrington. As the latter investigator says (*Proc. of Roy. Soc.*, vol. lii., p. 333): 'Although in a plexus each posterior spinal root gives separate contributions to several nerve-trunks, the cutaneous distribution of the root is composed not of patches which are disjoined, but of patches which are so joined that the distribution of the entire root forms one continuous field. . . . Each segmental skin-field spreads, to a certain extent, across neighbouring segmental skin-fields. . . . The *fore-lap* and the *after-lap* are, throughout the body, very great, and each region of skin appears to be supplied by at least two sensory roots. . . . The shape of a segmental skin-field is, where simplest—*e.g.* in the trunk and neck—band-like, wrapping transversely round one lateral half of the body; it has fairly parallel edges, but is somewhat broader near its vetnral than at its dorsal end. In the limb the segmental skin-fields are *distorted* from the simple band-like type;' and they are also seemingly *dislocated* from their attachments to the mid-dorsal and mid-ventral lines of the trunk. This peculiar distribution Sherrington explains by supposing that the mid-dorsal as well as the mid-ventral line of the body extends outwards in the position of the limb as a side branch or secondary axis (*see* diagram, *loc. cit.*, p. 337). 'Upon these dorsal and ventral side lines, as upon secondary dorsal and ventral axes, the cutaneous segments of the limb are ranged, as though upon folded portions of the axial lines of the trunk itself.'

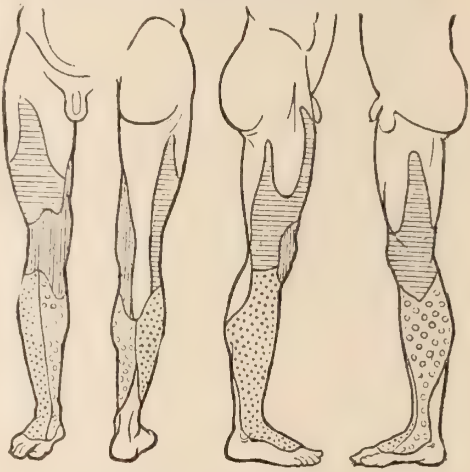

Fig. 157.—To show the presumed distribution of the areas supplied from the 2nd lumbar to the 1st sacral segments.

The area marked in *cross lines* represents L 2.
The area marked in *vertical lines* represents L 3.
The area marked with *circles* represents L 4.
The area marked with *dots* represents L 5.
The area left plain below represents S 1.

Now, as already stated (§ 7, (*a*), (5)), this overlapping of the segmental skin-fields exists, especially for tactile sensations, owing probably to the related tracts of grey matter in the spinal cord extending into the spinal segments above and below its own, and consequently being represented in the corresponding posterior spinal nerve-roots. The researches of Head (*Brain*, pt. lxi., 1893), however, seem to show that no such overlapping of segmental skin-fields or extension of related grey matter into adjacent spinal segments exists for painful impressions, or for those of heat and cold. Consequently, to determine the exact boundaries of a cutaneous area of defective sensibility, whether due to a lesion in the cord or of one or more posterior spinal roots, we shall get much more accurate results if we seek to map out the areas in which the patient may be insensitive to painful impressions, or to those of heat and cold, rather than those areas in which he is insensitive to ordinary tactile impressions. These different areas in relation with the several posterior roots have been definitely mapped out by Head, and the plates accompanying his paper will afford most useful guidance to future investigators seeking to determine the longitudinal level or extent of lesions in the spinal cord or in the posterior roots. The areas are too elaborate to admit of detailed description here; but a supplemental figure, showing the probable skin-fields from the second lumbar to the first sacral inclusive, has been reproduced above (fig. 157). For the rest the plates given by Head must be consulted.

Efforts were also formerly made to define the muscles that were paralysed, in any given case, with a view to determine the upper limit of the lesion in the cord. It was thought that a reference to the anterior roots by which such muscles are innervated ought to enable us to fix upon the particular segment of the cord from which their nerves proceed, and thus to determine with precision the upper level of the lesion in the *motor regions* of the cord.

This is a matter, however, by no means so simple as might be supposed, because the majority of limb and trunk muscles receive fibres from more than one motor root, as Preyer and Krause and others showed long ago. The same conclusion has been arrived at by Eckhardt, and later by Sherrington. The former says: 'A great number of muscles in the limb obtain nerve-fibres each of them from several nerve-roots. Most of the thigh-muscles always, some of the leg-muscles frequently, are supplied by three, the latter more often by two, nerve-roots.' According to Sherrington, when a muscle is supplied by three nerve-roots it is noticeable that the middle root of the three usually causes the most powerful contraction. However this may be, it is obvious that the fibres going to each muscle must take their origin 'over a certain considerable longitudinal region of the cord.'

This fact, that muscles receive their nerve-supply from two or three different nerve-roots, was formerly thought to be due to the circumstance that the same muscle is called into play in different coördinated movements. And the view of E. Remak, that functionally related or synergic muscles are represented together in the anterior horns of the spinal cord, was supposed to have been confirmed and extended by Ferrier and Yeo (*Proc. of Roy. Soc.*, March 24, 1881, p. 12) by their experimental observations on the functions of the anterior roots. They say that stimulation of the individual roots of the brachial and crural plexuses results, not in mere unrelated contractions of various muscles, but in highly coördinated synergic contractions, leading to definite movements. But as the 'muscles thrown into action by each root are innervated in most cases by several nerve-trunks,' the result 'of section of each motor root would therefore be paralysis of the corresponding combination, not necessarily, however, of the individual muscles involved . . . whilst *weakened*, they might yet act in other combinations in so far as they were supplied by other roots.' The different combined movements which they thought to be dependent upon particular motor roots are cited by the authors in this paper.

This important subject has been re-investigated of late by Sherrington (*Journ. of Physiol.* vol. xiii. No. 6, pp. 708-35), who comes to an opposite conclusion. He says: 'Contrary to Panizza's doctrine, revived and ably reappointed by Remak and by Ferrier and Yeo, and followed since by Bert, Marcacci, and others, I believe John Müller to have been right in attributing to the arrangement of the motor roots of the limb-plexus an anatomical significance, based on metamerism, rather than a teleological dependent upon supposed demands of functional coördination.' He considers that in the great majority of cases muscles innervated by the same nerve-root lie adjacent one to another, but 'that the loss of some particular coördinated movement results, from the severance of one of the motor roots of the limb-plexus,' he says, 'I have been unable to detect, and seen no evidence to support.' His own investigations lead him to believe that the section of some two, three, or even more anterior roots going to the upper or lower limb-plexus leads to a weakened condition of many movements. He adds: 'The helplessness, at first very apparent, rapidly diminished up to a certain point. The diminution seemed to be largely due to the overcoming in course of time of an unwillingness to attempt movements with the injured limb.' His experiments with monkeys convinced him that the execution of a coördinated movement was still possible when one motor root only of the plexus remained open as a channel from the cord.

All this shows that the upper level of a lesion in the cord can only be fixed approximately by reference to the motor paralysis existing in limbs or in the trunk of the body.

The integrity of those *reflex* actions which can be elicited either in health or in disease depends, of course, upon the integrity of the entire nervous arcs concerned (that is, upon the integrity of ingoing fibres, centres, and outgoing fibres). Thus, though the impairment of a reflex *may not necessarily* be due to central causes, its presence, on the other hand, clearly shows that the grey matter and other regions of the cord which must be traversed by its stimuli are not impassable: whilst its exaltation will indicate the probable existence of some congestion by which the grey matter in question is rendered more excitable, or else some central change by which it is cut off from cerebral inhibitory influences. In § 4 will be found all the needful indications referable to the presence or absence of reflexes which can be used for the determination of the upper level of a lesion existing in the spinal cord. The lower level of a lesion in this organ is always extremely difficult to determine; and if it is to be made out at all, it must be done by reference to the existence of particular muscular atrophies, rather than from the presence or absence of certain reflexes.

Other data in regard to the longitudinal situation of a lesion in the spinal cord are of a more precise order, and are dependent upon the *relations of the vertebral spines to different anterior nerve-roots.* These data are available in cases where the spinal cord becomes implicated in connexion with primary disease or injury of the vertebræ. To obtain such data, it is needful to know the exact relations subsisting between the bodies of the different vertebræ, their spines, and the origins of the different nerve-roots.

Only the highest cervical nerves arise from the cord opposite the place at which they leave the spinal canal. As we descend, the distance between these two points gradually increases, and it attains its maximum when we come to the nerves of the cauda equina. What nerve-origins correspond, therefore, to a given vertebral level can only be decided by careful anatomical investigation.

A further complication is introduced into this question, seeing that the vertebral spines, which we are compelled to deal with as localising guides, have different relations in different parts of the spinal column to the bodies of their respective vertebræ—*e.g.* they incline downwards in the dorsal region more especially, to a less extent in the cervical, and scarcely at all in the lumbar region.

Some of the principal facts in reference to these two points, namely, (1) the relations of spinous processes to bodies of vertebræ, and (2) the relations of vertebral spines to origins of nerve-roots, will be found to be embodied in the next section.

§ 8. For practical purposes it will be well here to group together the various indications as to longitudinal localisation to which we have referred—classifying them as they are related to one or other of four regions of the spinal cord.

(*a*) **Cervical Region of the Cord.**—*This corresponds externally to the space between the occiput and the upper border of the seventh cervical spine (eighth cervical nerve).*

The first, second, and third cervical spinous processes are respectively opposite the origins of the third, fourth, and fifth cervical nerves. The phrenic nerve (motor nerve of the diaphragm) arises from the fourth, or from the third and the fourth cervical nerves. Opposite the third cervical spine (level of fifth cervical nerve) the cervical swelling of the cord begins; whilst it ends opposite the seventh cervical spine (level of first dorsal nerve).

Disease of this region may involve interference with respiration, and possibly weakness of voice; interference with the heart's action—pulse very frequent, or the reverse, flushing or pallor of the head and neck; continued priapism (with crushing lesions); augmentation of temperature in the body generally (hyperpyrexia); and marked contraction or dilatation of the pupil.

The innervation of the shoulder, arm, and hand muscles is derived from spinal nerves between the sixth cervical and first dorsal inclusive; those supplying the ulnar side of the hand and forearm arising from the lower level, that is, from the upper part of the next region. The upper extremities may, therefore, be more or less paralysed, as well as the trunk and lower extremities.

(*b*) **Upper Half of the Dorsal Region of the Cord.**—*This corresponds externally to the space between the seventh cervical spine (first dorsal nerve) and the fourth dorsal spine (sixth dorsal nerve).*

The results of disease here are apt to be these: The 'scapular reflex' may be abolished, calling into activity as it does the last two or three cervical and the first two or three dorsal nerves; the intercostal muscles are paralysed at different levels; a 'girdle sensation' is felt at different levels; there may be prominence of certain vertebral spines, and possibly tenderness on pressure or on tapping over them; the 'epigastric reflex' may be abolished, depending as it does upon the spinal cord at the level of the fourth to the sixth or seventh pairs of dorsal nerves; and priapism (with crushing lesions) may occasionally be met with. We may have, therefore, some or all of these signs together with more or less complete paralysis of the lower part of the trunk and of the lower extremities.

(*c*) **Lower Half of the Dorsal Region of the Cord.**—*This corresponds externally to the space between the upper border of the fifth dorsal spine (seventh dorsal nerve) and the lower border of the tenth dorsal spine (space below twelfth dorsal nerve).*

Disease here may give rise to the following symptoms: The 'abdominal reflex' may be abolished, depending as it does upon the integrity of the cord between the levels of the eighth dorsal and the first lumbar nerves. Paralysis of lower intercostal muscles or of abdominal muscles may possibly occur, in addition to paralysis of the lower extremities. 'Girdle sensation' may be felt at different levels (the umbilicus corresponding with the tenth dorsal nerve, and the 'ensiform area' with the sixth and seventh dorsal nerves). There may be prominence of certain of the lower dorsal spines, with possible tenderness.

(*d*) **Lumbar Region of the Cord.**—*This corresponds externally to the space between the lower border of the tenth dorsal spine (just below the twelfth dorsal nerve) and the upper border of the second lumbar vertebra.*

Here the symptoms are: Paralysis, not

implicating the abdominal muscles, but limited to more or less of those of the lower extremities. No 'girdle sensations' around the trunk. Three superficial reflexes may be abolished, namely, the 'cremasteric,' which depends upon the integrity of the cord in the upper lumbar region; the 'gluteal' and the 'plantar,' both of which seem to be dependent upon the integrity of the lower part of the lumbar region of the cord. A deep reflex may also be abolished, namely, the so-called 'knee-jerk,' which is dependent upon the upper lumbar region of the cord. 'Ankle-clonus' may be met with when disease affects the upper or mid-lumbar regions of the cord, but not where the lower lumbar region is implicated. Loss of sensibility about the perinæum and anus (if not due to disease of nerve-trunks) is indicative of disease of the posterior columns in the lower lumbar region. Absolute paralysis of the bladder and rectum may be present, with tendency to inflammation and ulceration of the former organ. (With lesions higher up in the cord there may also be, according to their extent, some of the alterations in regard to the action of the bladder and rectum which have been set forth in a table on p. 809.)

In the clinical data above given are included the majority of the facts upon which the *regional diagnosis* of diseases of the spinal cord must in all cases be based. In them also will be found the explanations, so far as they can be given in moderate compass, of the *symptoms* met with in different diseases of the spinal cord. An obvious advantage will be found to have resulted from this somewhat lengthy preliminary discussion, if, as it ought to do, it tends to give the practitioner a more thorough insight into the nature and relations of the several diseases of the spinal cord, at the same time that it aids him in their diagnosis.

Although it is true that the groups of symptoms presented in different diseases of the spinal cord, considered individually and collectively, afford the materials upon which a *regional* diagnosis must be founded, it is no less true that a part of the symptomatology (namely, that comprised in the mode of origin and the mode of establishment of the disease, together with what may be gathered from the patient's state generally, from his family history, and from his personal history) constitutes the basis upon which a *pathological* diagnosis has to be arrived at. Again, although the arrival at a regional diagnosis is often spoken of, and may seem to be a process altogether distinct from that involved in the arrival at a pathological diagnosis, yet, as a matter of fact, in the investigation of many individual cases of spinal disease, it will be found that the one problem is not settled first, and the other afterwards, but that both are tentatively considered more or less simultaneously. Thus, certain empirically known pathological conditions may afford at once a ready explanation of a given group or sequence of symptoms, as in 'infantile paralysis,' in 'locomotor ataxy,' or, in a more general sense, in angular curvature of the spine. Here, therefore, the pathological diagnosis goes hand in hand with the regional diagnosis, and in working them out each gathers additional confirmation from the establishment of the other. Sometimes, however, as in the case of traumatic injuries (including stabs, and fractures with dislocations of vertebræ), the pathological diagnosis is at once obvious, and the regional diagnosis alone requires to be settled in detail.

For the above reasons, it has been necessary to tabulate in this article certain '**Pathological Data concerning the Spinal Cord**' (§ 5), though it would not be found specially advantageous were we to follow out this part of the subject further, and attempt here to set down the more general *clinical data and deductions of pathological import*, necessary to be borne in mind for the arrival at a pathological diagnosis, in order to form a series of facts and deductions comparable with those already given in elucidation of the problems of regional diagnosis (§§ 7 and 8). These other problems will be dealt with, as far as possible, in the descriptions of the several diseases of the spinal cord.

H. Charlton Bastian.

SPINAL CORD, Special Diseases of.—In order that the mutual relations of the different diseases of the spinal cord may be the more readily appreciated, their names are here set down in groups, and they will be severally considered in the same order, which is one based upon their causes and nature, rather than upon alphabetical considerations. This list will, therefore, in addition, serve as an index to the order in which the several diseases of the spinal cord are described. The names of the different diseases now to be described are in this list printed in ordinary Roman type; while the names of those diseases that are discussed separately in different parts of the work (to which descriptions the reader is referred) are printed in small capitals.

I. Diseases of the Spinal Cord dependent upon known organic changes:—

(1) Spinal Cord, Concussion of; (2) Spinal Cord, Punctured or Gunshot Wounds of; (3) Spinal Cord, Sudden Crushing Lesions of; (4) Spinal Cord, Slow Compression of; (5) Spinal Cord, Anæmia of; (6) Spinal Cord, Hyperæmia of; (7) Spinal Cord, Inflammation of; (8) Spinal Cord, Hæmorrhage into; (9) Spinal Cord, Softening of.

(10) INFANTILE PARALYSIS; (11) Acute Spinal Paralysis of Adults; (12) Acute

Ascending Paralysis; (13) Chronic Spinal Paralysis; (14) PROGRESSIVE MUSCULAR ATROPHY.

(15) LOCOMOTOR ATAXY; (16) Spasmodic Spinal Paralysis; (17) Amyotrophic Lateral Sclerosis; (18) Multiple or Disseminated Sclerosis; (19) Friedreich's Disease.

(20) Tumours and New Formations of the Spinal Cord; (21) Syringomyelia; and (22) Malformations of the Spinal Cord.

II. Diseases dependent upon unknown or imperfectly known organic changes:—

(23) TETANUS; (24) TETANY; (25) TORTICOLLIS; (26) WRITER'S CRAMP; (27) SPINAL IRRITATION; (28) Reflex Paraplegia; (29) Intermittent Paraplegia; (30) Functional Paralysis of Spinal Type; (31) Paraplegia dependent on Idea; (32) Neurasthenia Spinalis; and (33) Toxic Spinal Paralysis.

In addition to these diseases, dependent upon changes limited to the spinal cord, other affections should here be mentioned, in which the spinal cord is implicated (in modes more or less known) together with the cerebrum in one or other of its regions. These *cerebro-spinal* affections are as follows: (1) GENERAL PARALYSIS OF THE INSANE; (2) CEREBRO-SPINAL SCLEROSIS; (3) PARALYSIS AGITANS; (4) HYDROPHOBIA; and (5) CHOREA.

For an account of the diseases dependent upon morbid changes in the membranes of the spinal cord, *see* MENINGES, SPINAL, Diseases of.

1. Spinal Cord, Concussion of.—SYNON.: *Commotio Medullæ Spinalis*; Fr. *Commotion de la Moelle Épinière*; Ger. *Erschütterung des Rückenmarks.*

ÆTIOLOGY.—This condition is met with principally in persons who have fallen from a height, or in those who have been present in a railway collision. In these cases the brain is apt to suffer as well as the spinal cord, and it is not always easy to unravel the respective symptoms due to shock of this or that great segment of the cerebro-spinal system.

ANATOMICAL CHARACTERS.—In many of these cases there are, in all probability, no morbid changes that would be discoverable. In others, however, minute extravasations of blood, or actual ruptures of the nerve tissue, may occur. Sometimes, as in a case seen by the writer, even notable lesions are produced. An example of the slighter lesions is recorded by the late Sir William Gull, in which small extravasations of blood were found in the anterior and posterior cornua, as well as in the posterior columns of the cord. In neither of these cases was there any external or visible injury; but in each paraplegia was produced immediately after the fall that determined the lesions in the cord. In addition to hæmorrhages into the substance of the spinal cord itself, there is in these cases the possibility of the occurrence of meningeal hæmorrhages, pressing upon the cord or its nerve-roots; and within a day or two after the occurrence of the concussion itself, there is the possibility of some local and subacute inflammation being set up in the membranes of the cord.

SYMPTOMS.—In the great majority of these cases no complete paralysis is induced, even at first. There may at most be paresis of one or more limbs, general prostration, nausea with occasional vomiting, a rapid and possibly irregular or intermittent pulse (especially after the least exertion), with occasional startings and twitchings of the limbs, the sensibility of which may be diminished, exalted, or unaffected. The temperature will probably be at first depressed, as a result of shock, though subsequently a slight febrile elevation may continue for some days. The tongue may be furred, the appetite bad, the bowels constipated; whilst in regard to micturition there may be either some delay and difficulty, or, on the contrary, an irritability of the bladder, with difficulty in retaining its contents after the desire to micturate is once felt. With this there is often general restlessness, nervousness, and insomnia.

In more severe cases of concussion, even where there is no complication resulting from appreciable lesions, the shock to the system (*see* SHOCK) may be more profound, and there may be paralysis of limbs, lasting perhaps for some days, and then rather suddenly disappearing.

DIAGNOSIS.—The questions to be determined are, whether, looking to the symptoms presented by the patient, there is likely to be any organic lesion or change in the spinal cord or its membranes; or whether we have to do with mere functional perturbations induced by the shock or blow to which the patient has been subjected. In the absence of definite paralysis, or even with its presence for the first few days, the answer to this preliminary question will often be shrouded in doubt. To come to a definite opinion as to the precise nature of the change which a spinal cord, deemed to be damaged in some way after a concussion, has undergone, lapse of time and several examinations of the patient are often required.

In many cases in which compensation for an injury is claimed, a further complication appears. Here it is that the difficulty arises as to how much the symptoms experienced, or said to be experienced, may be due to an excited imagination, and how much to causes independent of the imagination, whether voluntarily or involuntarily aroused. It must be conceded that symptoms of injury are undoubtedly feigned by unscrupulous persons; and it seems also equally clear that, even unknowingly to the patient, the excitement consequent upon the accident, the details heard concerning the injuries of others, combined with the inquiries of doctors and of sympathising friends, tend to keep up and to exaggerate symptoms in many nervous patients, over and above those which may have resulted from the shock. Such patients also may make a more speedy recovery subsequent to trial and compensation than they had been making before the trial, and yet they *may* not have been in any sense impostors. It is true that such persons, however, do not recover quite so quickly as those others who for their own unscrupulous ends have been previously exciting their imaginations in a voluntary manner.

Prognosis.—In only the severest cases of concussion or shock is there actual danger to life (*see* Shock). Where, however, great prostration is induced, and especially in those who may previously have been suffering from heart-affections, or from a very excitable nervous system, life may be speedily brought to a close; or at most such patients may not survive a severe concussion more than a day or two.

Severe concussions of the cord may also form the starting-points of many and varied deviations from health, which may not begin to show themselves for weeks, or perhaps even months, after the initial shock. Among such sequelæ, which have come under the writer's notice, may be mentioned the following: Loss of flesh with general failure of nutrition, epileptiform fits, progressive muscular atrophy, lateral sclerosis of the spinal cord, a slowly increasing paraplegia (of uncertain pathological basis), and caries of vertebræ followed by angular curvature and paraplegia.

In other and slighter cases, time and rest, with suitable medical treatment, may be expected to lead to perfect recovery, sometimes speedily, but sometimes only after protracted periods of impaired health.

Treatment.—In the first instance, symptoms of shock have to be combated by the employment of warmth and stimulants. In subsequent stages, rest in the recumbent position must be enjoined for a time. It is of the first importance to make sure that the patient does take complete rest, and is kept free from excitement during the first few days after any concussion-accident, and that he gets sound sleep at night, under the influence of bromide of potassium, or of this together with chloral hydrate. If the condition of restlessness, with disturbed sleep, can be checked, then a mitigation of other symptoms may be expected to follow. The application of ice to the spinal column may at times be desirable; or pain must be relieved by the subcutaneous injection of small doses of morphine. Later on, tonics, with a simple nutritious diet and plenty of fresh air, together with rest, will be needed for the complete restoration of the patient.

H. Charlton Bastian.

2. Spinal Cord, Punctured or Gunshot Wounds of.—Synon.: Acute Traumatic Lesions of the Spinal Cord; Fr. *Plaies et Contusions de la Moelle Épinière*; Ger. *Rückenmarkszerreissungen.*

Ætiology and Anatomical Characters.—Punctured or gunshot wounds of the spinal cord are commonly made with knife, dagger, sword, or bullet.

In each set of cases, the wound in the spinal cord will be associated with perforation or rupture of some of the membranes, and also with hæmorrhage, either between them or into the substance of the cord. The arches of the vertebræ or their articular processes and some of the ligaments connecting them may be more or less damaged, and a wound commonly exists through the contiguous skin and muscles. In the cord itself, there may be either a clean-cut wound through certain of its columns and parts, or a broader crushing lesion. In each case more or less blood may be effused upon and below the cut surfaces of the cord. At later stages, there may be signs of inflammation of the membranes, as well as of local inflammatory softening of the substance of the cord.

Symptoms.—The signs and symptoms consequent upon wounds of this kind are subject to endless variations, in accordance with the different regions of the cord involved, the actual extent of the wound in its substance, and the possible presence of varying amounts of effused blood. These wounds often involve only a portion of the transverse area of the cord. It is indeed in this class of cases more especially that *hemiplegia spinalis* and *hemiparaplegia* are met with. Thus, where a unilateral lesion exists in the mid or upper cervical region, both arm and leg are paralysed, so that the state known as *hemiplegia spinalis* is produced; but where it occurs in the dorsal region, the one leg only is paralysed, and we have what is known as *hemiparaplegia.*

Since the experiments made many years ago by Brown-Séquard on the result of hemisection of the cord in certain animals, it has been supposed that the essential peculiarity in the latter cases is that on the side of lesion there is complete motor paralysis in the limbs or limb below; whils on the opposite side, the limbs or limb, and the trunk up to the middle line, are more or less completely anæsthetic—sensitiveness to impressions of touch, pain, temperature, and tickling being alike abolished.

Other minor peculiarities that have been described are these: On the side of *motor paralysis*, there is also vaso-motor paralysis, which carries with it, as consequences, (*a*) an elevation of temperature (from 1½° to 2° F.), and (*b*) a hyperæsthesia for all modes of sensibility (owing in part to hyperæmia in the limb and cord). Surrounding the body, at the level of the upper margin of anæsthesia on the side of sensory defect, there is usually a narrow girdle of hyperæsthesia; whilst below this level, on the side of the lesion, there is a half band of hemianæsthesia—whose depth varies with the longitudinal extent of the lesion. (The complete zone of hyperæsthesia has been thought to be due to hyperæmia of nerve-roots, and of the grey matter of the cord immediately above the lesion; while the half-zone of anæsthesia was supposed to be dependent upon destruction of the nerve-roots, and of the spinal cord for a certain extent at the seat of lesion.)

If bed-sores occur, they are said to be met with on the side of sensory paralysis; whilst in one or two cases signs of a joint-affection (in the knee principally) have occurred on the side of motor paralysis. There seems no reason for expecting any special muscular atrophy or diminution of faradic irritability on the side of motor paralysis, except in parts of those muscles whose nerve-supply comes from the portion of the anterior cornua actually destroyed by the lesion. In many cases, especially at first, there is paralysis of the bladder and of the rectum, or there may be incontinence of urine. Later on, these troubles tend to diminish. The superficial and deep reflexes are generally found to be exaggerated on the side of lesion.

In gunshot wounds, whether occasioned by pistol or rifle, splinters of bone may be depressed at times, so as to compress and irritate the cord, and thus the symptoms may be made to approximate more closely to wounds of the next category.

After a few days the symptoms may be complicated by those of spinal meningitis, or extended by the spread of an inflammatory softening of the cord above and below the seat of lesion.

Diagnosis.—The primary cause of the patient's condition is generally only too obvious. It may be clear that we have to do either with a punctured or with a gunshot wound in some region of the spine; but subsequently many, and often very difficult, questions require to be solved. It is of first importance to learn whether the cord itself is really damaged, or whether the symptoms are in the main caused by epi-dural or sub-arachnoid hæmorrhages (*see* Meninges, Spinal, Hæmorrhage into). In the former case there will be evidence of complete or partial interruption of conduction in the cord, to or from all parts below the seat of lesion, and not of a mere local implication of nerve-roots. If it seem probable that the cord itself is damaged, we have to determine whether it is completely cut across, or only partially damaged—and if the latter, to what extent. These questions must be decided in the main by reference to the signs given in Spinal Cord, Diseases of, § 7.

Should the case be seen for the first time several days after the injury, an exact diagnosis as to the amount of damage to the cord itself is often greatly obscured by the existence then of certain secondary pathological conditions—more especially localised inflammation of the meninges, or secondary inflammatory softening, extending perhaps above or below, or in both directions, from the original wound. A process of softening may also extend transversely through the whole substance of the cord, even where only a unilateral lesion had previously existed.

Prognosis.—This, as a rule, is bad in all cases of traumatic injury of the spinal cord; and the gravity of the case is usually the greater the higher the wound happens to be situated in the cervical region. Wounds of the dorsal or lumbar region of the cord are rather less serious, so far as life is concerned.

The degree of recovery from paralysis of limbs will greatly depend upon the nature and extent of the wound. A clean-cut wound may be filled up by the growth of a kind of cicatricial tissue; but, so far as our knowledge goes at present, it must be said that there is no definite evidence that the nerve-substance of the cord can be reproduced in man. It is remarkable that this should be so, seeing that the power of repair in cut or damaged peripheral nerves has been so clearly established.

Treatment.—Absolute rest, with cold applications, and possibly local blood-letting, will be needed in the first instance.

Subsequently, when immediate danger from shock and from the spreading of local inflammation has passed away, the patient must be treated upon the general principles applicable to all cases of paraplegia—which principles will be found set forth in 9. Spinal Cord, Softening of.

H. C. B.

3. Spinal Cord, Sudden Crushing Lesions of.—Fr. *Compressions Brusques de la Moelle Épinière*; Ger. *Rückenmarksquetschungen.*

Ætiology and Anatomical Characters.—The above form a class of wounds sufficiently distinct to need separate treatment. This kind of damage to the cord may be produced by the sudden giving way of a carious vertebra in any part of the spinal column; more rarely by a heavy blow on the back, which does not fracture the spine; or, in a modified form, by the bursting into the spinal canal of an aortic aneurysm, after its erosion through the vertebræ. But in the majority of cases such wounds of the spinal cord are the results of forms of external violence which cause fracture and dislocation of vertebræ, in some portion of the spinal column between the upper cervical and the upper lumbar region. When this occurs, displacement of vertebræ, even to a slight extent, especially in the dorsal region, in which the spinal canal is narrowest, is sufficient to produce severe pressure upon, or crushing of, the spinal cord. The membranes may not be torn across, and the actual dislocation may at times be only momentary, but the substance of the cord itself may be greatly compressed or reduced to a blood-stained semi-fluid mass of pulp. After some hours there are obvious signs of a commencing inflammatory reaction in the membranes; and above and below the seat of lesion similar changes are apt to be set up in the spinal cord itself, which may go on to the production of a variable amount of inflammatory softening. The patient may die, however, before any of these latter changes have been established.

Symptoms.—These vary much, according to the region of the cord involved. Still, in spite of differences thus dependent upon the seat of injury, there is a certain general similarity in the symptoms produced by all crushing lesions of the spinal cord. They are usually of this nature: There may be more or less marked evidence of shock; complete paralysis, both motor and sensory, of parts below the seat of lesion; in addition to severe pains in the back, girdle pains surrounding the body at the upper limit of sensory and motor paralysis; increased heat or possibly undue coldness of the body throughout the paralysed parts; complete paralysis of bladder with retention of urine, gradually giving place to incontinence; paralysis of intestine, extremely obstinate at first, but subsequently complicated with involuntary evacuations after the administration of purgatives; and extinction of all reflex actions at first.

In the course of two or three days, if the patient should survive, other general symptoms become well-marked, owing to the establishment of a local meningitis, together with some amount of traumatic myelitis. Amongst these we have general fever, with an increase of the 'girdle sensation,' and of pains in the limbs; twitchings in the limbs or in particular muscles; and also a general increase in reflex actions, where the crush has been only partial, though where the whole thickness of the cord has been destroyed the deep and most of the superficial reflexes in the paralysed parts continue to be abolished.

The above-mentioned complicating pathological processes may gradually subside, but there will still be danger to life from the supervention of severe cystitis or of extensive bed-sores, together with one or other of the various sequelæ to which such conditions are apt to give rise.

The additional symptoms and variations met with, according as the crushing lesion occurs in different regions of the cord, are as follows. They increase in number the higher the lesion occurs in the spinal cord. *See* Spinal Cord, Diseases of: § 8.

When it is situated in the *lumbar swelling* we have, in addition to the limitation of the paralysis to the lower extremities, and a more or less complete extinction of related reflex actions, the appearance of rapid atrophy in some of the paralysed muscles, together with the manifestation of the electrical reaction of degeneration. The bladder and rectum are apt to be completely paralysed.

With the lesion in some part of the *dorsal region* we have sensory and motor paralysis of the trunk up to a certain level, with an absence of the rapid atrophy and before-mentioned electrical reaction in the muscles of the lower extremities, though some atrophy and the presence of this reaction may occur in some of the trunk-muscles innervated from the damaged region of the cord. In addition (and notably where the lesion is in higher parts of the dorsal region) there may be some weakness of voice, some interference with the movements of respiration (especially with those of expiration), as well as marked and continuous priapism. The superficial and deep reflexes may be depressed or exalted, according to the complete or partial nature of the damage at the seat of lesion.

With the lesion in the *lower cervical region* the upper extremities are partly paralysed, both as regards sensation and motion; the movements of respiration are much more gravely interfered with (expiration especially), whilst inspiration is of a purely abdominal type; the voice is notably weak and feeble. Continued erection of the penis is more frequently met with; and in some cases a remarkable hyperpyrexia supervenes, in which the temperature before death may rise to 108°–110° F. Should death not occur in this way, it is very apt to supervene in the course of a few days, by gradual failure of respiration, which grows worse than it was in the early days of the affection, owing to the secondary myelitis which becomes established, implicating the cord and nerve-roots at a level higher than the original wound. The pulse is often much interfered with, but variously: it may be less frequent or much more frequent than natural; it may be small, irregular, and frequent; or full, regular, and infrequent in its beats. There may also be signs of paralysis of the vasomotor nerves supplying the neck and head, perhaps to a more marked extent on one side than on the other.

Where the lesion occurs in the *upper cervical region* of the cord, complete paralysis of the trunk and of all four extremities may be recognised, if death does not occur too suddenly to allow even this to be observed. The sudden death, so apt to occur in these cases, is due to shock, and to the fact that the diaphragm may be paralysed as well as the other respiratory muscles. Where the lesion does not involve the whole of the roots of the phrenic nerve, and where the shock has not been too abrupt and violent, life (with extremely difficult respiration and almost complete loss of voice) may be prolonged for a few hours.

An admirable series of cases illustrating these crushing injuries to the spinal cord is to be found in Ollivier's work (3^{me} éd., t. i., p. 253 *et seq.*); whilst the best modern book dealing with the subject is Thorburn's work, *A Contribution to the Surgery of the Spinal Cord*, 1889.

Diagnosis.—If the existence of fracture and dislocation of vertebræ can be substantiated, the probabilities are always in favour of the presence of a crushing lesion in the spinal cord. Otherwise, after a very severe fall or blow upon the back, doubts may be at first entertained as to whether we have to do with the effects of concussion alone, or with this *plus* some amount of crushing of the cord or of hæmorrhage upon or beneath its membranes. The subsequent course of the symptoms may, however, in a day or two, enable us to resolve these doubts.

Prognosis.—The prognosis in lesions of this kind, as already indicated, is much graver than in the case of mere punctured wounds of the cord—these being oftener slight and partial in their transverse extent. Death may occur immediately; or at any time during the first week—in the main from failure of respiration and of the heart's action. It is only in exceptional cases, and where the lesion is in the dorsal or lumbar region, that life is prolonged for several weeks or months. Such lesions are probably too severe to admit of anything like thorough repair. Paralysis, therefore, of a more or less complete kind, is lasting, and the prognosis will always be distinctly bad wherever the superficial and deep reflexes remain absent after the symptoms of shock have subsided (*see* Spinal Cord, Diseases of: § 4, (*a*)). But even where life is prolonged for six to twelve months or more, it is, as a rule, ultimately lost, owing to the establishment of sloughing bed-sores and ulcerative cystitis, followed perhaps by blood-poisoning, extensive meningitis, or other complications.

Treatment.—In many of these cases treatment is useless and death inevitable. In those which are of a less urgent nature, the possibility of bringing about some relief by trepanning, with the view of elevating any depressed fragments of the vertebral arches, should not be lost sight of; and, as Mr. Bowlby has pointed out, this should be borne in mind especially in those cases in which the reflexes in the paralysed parts are not abolished. Except, indeed, for the fact that parts surrounding the cord are damaged, so that rest in one position is often indicated, the treatment of these cases after the first urgent symptoms have abated does not differ from that which is appropriate (*see* 9. Softening of) in other well-marked cases of paraplegia, where there is a tendency to the formation of sloughing bed-sores, and to the establishment of cystitis.

H. Charlton Bastian.

4. Spinal Cord, Slow Compression of.

—Synon.: Chronic Traumatic Lesion of the Spinal Cord; Fr. *Compression Lente de la Moelle Épinière*; (in part) *Paraplégie Douloureuse des cancéreux*; Ger. *Langsame Compression des Rückenmarks.*

Ætiology and Anatomical Characters.—The most frequent causes of the set of symptoms grouped under this head are to be found in diseases of the vertebræ, and especially simple inflammatory or scrofulous caries of the bodies of the vertebræ, leading to *angular curvature*, or 'Pott's disease.' Still, other kinds of disease of the vertebræ may also be productive of slow compression of the spinal cord, and of that form of localised softening of the organ which is so commonly met with in this class of cases, the so-called 'compression myelitis.' Among these may be mentioned *cancer* of the vertebræ, either primary or secondary; also *exostoses* projecting into the spinal canal, or more irregular thickening of the bones in this situation. In cases of vertebral caries, in addition to the not infrequent presence and pressure of abscesses, a tough, yellow, scrofulous growth often infiltrates the posterior vertebral ligament, and thence spreads to the dura mater, here producing thickening and irregular fungosities which may press injuriously upon the spinal cord—more especially upon its antero-lateral columns. In these cases, though no tubercular disease is found within the dura mater, the spinal cord, as a result of degenerative changes, may, in the worst cases, be distinctly softened opposite, and perhaps for a very short distance above and below, the site of compression. At first such softening is principally apparent in the columns above mentioned; but in cases of longer duration it may involve nearly the whole thickness of the cord, and be followed by the usual ascending and descending 'secondary degenerations' (§ 5, (13)). The softened matter itself is generally reduced to an almost bloodless fluid or semi-fluid pulp, either of a whitish or dull yellowish-white colour, and there is generally no undue vascularity of the immediately adjacent portions of the cord.

In certain cases of very slowly induced

compression no such softening of the cord is produced; there is rather a gradual atrophy or disappearance of the nerve-substance as the pressure increases, together with a sclerosis of what remains. This may occur, for instance, where the cord is pressed upon by some exostosis, or by irregular growth and thickening of the inner surface of the spinal canal, such as occurs occasionally in one or other of the cervical vertebræ.

It has long been known that no constant relation exists between the amount of angular curvature and of paralysis in different cases of vertebral caries. Paralysis may be absent where curvature is most marked. On the other hand, with no curvature and with only a slightly marked projection of one or two vertebral spines, paralysis may yet exist to a well-marked degree. This is due to the fact, that in such cases the cord is only very rarely compressed by the bones, whilst it is frequently more or less pressed upon by abscesses or by the yellowish growths which protrude from the inflamed or carious vertebræ, or which produce thickening and infiltration of the dura mater at the seat of disease; and changes of this sort may be well-marked even where angular curvature is scarcely appreciable.

Again, where angular curvature is present, the posterior surface of the bodies of the vertebræ, corresponding with the angle, is often bent, rough, and eroded, and the cord over it is apt to become softened, though there may be no compressing growths or thickenings of the membranes.

Thus it happens that the paralysis in these cases may be variously produced. And seeing that it is often due to pressure by inflammatory products rather than to pressure or irritation from the diseased bones themselves, we may the better understand the fact that occasionally a great improvement may set in and become established in regard to the paralysis, although the angular curvature of the spine remains as obvious as it ever has been.

In addition to slow compression of the cord resulting from diseases of the bones of the spine, a somewhat similar condition may be induced by the various kinds of tumours of the meninges, or by hydatid growths implicating these parts (*see* MENINGES, SPINAL, Diseases of: New-Growths and Adventitious Products of). Confined within the narrow limits of the spinal canal, such tumours, even though of small size, may soon come to exercise a very injurious amount of pressure upon the spinal cord.

SYMPTOMS, COURSE, AND TERMINATIONS. — We shall point out some of the distinguishing characteristics of the paralysis which is often associated with vertebral caries, and afterwards refer to the peculiarities met with where meningeal tumours exist.

In *vertebral caries* with commencing pressure upon the spinal cord, the symptoms will be different, according to the part of the column implicated. The affection is frequently ushered in by an abiding pain in the spine and parts adjacent, often supposed to be 'rheumatic' in nature. Such pains commonly disappear when the patient is in the recumbent position, except during the acts of sneezing or coughing. They are commonly induced by particular kinds of movements, which are more or less difficult on this account. There is also some weakness in the lower part of the body and in the lower extremities. The mere 'weakness' may continue for weeks or even months before there is anything like actual paralysis; though at last this may show itself somewhat abruptly. The patient now becomes unable to stand, though still able to move the legs slightly whilst lying in bed. At this stage sensation is little, if at all, interfered with; but there may already be some increase in the readiness with which the knee-jerk manifests itself, and ankle-clonus may also be easily attainable. Next there may be startings of the limbs, and commencing rigidity of the muscles when passive movements are attempted; followed after a time by a more marked rigidity, which, when present in the calf muscles, will often prevent the manifestation of ankle-clonus and of the knee-jerk. Later, if pressure increases either upon the spinal cord or upon its posterior nerve-roots, sensibility in its various modes becomes implicated. At this period the exaltation of the reflexes often diminishes. For a time the degree of impairment of sensibility and the freedom with which the knee-jerk and ankle-clonus may be obtained fluctuates. Meanwhile, painful spasmodic contractions of the legs (with flexion of hip and knee joints) become habitual, persisting through day and night with only rare intermissions.

Although there is some general wasting of the muscles, together with a flabby condition when they are relaxed, they still react almost normally to the faradic current. The skin is often dry and scurfy. The temperature of the limbs is generally slightly lower than normal.

At the first onset there may be for a few days a difficulty in voiding the urine, but this power soon returns, and it often continues long after the limbs have become powerless. The bowels are perhaps somewhat constipated, but there is no incontinence of fæces, unless diarrhœa supervenes from any cause, or except when the reflex activity of the bowel is greatly exalted under the influence of aperient medicines.

The above condition of things may last long without much variation. But after a time there will be a gradual mitigation of the symptoms, or the reverse. In the latter case loss of voluntary control over the bladder and rectum appears; and (especially when the sensibility of the body and limbs becomes impaired) the tendency to the formation of sloughs and gangrenous bed-sores becomes increased. With these conditions other complications, such as cystitis, blood-poisoning, &c., may appear and greatly aggravate the condition of the patient, helping to bring about a more speedy termination.

In the case of *tumours arising from the meninges*, the onset of the affection may also be very gradual at first, though, perhaps, rather suddenly intensified at last. Here, however, the pressure very often comes upon the cord from behind, or it may at the same time implicate one or both lateral regions of the cord. At first, therefore, we commonly get variously impaired sensibility and neuralgic pains, or pains mixed with startings and cramp-like contractions in certain muscles, occurring in those particular regions of the body or limbs which are in relation with the nerve-roots slightly pressed upon and irritated by the new-growth. Great differences exist in different cases in regard to the degree and persistence of the initial pains. Subsequently these same nerves and the cord itself may become more severely pressed upon, and then loss of sensibility over the field of distribution of the nerve-roots is met with, together with loss or impairment of sensibility in all or some parts of the body the nerve-supply of which is from the cord below the compressed region. With this a minor amount of motor paralysis also occurs, which, however, subsequently becomes more marked, and ultimately complete. When this takes place we have all the signs and symptoms met with in a case of total transverse softening of the spinal cord at the level implicated (*see* Spinal Cord, Softening of). This change is, in fact, commonly established by the persistence and increase of pressure due to the new-growth.

These are the broad outlines of the symptoms met with in such cases, which, of course, are subject to innumerable variations in individual cases, in accordance with differences in the region of the cord affected, together with the rate of growth, mode of incidence of pressure, and size of the tumour.

In *cancer of the vertebræ*, also, we have much the same grouping of symptoms; the preliminary pains being here especially severe (*see* Charcot's *Leçons*, 3^me^ éd., t. ii., p. 86).

Diagnosis.—In the paralysis associated with *vertebral caries* the diagnosis depends upon the recognition of this causal condition, which, in the early stages, is often a matter of some difficulty. Much will depend upon the existence of pain in particular regions of the spine, or radiating therefrom; of pain which is relieved by the recumbent position, and greatly aggravated by coughing, sneezing, or stooping movements of different kinds (*see* H. Marsh in *Brit. Med. Journ.*, vol. i., 1881, p. 913). And yet in the absence of signs of caries, or of a scrofulous habit of body or history, or of an exciting cause for caries, in cases where there may be little or no prominence of vertebral spines, and even no pain from firm pressure or the application of a hot sponge, we may be helped in our diagnosis of the existence of caries by the distinctive characters of the paralysis itself, namely, its implication of motility principally, the exaggeration of the tendon-reflexes, the more or less marked rigidity of the legs, and the continuance of control over the bladder and rectum.

In cases of the latter type, or where there is only a slight prominence of two to four vertebral spines, it may be difficult, however, to establish a diagnosis between caries and *cancer* of the bodies of the vertebræ. It is true that a rounded prominence of several vertebral spines is met with in cancer more frequently than the angular projection commonly associated with caries; yet this single character will not always aid us: we must look also to the presence or absence of severe pains, to the clinical grouping of symptoms generally, and to the history of the patient.

The diagnosis of the other causes of slow compression of the cord to which reference has been made (exostoses or meningeal tumours) is usually a matter of extreme difficulty. We must be guided by probabilities based upon other associated states or conditions that may be recognisable in our patient, and also by the mode of onset of the affection.

Prognosis.—We can only speak in general terms concerning the prognosis of the rather miscellaneous conditions which form the subject of this article. Cancer of the vertebræ or of the dura mater, compressing the cord, is the most serious of them all. The progress of such cases is usually both rapid and very painful, so that the end comes inevitably before many months have elapsed.

In vertebral caries associated with compression of the cord, the prognosis is extremely uncertain, especially where the disease occurs in the cervical region. It is also generally more grave where the pressure upon the cord is due to an abscess rather than to mere thickening of the dura mater. Under suitable treatment many of these cases practically recover more or less fully; in others complete transverse softening of the cord is produced. In the former class of cases the process of caries is arrested, the spoiled vertebræ are strengthened and bridged over by growth of new bony tissue (though, of course, the angular curvature of the spine remains), whilst recovery from the paralysis may be more or less complete. This latter kind of recovery takes place occasionally even after paralysis, with almost persistent contractions of the lower extremities, has existed for from twelve to eighteen months or even longer.

In cases of exostosis, hydatids, or meningeal tumours compressing the spinal cord, the prognosis will depend upon the part of the cord involved, upon the rate of increase of the symptoms of compression, and upon the extent to which a secondary myelitis or softening is established. The disease in these cases, in spite of stationary periods, or even those of slight improvement, is more or less continuously progressive, though it may last for many months, or, occasionally, even for a year or two. Some of the complications or accidents incident to the paraplegic condition ultimately bring the patient's life to a close.

TREATMENT.—Rest in the recumbent or in the prone position is, of course, absolutely essential in cases of vertebral caries or of cancer of the vertebræ. In addition to this, in many cases of vertebral caries, a poroplastic or plaster jacket may be needed, in order more effectually to secure absolute immobility of the affected portion of the spinal column. This, however, would have to be reserved for the more chronic cases or stages—for those in which active local treatment was no longer considered to be necessary or desirable, though a prolonged rest in bed may still be needed. Under such conditions the application of the jacket is a means of obtaining more complete rest for the damaged spine. Some surgeons, however, prefer to have recourse to a method of 'elastic extension' for procuring this fixation of the spinal column.

In cases of paraplegia associated with vertebral caries, the patient's general health requires the utmost attention during the period in which we are endeavouring to check the disease by the influence of rest. Good nutritious food and cod-liver oil will be required, combined with steel wine or the syrup of phosphate of iron. In some cases 10 to 20 grain doses of iodide of potassium (together with iodide of iron or small doses of perchloride of mercury) seem to do good. Where the patient suffers much from painful contractions of the legs (which may greatly disturb sleep), these may be very distinctly lessened by suspending weights to the feet (each being from two to four lbs.) from leather anklets, by a cord which passes over a pulley. Such weights may be used for weeks or months together, where necessary.

In regard to local measures, counter-irritation of some kind is generally had recourse to, either in the form of flying blisters near to and on each side of the portion of the spinal column which is affected, or else by the renewed application of moxas or the actual cautery to these regions. The latter more severe measures are still recommended by some authorities, though the experience of others, amongst whom was the late Sir Benjamin Brodie, is against their employment, as being of little or no use, and therefore adding needlessly to the sufferings of the patient. The writer is inclined to think that all the good which moxas or the actual cautery are intended to bring about may generally be as effectually achieved by the application of iodine liniment over the affected region of the spine about every fourth day.

There can be no doubt that treatment of this kind is often successful, though frequently after prolonged periods. The question, therefore, naturally presents itself, whether the duration of the illness, and in some cases the saving of life, may not be brought about by an early resort to surgical operation, with a view to opening abscesses and removing scrofulous growths that may be pressing upon the spinal cord. If some signs of recovery do not commence in three or four months it will probably be advisable to have resort to operation. Each case, however, will require anxious consideration in regard to this point.

Again, it must be borne in mind that some cases of compression of the spinal cord by meningeal growth may be also greatly relieved for a time, or even cured, by operative measures.

In the case where a hydatid tumour presses upon the spinal cord, and is also situated in part outside the vertebral spines, tapping might bring much relief. In the majority of the other conditions comprised within the limits of this article, little can be done to cure the state of things which is the cause of the spinal disease, so that it would only remain for us to treat the paraplegia and its attendant conditions upon the general principles applicable to them. These are fully considered under 9. Softening of.

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5. Spinal Cord, Anæmia of.—Anæmia is not to be considered as the basis of any ordinary or common disease of the cord: in other words, there is no definite group of symptoms the existence of which is likely to be recognised more than once in a lifetime in any actual patient, which would justify the diagnosis 'anæmia of the cord.'

First, the writer would repudiate the notion that *anæmia* or *chlorosis*, as a mere blood-disease, is capable of producing, on the side of the spinal cord, any set of symptoms which can be marked off from those characterising the condition as a whole. In these diseases the functions of all the organs are impaired by reason of the impoverishment of the blood. The brain and spinal cord, on account of the delicacy of their functions, will, of course, suffer to a notable degree; and when general debility is extreme, a paresis of the lower extremities may be notable beyond that of other parts of the body, because the legs in standing or in walking have to support so great a weight. Where anything more than such paresis exists—that is, where there is actual paraplegia, such symptoms are not to be explained by a mere anæmia of the cord. Other causes are to be looked for. Jaccoud's whole group of *paraplégies dyscrasiques* will probably disappear before a more thorough knowledge of the actual mode of causation of these and many other obscure forms of paraplegia.

Secondly, *embolism* and *thrombosis* of spinal arteries will produce temporarily, and in quite limited regions of the cord, a condition of anæmia. Such local anæmia would probably soon be rectified by the establishment of a collateral circulation; and in the event of this not taking place, local 'softening' of the organ would ensue. A paralysis owning such an origin would not, therefore, be spoken of as resulting from 'anæmia of the cord.'

Thirdly, *pressure* upon parts of the cord will occasion anæmia and ultimately softening, but the symptoms in a case of this sort will depend mainly upon the pressure itself interfering with the functions of the nerve-tissue thus affected.

Beyond the conditions above referred to, there is the possibility that definite groups of paralytic symptoms may be occasioned by anæmia induced by mere functional *spasm of the arteries* in certain regions of the cord —spasm, that is, which persists day after day. This has been supposed by Brown-Séquard to be the condition existing in the cases of so-called 'reflex paraplegia' (*see* No. 28), and also in some forms of functional paralysis of spinal type (*see* No. 30). If such a condition of persisting arterial spasm be possible, and an actual cause of paralytic symptoms, we may well ask whether it too ought not after a time to lead to actual softening, or at least to some degree of degenerative change in the spinal cord. It seems possible, however, that where the amount of blood sent to a part of the cord is but small, the degradation of function may be more marked than the degradation of structure.

There will still remain a very few exceptional cases, in which a condition of real anæmia of the spinal cord is brought about in man, just as it has been brought about in some of the lower animals whose abdominal aorta has been tied or compressed. When the blood-supply is thus suddenly cut off from the lumbar region of the cord in animals, their hinder limbs become paralysed almost immediately, and continue paralysed as long as the blood-supply of the cord happens to be arrested. But if, after a mere brief interval, the blood is again allowed to take its natural course, the temporary paralysis disappears completely in a very short time. A condition of this kind seems to have occurred in a patient, formerly under the care of the late Sir William Gull, who suddenly became paraplegic, apparently owing to an abrupt arrest of the blood-current through the abdominal aorta, as was indicated by the cessation of the femoral and other pulses in the lower extremities (see *Guy's Hospital Reports*, 1857, p. 311). The man continued paraplegic for months, and only recovered when the collateral circulation became, after a time, pretty fully established. In a very few other cases referred to by Erb, in which paraplegic symptoms were associated with an obstruction of some kind in the abdominal aorta, he thinks that these symptoms, supervening as they did rather less suddenly, may have been in great part due to the deficient blood-supply to the muscles and nerves of the lower extremities, rather than to anæmia of the cord—to a peripheral, that is, rather than to a centric anæmia.

H. C. B.

6. **Spinal Cord, Hyperæmia of.**—This condition again is more frequently talked of than it deserves—looking to the small amount of positive knowledge we possess upon the subject.

Hyperæmia of the cord must be either passive or active, that is, it must be a result of *mechanical congestion* or of *arterial determination.*

Mechanical congestion.—In obstructive heart-disease extreme congestion of the spinal cord may exist for months without producing any distinct symptoms of disease of the spinal cord. A constantly congested spinal cord would doubtless perform its functions in a less vigorous manner than natural, but such effects would be slowly evolved and comparatively obscure. After a long time the effects might become more marked, owing to the overgrowth of connective tissue within the organ. We may indeed have the starting-point of a general sclerosis of the spinal cord under such conditions; but this secondary change, when only slightly marked, may, even in the spinal cord, produce no very definite symptoms.

General mechanical congestion of the cord is probably more frequent and more easily brought about than a congestion involving parts of the organ. Still from various causes there may be undue pressure upon certain veins, which directly or indirectly convey blood away from special regions of the cord and its membranes. Such an event cannot, however, be regarded as a likely cause of a congestion productive of morbid spinal symptoms, if we consider the absence of distinct symptoms resulting from extreme general congestion of the cord; and also the fact of the very free anastomosis of all the spinal veins.

Active hyperæmia may in its origin be of two kinds—'reflex' or 'inflammatory.'

'Reflex' hyperæmia of the cord and its membranes is possibly a phenomenon of great frequency, manifesting itself locally in certain regions—the seat of the process varying according to the conditions under which it arises. It might be immediately caused by vaso-motor paralysis, implicating certain vessels of the cord and their branches; and would thus involve an increased afflux of blood to the tissues contained in the corresponding vascular territories. We know that such an increased afflux of blood may exist in other tissues for some time without inducing tissue-changes of an appreciable kind (Brown-Séquard). It is fair to suppose, moreover, that any symptoms induced by such increased afflux of blood to certain regions of the cord would be indicative of exalted rather than of depressed function; for example, hyperæsthesia, actual pains and spasms, or increased reflex excitability, rather than their opposites.

In weak and irritable states of the nervous system it is quite possible (though nothing more definite can be said) that such vaso-motor paralysis, and also vaso-motor spasms inducing localised anæmias, may manifest themselves in spinal vessels, as they do in cutaneous vessels, by familiar flushes or pallors. If occurring in the skin, however, these would mostly be temporary phenomena, and not capable of producing the symptoms of an abiding disease. How frequent such reflex local hyperæmias (whether brief or prolonged) may be in the spinal cord, and in what precise manner they are excited, we do not know. Suppression of the menses or of hæmorrhoidal fluxes, the presence of worms in the intestine, the prolonged incidence of cold and wet, or severe concussions of the spine, any or all *may* operate in this particular manner—but for proof that, as matter of fact, they do, we may look for evidence in vain.

The subject of 'inflammatory hyperæmia' will be briefly considered under the next heading. In this case, in addition to changes in the vascular system, the effects of the inflammatory process as a whole have to be taken into account. Even in the first stage of inflammation something prior to and beyond the mere 'active' congestion has to be thought of.

From what is said above, it may be seen how shadowy is our present knowledge concerning the existence of any definite sets of symptoms which can be ascribed to non-inflammatory hyperæmia of the cord, either general or local.

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7. Spinal Cord, Inflammation of.

Synon.: Myelitis; *Myelitis Acuta*; Softening of the Spinal Cord (in part); Fr. *Myélite*; *Myélite aiguë*; *Inflammation de la Moelle Épinière*; *Ramollissement de la Moelle Épinière* (in part); Ger. *Myelitis*; *Rückenmarksentzündung*; *Erweichung des Rückenmarks* (in part).

Nature, Ætiology, and Pathology.—To speak definitely on this subject, in the present state of knowledge, is extremely difficult. This is due to several causes. In the first place, it is owing to the fact that so much uncertainty exists in the minds of many eminent pathologists and physicians as to what ought rightfully to be included under this term; and, secondly, because by a very large number of writers the term is understood and used in the vaguest manner, but with a manifest tendency to comprise under it the largest possible number of affections of the spinal cord. Critical discrimination seems to have been, and still to be, in abeyance with many who describe or report cases of disease of the spinal cord. They set down as instances of 'myelitis' not only all cases in which the substance of the spinal cord is softened, but still more all those in which it is indurated—and, no less impartially, those in which it is merely degenerated.

(1) The notion that common 'softenings' of the spinal cord are of inflammatory origin has persisted with little alteration, although for nearly thirty years pathologists have been interpreting altogether differently the mode of production of apparently similar 'softenings' of the cerebrum and cerebellum. Can it be that 'softening' as it occurs in the majority of cases in these latter organs is of non-inflammatory origin; while in the majority of apparently similar cases occurring in the spinal cord, the process is really inflammatory in its nature? It is true that in association with the majority of cases of primary softening in the brain thrombosis or embolism of its arteries may be detected, and that (owing to the peculiarities of its vascular supply) no such occlusions of vessels can often be detected in association with softening of the spinal cord. *See* Spinal Cord, Diseases of: § 5, (8) and (9).

(2) Then, again, perhaps it may be said that without adequate cause the very localised changes occurring in and around the great ganglion-cells of the anterior cornua, in 'acute' and 'chronic spinal paralysis,' have been set down as inflammatory in their nature, and new names have been given to these affections, tending to ratify this view as to their origin. Thus they are spoken of by some as cases of *anterior polio-myelitis*, or more briefly, and, so far, better, as cases of *cornual myelitis*. But localisation of an inflammatory process to great ganglion-cells and their immediate surroundings at present constitutes a rather unintelligible process to many pathologists. And mysterious as these particular changes are, from the point of view of their ætiology, on any hypothesis that has yet been started, it would perhaps be simpler, and more harmonious with the nature of the observed conditions themselves, to regard them as of a degenerative type. If

the slower and more isolated changes characteristic of 'progressive muscular atrophy' are to be placed in this category (and in regard to them there is absolutely no evidence either clinical or pathological that can be adduced in favour of an inflammatory origin), then also it becomes easy to believe that, under some at present imperfectly defined conditions, a change of the same kind may set in more rapidly in these the most specialised of all the anatomical elements met with in the spinal cord, so as to produce the more acute affections above referred to. The slight secondary overgrowth of neuroglia often occurring around the degenerated ganglion-cells does not in the least militate against this view as to the pathology of the process; a similar secondary change occurs also in the process next to be referred to, and will be found to be easily explicable without the necessity of having recourse to the ever-ready and fashionable hypothesis of inflammation.

(3) 'Secondary degenerations' of the spinal cord have indeed, in spite of their name, and of what is known as to their origin, been erroneously regarded by some writers as inflammatory changes (Ziemssen's *Cyclopædia*, vol. xiii. p. 769). When nerve-fibres are cut across, those portions which are severed from their connexion with certain ganglion-cells are no longer able to preserve their nutritive integrity. Simultaneously throughout their whole length fatty degeneration affects their white substance. Myeline breaks up, and becomes disintegrated as it does in non-inflammatory softenings in the brain; and very speedily granulation-corpuscles begin to form abundantly throughout the changing area. But though fatty degeneration thus occurs simultaneously in all the cut fibres of the band, the vascular supply of this tract of tissue has not been altered. Since the blood in the diseased area is not utilised by the nerve-tissues proper, except to a very small extent, a large excess of nutriment is placed at the disposal of the neuroglia, and this undergoes a well-marked hyperplasia. Thus a band of tissue-change is produced in which some of the characteristics of softening are blended with those pertaining to a patch of sclerosis. In brief, we have effects resulting from a primary fatty degeneration of the nerve-fibres, and a secondary hyperplasia of the neuroglia; and from first to last there is not the least reason for believing in the existence of an inflammatory process.

(4) If we turn now to 'sclerosis' of the cord of primary origin, we again meet with processes which are commonly regarded and described as forms of '*chronic myelitis*.' This nomenclature is objectionable as applied to the processes in the spinal cord, just as it is in its application to like processes occurring in other organs, as the liver, the lungs, or the kidneys. Fibroid overgrowth, which forms the basis of so many examples of 'cirrhosis' or 'sclerosis' in different organs and tissues of the body, is a process pathologically intermediate between inflammation on the one hand, and degeneration on the other. What were formerly named 'interstitial inflammations' are now the 'non-inflammatory hyperplasias' of some pathologists, and the 'fibroid degenerations' of others. It would seem that the view as to the inflammatory nature of such processes is erroneous, if we look either to what is known concerning their modes of initiation, or to the actual nature of the changes themselves (which agree in every particular with those of infiltrating new-growths); it would seem, moreover, not less erroneous if we look to the clinical history of the affections themselves in which these scleroses occur. It conveys, therefore, an altogether erroneous implication to speak of such mere fibroid overgrowths as so many instances of 'chronic myelitis.'

Thus, it will be seen that the writer attributes to inflammation a far more restricted *rôle* in the production of morbid conditions of the spinal cord than is customary. The various forms of so-called 'chronic myelitis' he would exclude from that category. He would do the same for the set of changes known as 'secondary degenerations'; and also for those which are characterised by more or less acute atrophic processes implicating the great ganglion-cells of the anterior cornua.

Of the processes above referred to in order, there remains, therefore, only the class of 'softenings' of the spinal cord. That many of these are of a simply degenerative type (due to vascular occlusions and disturbances of blood-supply), and that, in the great majority of cases, these are the instances in which 'softening' appears to occur as a *primary* process, is the view which seems to the writer most in accordance with existing knowledge. On the other hand, it seems clear that in many cases changes, truly inflammatory in their origin and progress, may terminate in the production of states of 'softening' of the cord, which are indistinguishable by the naked eye from the softenings of degenerative type, and which, except in their early stages, can as yet also be very imperfectly discriminated by the microscope.

These latter true *inflammatory softenings* very rarely occur as primary pathological states; they are met with rather as *secondary* changes.

Thus we may get inflammatory softenings (*a*) spreading around and from wounds or other traumatic lesions of the spinal cord; or (*b*) starting from some blood-clot or tumour situated in or pressing upon the substance of the cord. It is not by any means clear, however, that all the forms of softening which arise in the latter manner should be regarded as of an inflammatory nature; and much room for doubt also exists as to the real pathogenesis of many cases of so-called 'compression myelitis.' Again, inflammatory softenings, going on even to suppuration, may be set up in the spinal cord (*c*) by embolism or thrombosis of septic origin. Still another cause of true inflammatory changes in the spinal cord (*myelitis peripherica*) is to be found (*d*) in spinal leptomeningitis (*see* MENINGES, SPINAL, Diseases of: Leptomeningitis).

Suppuration is clearly a process of inflammatory origin, and might therefore be expected to occur occasionally in the midst of 'softenings' which result from inflammation. In the light of what has been said above, the following statement by Erb is of considerable interest. 'Actual suppuration occurs very rarely,' he says, 'in acute myelitis. When abscess of the cord does form, it is generally secondary to a severe traumatic lesion or to suppurative meningitis. In spontaneous myelitis, on the other hand, suppuration is exceedingly rare, and has only been observed in a very few cases.' Thus suppuration is met with just in those forms of softening which are undoubtedly of inflammatory origin; and, on the other hand, it is not met with in the ordinary cases of primary or spontaneous softening, here assumed to be of non-inflammatory nature.

One other condition requires to be referred to here, and that is the so-called *acute central myelitis*, described originally by Albers, and afterwards studied by Hayem (see *Archives de Physiologie*, 1874, p. 603). These are cases in which apparently spontaneous 'softening' is met with, implicating in the main the central grey matter, and that often through a considerable extent of the cord. At times, however, the softening extends beyond the grey matter, so as to involve more or less of the surrounding white substance, when it has been termed *myelitis diffusa*. Considerable obscurity still prevails in regard to the ætiology of these affections. In some cases, such a change has been met with as part of an infective process, in which minute vessels in the grey matter of the cord have been found obstructed with micrococci. Occasionally, moreover, in certain at present imperfectly known conditions, minute thromboses may, as Dr. J. Hamilton has shown, occur throughout the spinal cord, and more especially in its grey matter, and thus lead on in the main to the production of a central softening (see *British and Foreign Review*, April 1876, p. 447). In this latter case, the patient was suffering from pyelitis, and it is supposed that there may have been some blood-poisoning. Still it was not ascertained that the multitudes of minute thrombi were either associated with or caused by micrococci in the vessels. It appears probable, however, that if from any cause minute widespread obstructions of small vessels occur in the spinal cord, softening would take place principally in the grey matter, owing to its greater vascularity. We should thus get that particular distribution of this change which is met with principally in cases of so called 'acute central' or 'diffuse myelitis.'

A careful study of the two cases of this disease recorded by Hayem has by no means sufficed to convince the writer that they ought to be regarded as having had an inflammatory origin. Neither the mode of onset nor the symptoms of the disease lend any distinct support to this view; nor do the results of the elaborate examination, to which the spinal cords were submitted by this accomplished observer, at all satisfy the writer that the pathological conditions met with were inflammatory either at their commencement or in their subsequent progress. *See* 9. Softening.

SYMPTOMS, COURSE, AND TERMINATIONS.—From what has been said, it will be seen that true inflammatory conditions of the cord are only with extreme rarity of *primary* origin, and that they occur, for the most part, as *secondary* complications in association (*a*) with wounds or injuries of the cord; (*b*) with foreign bodies in its substance; (*c*) with pyæmic processes; or (*d*) with spinal leptomeningitis, either simple or tubercular.

The supervention of a real myelitis in the course of either of these diseases of the spinal cord would perhaps be associated with an exaggeration of the already existing febrile condition; with an increase in the amount of paralysis, and in the degree of interference with sensibility; possibly also with more pain, restlessness, and spasms.

Myelitis may become associated with more or less of distinct suppuration, and almost certainly goes on to the formation of well-marked foci of softening. These may remain limited in site, but occasionally they have a distinct tendency to spread above and below the original seat of injury or disease. Such depots would probably undergo subsequent changes, very similar in kind to those which occur in foci of non-inflammatory softening.

DIAGNOSIS.—All that can be said under this head has been referred to above in connexion with the symptoms characterising the supervention of myelitis.

PROGNOSIS.—The gravity of any wound or lesion of the spinal cord, or attaching to the presence in it of blood-clot or tumour, is, of course, greatly increased by the supervention of inflammatory changes about their immediate confines. Again, the fact that an inflammation of the spinal meninges is complicated with similar changes in the substance of the spinal cord itself, cannot fail greatly to aggravate a case of simple spinal leptomeningitis. For, even should recovery from the acute affection take place, the actual degree of abiding paralysis, ataxy, or impairment of sensibility would much depend upon the degree in which the substance of the spinal cord had been itself implicated.

Treatment.—The amount of power that we possess in controlling an inflammatory condition of the spinal cord is probably not great. Little, if anything, is at present to be done with mere drugs. The patient should, if possible, lie in the prone position, or, failing this, on his side, with absolute rest. The advisability of abstracting blood locally by cupping or leeches should be entertained, and must depend much upon the amount of local pain or tenderness. In some cases it seems to be of service. Or we may trust rather to the application of cold externally, in the form of ice-bags, along the spine. At the same time the patient should be kept upon spoon diet, with a sparing amount of stimulants; and the bowels should be relieved by the aid of copious warm enemata, which may also act usefully as derivatives. The limitations circumscribing our efforts at direct therapeutics must be compensated as far as possible by attention to the state of the general health, and by the most careful and assiduous nursing, in the hope that the morbid process may after a time abate, and that, in the absence of collateral complications, the patient may make at least a partial recovery.

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8. Spinal Cord, Hæmorrhage into.

Synon.: *Hæmatomyelia*; *Hæmatorrhagia Medullæ Spinalis*; Spinal Apoplexy; Fr. *Hématomyélie*; *Apoplexie de la Moelle Epinière*; *Des hémorrhagies intrarachidiennes*; Ger. *Rückenmarksapoplexie*; *Spinalapoplexie.*

Ætiology and Anatomical Characters. Hæmorrhage into the spinal cord is a comparatively rare event. It occurs under three different conditions, namely: (1) as a result of concussion or violence; (2) as a secondary event, consequent upon some definite pre-existing morbid condition; and (3) as a primary event, or local pathological accident.

We are here specially concerned with hæmorrhages into the spinal cord belonging to the third of these categories, and may in a few words dismiss the other two.

(1) Traumatic hæmorrhages, small in extent, may, as already stated, occur in almost any region or part of the cord as a result of some severe concussion (*see* 1. Spinal Cord, Concussion of). Again, it may occur in the grey matter, and even in the white substance to a smaller extent, close to and as an appanage of wounds of the cord. In each of these cases symptoms due to the hæmorrhage itself would probably be obscured by the general set of symptoms resulting from the concussion or injury.

(2) Secondary hæmorrhages are, however, more closely connected, from the point of view of symptomatology, with those forming the special subject of this article. During the growth of certain soft tumours in the cord, a rupture of some of their vessels may take place, so as to cause hæmorrhage either into the growth itself, or else into contiguous regions of the cord. Such an event would be signalled clinically by the sudden exacerbation of the symptoms previously existing. But a combination of greater importance, though one of considerable obscurity, consists in the co-existence of a 'central myelitis' of the grey matter of the cord through more or less of its length, with a central hæmorrhage of nearly similar extent. The existence of any such 'central myelitis' as an independent disease of the cord seems to the writer very doubtful. It is at least equally probable that the hæmorrhage has been primary, and that the 'myelitis' is of secondary origin around the blood-clot. It need not be denied, of course, that in other cases hæmorrhage does occur occasionally into the midst of a focus of softened tissue in the spinal cord, just as it occurs occasionally under similar conditions in the midst of softened brain-tissue. Again, hæmorrhage may take place into or on the confines of a soft sarcoma or glioma in the substance of the spinal cord.

(3) Primary hæmorrhages differ as regards the amount, the site, and the distribution of the blood effused in different cases. In connexion with scorbutic states, and also independently of these, small hæmorrhages may occasionally occur into the substance of the cord, without producing any very distinct symptoms. But, at other times, a comparatively large quantity of blood may be effused into the cord, and then it occurs almost invariably into the central regions of the grey matter, through which it may extend for a variable distance, upwards or downwards, or both. When the quantity is smaller, the blood may be effused into the grey matter of one side only.

Though this kind of hæmorrhage is, in contradistinction to the others, spoken of as primary, yet it is almost invariably preceded by some pathological changes in the vessels of the cord. These constitute the predisposing conditions, and the actual rupture takes place, rarely, when the person is at rest, but more frequently under the influence of some distinct exciting cause—such as muscular exertion of one kind or another.

Primary hæmorrhage, though rare, is most prone to occur in persons between the ages of twenty and forty, and not with increasing frequency as age advances. This constitutes a further notable difference between hæmorrhages of the spinal cord and those into the brain.

Symptoms.—These are necessarily subject to great variations, according to the amount of blood effused, and as the hæmorrhage takes place into the cervical, the dorsal, or the lumbar region respectively. The kind of variation thus induced may be gathered by reference to the article, Spinal Cord, Diseases of: § 7, (*a*), and § 8.

Here it is of importance to set forth the peculiarities (both as regards mode of onset and nature of the symptoms) which belong to hæmorrhage as compared with other pathological conditions of the cord. First, its tendency is to take place suddenly and without warning; and, secondly, for the blood to be effused into the grey matter for some distance, thus giving rise to a characteristic grouping of symptoms. There may, therefore, be a sudden onset of pain in the back (possibly severe), followed almost immediately by complete motor and sensory paralysis of the legs and trunk up to a certain level, together with complete paralysis of the bladder and rectum. At first there may be an abolition of all reflexes, and possibly a lowering of temperature in the legs; though after a day or two—should the injury be in the dorsal or lower cervical region of the cord—there may for a time be increased heat of legs, owing to vaso-motor paralysis, and a return, with some exaggeration, of various reflexes. Rapid atrophy, with the appearance of the electrical 'reaction of degeneration,' occurs in all muscles that are in immediate functional relations with the portions of the anterior cornua of the cord that may be damaged. Cystitis, together with sloughing bed-sores and all their consequences, tends to occur early, and that often in spite of all precautions that may be taken.

Where the hæmorrhage invades pretty fully, but is limited to, the grey matter of one-half of the cord, we may have groups of symptoms that take the form of *hemiplegia spinalis* or *hemiparaplegia*. *See* 2. Punctured or Gunshot Wounds.

Diagnosis.—The absolutely sudden onset of the paralysis, which may be complete in the lower extremities in the course of a few minutes (especially when associated with a sudden painful sensation in the back, or one which radiates into the limbs), as well as the almost complete and sudden loss of sensibility in the paralysed parts, form a group of symptoms which are typically distinctive of hæmorrhage into the grey matter of the cord.

The condition most likely to be confounded with it is a large *hæmorrhage outside the dura mater*, causing compression of the cord. Here the onset would also be sudden, but almost invariably associated with some mechanical injury or shock. The paralysis of motion, too, would generally be much more marked than the interference with sensibility. The subsequent progress of such a case would further tend to separate it from a case of intra-medullary hæmorrhage, since (even with a severe meningeal hæmorrhage in the cervical region), if the patient should survive the first effects of the lesion, the symptoms might be expected soon to grow less and less urgent, and recovery may be more or less complete. No such amelioration is, however, to be expected in the case of a well-marked hæmorrhage into the grey matter of the cord, in the cervical region or elsewhere.

On the side of the brain *embolism* is capable of initiating paralytic symptoms with as much suddenness as a hæmorrhage, but in the spinal cord, for reasons previously stated, this does not occur. *See* Spinal Cord, Diseases of: § 5, 8.

It does, however, happen occasionally that a process of softening—probably caused by *thrombosis*—has its occasioning conditions initiated suddenly. When this occurs, paraplegia sets in almost as abruptly as if it were produced by hæmorrhage; but then it is usually an incomplete paraplegia, and, for a time at least, unaccompanied by loss of sensibility. In the course of a few days, in such a case, sensory paralysis may supervene, and the motor paralysis may become more complete. In the exceptional cases of paraplegia of sudden onset due to this cause, there is generally no initial pain in the back, though there may be pains and burning sensations in the limbs.

Prognosis.—Where the hæmorrhage is at all large, so as to extend through the grey matter for the distance of an inch or more, the prognosis is always grave. Very few of such cases recover. They are, in fact, liable to be aggravated by the establishment of a secondary process of softening in the grey matter, which may slowly extend both above and below the blood-clot as well as around it. Should this softening reach far into the cervical region, or should the hæmorrhage itself implicate this part of the cord, the patient may not survive more than a few days. But if the primary and secondary pathological changes are limited to the lumbar or to the dorsal region of the spinal cord, the fatal event is usually brought about more slowly, after an interval of weeks or perhaps even of months—and then commonly from the occurrence of sloughing bed-sores, together with cystitis and other frequent accompaniments of a severe paraplegia.

In the case of small hæmorrhages limited to some fractional part of the transverse area of the cord, and of slight longitudinal extent, the prognosis is, of course, much more favourable, and there is no reason why partial recovery, at least, may not occur.

Treatment.—In the treatment of a case of spinal hæmorrhage, should the patient be seen immediately after its occurrence, absolute quietude, with rest in the recumbent or prone posture, should be ensured.

Bleeding, either local or general, is useless. Purgatives also are contra-indicated.

Should the pulse be full, and the heart's action excited, decided benefit may be derived from 10-minim doses of tincture of digitalis, in combination with 15 or 20 grains of bromide of potassium, given for the first three doses at intervals of three or four hours, and subsequently every six or eight hours, for two or three days. These drugs will also favour sleep, and exercise a general calmative influence.

Position and rest are perhaps the means to be principally relied upon to prevent a recurrence or continuance of the hæmorrhage; such measures may be supplemented by warm applications to the feet and calves of the legs; though the patient should in other respects be kept perfectly cool. Ice to the spine may be applied, but is of doubtful utility. Spoon-diet should be strictly enjoined for a few days at least.

The patient's urine will require to be drawn off by catheter; and extreme care ought to be taken to ensure its antiseptic cleanliness. After a day or two, if the bowels have not been moved, a laxative or an enema should be administered, since, as in many other forms of paraplegia, there may, at first, be obstinate constipation rather than incontinence of fæces.

Subsequently, the case requires to be treated in all respects like any other very bad case of paraplegia—extra precautions being observed throughout, in order, as far as possible, to guard against the onset of bed-sores and cystitis. Fuller details concerning such treatment will be found under 9. Softening, since this is by far the most common cause of paraplegia.

H. Charlton Bastian.

9. **Spinal Cord, Softening of.**—Synon.: Non-inflammatory, White, or Simple Softening; *Myelomalacia*; *Mollities Medullæ Spinalis*; Acute Myelitis (in part); Compression Myelitis (in part); Fr. *Ramollissement de la Moelle Épinière*; Ger. *Erweichung des Rückenmarks.*

Nature of Change. — The writer has already intimated his opinion that far too large a share is assigned to inflammation in the pathogenesis of diseases of the spinal cord. This mistake is particularly obvious in regard to acute inflammations. It has long been the fashion to speak of almost every focus of 'softening' that occurs in the spinal cord as being the result of an 'acute myelitis'; and we find even Erb (in Ziemssen's *Cyclopædia*, vol. xiii.) putting forward, as characteristics of an inflammatory softening, peculiarities which certainly ought not to be regarded in such a light - and this although he seems otherwise strongly inclined to hold a similar opinion to that above expressed. Whilst admitting that a true myelitis is not distinguishable macroscopically, in the great majority of cases, from a simple or non-inflammatory softening, Erb adds a statement to the effect that the 'microscopical examination can alone furnish conclusive evidence.' In the opinion of the writer, however, such evidence as that which is cited by Erb (*loc. cit.* p. 470) is quite inconclusive.

It is evident, indeed, that we are still almost as destitute of microscopical as we are of macroscopical characters, of a trustworthy description, for enabling us to decide whether any given focus of softening has been of inflammatory or of simple non-inflammatory origin. Such researches as those of Hamilton (*Quart. Journ. of Micros. Science*, Oct. 1875) and others must be prosecuted further and multiplied before any certain means of deciding such a question can exist. In the early stages, or on the confines of a focus of inflammatory softening, we may expect to find a very distinct infiltration of the tissues with leucocytes, which would, of course, at once give a key to the true nature of the change in question.

In the present state of knowledge, however, it would appear that the 'non-inflammatory softenings' of the cord are represented by the great majority of the primary and apparently idiopathic 'softenings' which frequently occur in this organ.

Ætiology and Pathogenesis.—Concerning the ætiology of non-inflammatory softening of the spinal cord, it is impossible to speak positively. The disease presents itself as a spontaneous or idiopathic affection, sometimes without apparent cause or definite antecedent conditions of any kind, but at others as a sequence of one or other of various known and common precursors of diseases of the spinal cord.

Thus in certain cases the symptoms set in more or less suddenly after some great bodily fatigue; in others after extreme sexual excesses; or they may occur during the period of convalescence from certain acute fevers, such as variola, typhus, and other exanthemata, or after rheumatic fever. During the first week or two after childbirth there is likewise a liability to such symptoms; and also in the later stages of syphilis. These different conditions may act very variously in contributing to bring about a focus of softening in the spinal cord, and nothing more than conjectures can be advanced in regard to its pathogenesis in the several cases. It may be recognised, however, that most of them tend to entail cardiac weakness, either alone or in association with blood-changes which may favour the occurrence of thrombosis.

Again, the symptoms indicative of a primary softening of the cord may set in after the action of other conditions, regarded by some as exciting rather than as predisposing causes. Of these the following may be enumerated: Prolonged exposure to cold and wet; sudden suppression of the menses or of other accustomed fluxes; violent emotional disturbances; or the existence of some inflammation in one or other of the pelvic organs, such as the uterus or the bladder and urethra (instances of the latter class being some of the cases formerly supposed to be of 'reflex' origin). In regard to these 'exciting causes,' all that is certainly known is, that softening of the cord seems to set in not infrequently in persons who have been subjected to one or other of them; but in what precise mode either of them is related to the subsequent softening, nothing very definite can be said. Something, nevertheless, may be advanced by way of suggestion, with the view more especially of giving direction to the investigations needful for clearing up this subject.

Spinal and cerebral softenings probably own a similar mode of origin. Of the obstructions of vessels which so largely determine cerebral non-inflammatory softenings, it is those due to thrombosis, rather than to embolism, which intervene in the main for the production of corresponding conditions in the spinal cord. *See* SPINAL CORD, Diseases of: § 5, (8) and (9).

It is well known that the causes of thrombosis are principally three, and that in different cases, now one, now another of them may be most influential; whilst in other instances two or more of these causes may cooperate. These three causes are—(*a*) thickenings, irregularities, or degenerations of the inner coats of the vessels; (*b*) slowness of blood-current; (*c*) peculiarities in the chemical composition of the blood, rendering it more than usually prone to coagulate.

The thrombosis may take place in the arteries or in the veins, and the plexiform arrangement of the spinal vessels, together with the slowness of their blood-current, may favour the occurrence, as well as the spread of the process when it has once been initiated. Thus a process of coagulation, beginning, perhaps, in some very small vessel, may gradually extend so as to involve many other contiguous branches, and thereby gradually increase the area of the cord which is deprived of its proper blood-supply. The small size of the vessels, however, makes it extremely difficult to establish the fact of their occlusion, whereas in the large vessels at the base of the brain thrombosis is easily enough detected. And it is especially worthy of note, in this connexion, that the blood-supply of the lower end of the cord (where primary softenings are most common) is peculiar and easily interfered with. To this important point Dr. Moxon called attention (*Brit. Med. Journ.*, vol. i., 1881). In short, the anatomical conditions existing in the cord, both on the arterial and on the venous side of its circulation, are probably of a kind distinctly to favour the occurrence of thrombosis.

ANATOMICAL CHARACTERS. In regard to their distribution or extent in the cord many varieties of softening exist which have been commonly recognised, though they have been mostly described under corresponding designations as so many varieties of 'myelitis.' Thus, we may have a 'complete transverse softening,' involving the entire thickness of the cord for a variable longitudinal extent, either in the lumbar, the dorsal, or the cervical region. Or the softening may be more limited to certain subdivisions of the cord in one or other of these regions—and then constitute an 'incomplete transverse softening.' Thus it may, in one set of cases, principally affect the anterior columns and grey matter; in another set the posterior columns and more or less of the grey matter. Or the softening may be central, and almost confined to the grey matter through a considerable extent of the cord, as in 'diffuse central softening'; when this change involves the white columns as well as the grey matter for a considerable extent, we have what is called 'diffuse softening' of the cord. When a small focus of softening exists which only involves part of the transverse area of the cord, and that for a very limited extent, we have what is commonly spoken of as a 'circumscribed softening' of the cord; and where many of these small foci are scattered through different parts and regions of the organ, we have what is known as 'disseminated softening.'

An accidental damage during the opening of the spinal canal must not be confounded with the results of pathological change. In a spinal cord bruised in the manner indicated the nerve-substance may be softened and diffluent, and somewhat resemble a patch of real pathological softening. Examination with the microscope, however, would show, amongst the fragments of myeline from the broken nerve-tubules in the former case, an entire absence of the large granulation-corpuscles, which are, on the contrary, invariably present in a patch of real pathological softening. If there were, after such an examination, still room for doubt, this might be resolved by the fact that the softened nerve-matter in a patch of real softening of the cord, has its specific gravity lower by 3–5 degrees than that of other healthy portions of the organ, whilst in the patch of merely bruised nerve-substance it would not be appreciably lower than normal. The normal specific gravity of the spinal cord varies commonly from 1033–1041 in different individuals—the higher figures being most frequently met with in elderly persons. The modes of estimating the specific gravity have been discussed by the writer in *Journ. of Ment. Science*, vol. xi. 1866.

Where the process of softening has gone on to its final stages—in a case, for instance, of 'complete transverse softening'—the whole substance of the cord in the affected site is reduced to a rather dirty-looking milky fluid, which, when the membranes are cut across, flows out so as to leave a complete gap in the cord-substance for an extent, it may be, of one to three inches. All intermediate stages may be found between such a condition and a slight degree of softening, in which the cord-substance is only a little more pulpy than natural.

Symptoms, Course, and Terminations.—The symptomatology of this disease presents an extremely wide range, in accordance with the varying extent and sites of the softening in the cord, as existing in different patients.

In 'circumscribed' and 'disseminated' softening, for instance, the symptomatology would be excessively variable in different patients; and, especially in the latter class of cases, it might be extremely difficult to arrive at a diagnosis. The symptoms could, in fact, only be interpreted by the light of the general principles applicable to the regional and pathological diagnosis.

Again, in cases of 'diffuse central softening' the symptoms—except for the fact that they set in gradually rather than abruptly—would bear a close resemblance to those of hæmorrhage into the spinal cord, where the blood is effused into the central grey matter for a certain extent (*see* 8. Spinal Cord, Hæmorrhage into). There is some doubt, indeed, whether these latter cases may not occur principally as epiphenomena sequential to a primary central softening.

The symptomatology of 'incomplete transverse softenings' of the cord is for the most part exemplified by the second stages of various forms of so-called 'compression myelitis'—cases, that is, in which the anterior regions of the cord more especially are, in one set of cases, principally pressed upon either by tumour, or by the inflammatory products associated with vertebral caries ('Pott's disease'); whilst in another set the posterior columns and posterior grey matter may undergo a similar softening, under the influence of the pressure of a new-growth impinging upon the cord from behind. Cases of this type, however, may easily and do often merge into 'complete transverse softening' (commonly known as 'complete transverse myelitis'). Both complete and incomplete forms also often occur in the cord quite independently of pressure.

Of these states it will be well, for the sake of brevity, to confine our attention principally to '*complete transverse softening*.'

In a case of *complete transverse softening* involving the mid-dorsal region, the temperature in the axilla usually varies between 98° and 100° F., though with an extension of the pathological process, or towards the close of the disease, it may rise to 101°, 102°, or even higher. Meanwhile the lower extremities themselves are often distinctly cold to the hand—the temperature being in some cases more or less subnormal. It is important to note this, because it might have been supposed that hyperæmia and a slightly elevated temperature would exist, owing to the vaso-motor nerves of the limbs being paralysed.

The motor paralysis of the lower extremities is absolute, and the abdominal muscles are also powerless. The feet, as the patient lies in bed, are extended and often inverted, so that the great toes cross one another. The skin after a time tends to become dry and scurfy. The muscles feel flabby to the hand, but they waste only to a slight extent, and continue week after week to show only a small amount, if any, of diminution in the degree of their irritability to faradic and to galvanic currents.

The sensibility of the limbs is completely abolished both for tactile and painful impressions, as well as for differences of temperature and tickling. A like abolition of sensibility exists over the trunk up to the level of the 'ensiform area,' whilst above this level the sensibility is found to be quite natural. Though the upper limit of anæsthesia may be quite sharply defined, yet in these cases of complete transverse softening there is often no distinct 'girdle-sensation.'

The muscles of the lower extremities may show some slight irritability when they are forcibly tapped, and when the soles of the feet are strongly tickled there may be very slight movements of the toes; but beyond this there is often an entire absence of all reflex movements—there is no ankle-clonus, no knee-reflex, and a similar absence of the cremasteric and abdominal reflexes.[1] In the initial stages of the affection, however, and especially when the softening is not completely transverse, all these reflexes may be extremely well-marked for a time, though they tend gradually to diminish.

For the first ten days or a fortnight there is often complete retention of urine, but after this time, when the lumbar region of the cord again becomes capable of manifesting to some extent its centric functions, the initial retention gives place to incontinence of urine. This fluid may be discharged at intervals of two to three hours in small quantities, owing to the occurrence of reflex contractions of the bladder whenever the organ attains a certain degree of fulness. The passage of a catheter, however, in these cases will often show that the bladder is never completely emptied — two to four ounces remaining after the reflex contractions. Unless special precautions are taken, the urine, in such patients, speedily becomes ammoniacal, and more or less loaded with mucus.

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[1] In one case in which paraplegia had existed for over three months, in consequence of a complete transverse softening in the upper dorsal region (with the above-mentioned clinical signs), the writer was much struck with the extremely pallid appearance of the grey matter through the whole length of the cord below the seat of softening. The absence of the reflexes may be in part due to such condition of the grey matter, and this itself may be caused by a spasm of its vessels in some way induced by the lesion above. Some amount of spasm may also exist in the vessels of the limbs, whose temperature is often rather sub-normal. *See* a paper by the writer on 'The Symptomatology of Total Transverse Softening of the Spinal Cord,' in *Med.-Chir. Trans.*, vol. lxxiii., 1890.

The bowels are usually constipated, and relieved only after the administration of aperients or enemata. At these times there is generally incontinence of fæces — the patient having no power of controlling the reflex actions concerned in defæcation when they have once been strongly excited. The actual passage of the motion is, moreover, unfelt.

Under the irritative influences emanating from the seat of softening during the period of its establishment, a small bed-sore may begin to form, often amenable to treatment. Later on, sloughs are prone to appear upon the heels, over the malleoli, and in other situations habitually exposed to continuous pressure. But the most frequent site for intractable sloughing bed-sores is over the sacrum. Inflammation of the mucous membrane of the bladder is at last set up; and the inflammation may extend up one or both ureters, so as to implicate the pelvis of the kidney, when minute abscesses may also form in the kidney itself.

Under the influence of these various conditions the patient's appetite and strength gradually fail; emaciation proceeds; and death after a time may come from sheer exhaustion, aided, perhaps, by some intercurrent inflammatory affection of the lungs. Such complications may, however, be occasionally warded off for eighteen months or more. Other modes of death are pointed out in the section on Prognosis.

Diagnosis.—The recognition of this disease at the bedside often presents considerable difficulties. We must be guided partly (*a*) by the patient's history and state; partly (*b*) by the mode of onset of the disease; and partly (*c*) by the symptoms of the fully established affection.

(*a*) The points in regard to previous history which are of principal significance are referred to under the head of Ætiology. In regard to (*b*), the mode of onset, this is usually not abrupt and sudden; there is rather a slow increase of paralysis during a week, ten days, or a fortnight. Still, it is a fact that softening of the cord (apparently due to thrombosis) does occasionally cause a sudden incomplete paralysis, though such paralysis increases subsequently in the manner above stated. Such a case must not therefore be confounded with hæmorrhage into the cord, merely by reason of its absolutely abrupt onset.

The extent to which the diagnosis turns upon (*c*), the nature of the symptoms of the fully established affection, cannot be very strictly defined except in some cases. When the softening is slight and partial, it gives rise to no distinctive symptoms; but where there are clinical signs of the existence of a complete transverse lesion, the chances are that the lesion itself is, if not a primary, at all events a secondary softening.

In regard to the *regional diagnosis* of softening of the spinal cord, the following points require to be borne in mind:—

The indications as to the transverse area involved, and as to the upper limits of the change in the spinal cord, are wholly derivable from the presence or absence of the various signs and symptoms which have been set forth in the article, Spinal Cord, Diseases of: § 7, (*a*), and § 8.

The attempt to ascertain the lower level of the lesion, and consequently its longitudinal extent in the cord, is always difficult, and often cannot be achieved with any success. The indications are all obscure, uncertain, and apt to fail. This is especially the case if we attempt to base an opinion on the fact of the existence or absence of superficial reflexes (*see* § 4, (*a*)). Thus, complete transverse softening may exist in the upper dorsal region, and extensive secondary degenerations may have been produced, yet for week after week there may be a complete absence of all the reflexes, superficial and deep, dependent upon the cord below the upper dorsal region. This the writer has ascertained by repeated clinical examinations of cases whose nature has been subsequently verified *post mortem*.

Prognosis.—The prognosis in a case of paraplegia must always involve a twofold problem: (1) as to the duration of paralysis, or the probability of recovery; (2) as to the danger to life.

(1) The chance of ultimate recovery from paralysis would vary inversely with the size or extent of the lesion existing after the first ten days or a fortnight—that is, by the time softening has been unmistakably established, and when the chance of such an event being warded off by the establishment of a collateral circulation no longer exists. But where a pretty complete reinstatement of blood-supply does take place, all symptoms of paralysis may gradually disappear in the course of some weeks, or, it may be, months.

(2) Danger to life is brought about in many ways, and a fatal result may be entailed (*a*) by a gradual extension upwards of the process of softening (especially where it exists in the lower cervical or upper dorsal

region) so as to involve paralysis of the diaphragm, or an extreme interference with the heart's action. (*b*) Inflammation of the bladder, followed by implication of other portions of the urinary tract, may lead on to death after the paralysis has lasted for some months, or perhaps not for a year or two. (*c*) About the same period (sometimes early and sometimes late) extensive bed-sores may form, and the patient may, after a time, die exhausted, or from blood-poisoning. (*d*) Again the supervention of an intercurrent pneumonia may lead on to a fatal result; or (*e*) the end may come from the extension inwards of the process of sloughing, so as to lead to the establishment of a rapidly fatal spinal meningitis. Still in some cases, as above indicated, the patient may remain paralysed for even two years or more before a fatal termination is brought about.

Treatment.—Our power to deal with the softened condition itself of the spinal cord is extremely small, whether it may have been caused by thrombosis or by compression. During the early stages probably the less that is done in the way of active interference the better. The principal indications are that the patient should have absolute rest in bed, and for the first few days at least a rather sparing diet; spoon-diet being desirable where distinct elevation of temperature exists. The secretions should be regulated, and the urine, if necessary, drawn off by a thoroughly clean catheter smeared with carbolised oil, and kept in the intervals in a bichloride of mercury solution. Sedatives, such as bromide of potassium, either alone or in combination with chloral, may be needed at night, for a time, so as to ensure an adequate amount of sleep.

Should the patient's general health be weak or deranged, as is so often the case, every effort must be made to improve it by means of an easily assimilable but generous diet, gradually increased, and by the exhibition of suitable tonics, with or without small doses of cod-liver oil. It is far better to trust to such general means than to the supposed influence of phosphorus, or any other drug. To expect any of them to have a direct influence in restoring softened nerve-tissue is vain; and any good that may be achieved by drugs alone is probably brought about either by their power of regulating some of the principal functions of the body, or by improving its nutritive processes generally.

Still scarcely any morbid condition exists in which more constant care and vigilance are needed than in the *paraplegic state*, in order to correct or ward off its numerous incidental troubles or complications.

One of the first points claiming attention in the early stages of a case of paraplegia is to take such measures as will stave off the occurrence of bed-sores as long as possible. These precautions are especially needful where the paraplegia is complete, and where loss of sensibility exists. The patient should at an early stage of the disease be placed upon a water-bed; and those forms are most suitable in which there is a canal through centre the for the passage downwards of the evacuations. The patient must be kept scrupulously clean and dry; and no folds of the bed-clothes must be permitted to press against the skin. If possible, the patient should not be allowed to lie habitually upon his back, but occasionally in a prone or lateral position. The skin over the sacrum especially must be carefully watched, and on the least sign of a patch of undue redness there, it should be rubbed once or twice a day with a mixture of equal parts of olive oil and spirits of wine. If it becomes actually abraded, it should be dressed with zinc ointment, smeared over a piece of soft lint.

For the first fortnight or more there may be complete retention of urine, which then requires to be drawn off night and morning by catheter. During this period the greatest care should be taken in regard to the cleanliness of the catheter employed. Carelessness in this respect will tend to bring on cystitis at an early date, with alkalinity of urine, and may thus quite prematurely aggravate the bladder-troubles. As soon as the bladder begins to empty itself again, in a reflex manner, at intervals throughout the day, the use of the catheter may be discontinued as long as the water which comes away continues to be clear and acid. During this period of incontinence it will be necessary to draw off the urine from time to time for the purposes of examination. As before stated, the bladder never completely empties itself. After this state of things has continued for some months, the urine is apt to become alkaline, ammoniacal, and more or less mixed with mucus. At this stage the bladder should again be emptied once or twice daily, and washed out each time with 6 to 8 oz. of quinine solution (2 grains to the ounce, with enough of diluted sulphuric acid to dissolve it); or with a 2 per cent. boric acid solution. This will prove the best means of warding off or of mitigating inflammation of the bladder; and thus perhaps of preventing its extension to the ureters and kidneys.

In regard to the bowels, purgatives will probably be required from the first, as without their use there will be no evacuation. Sometimes a simple enema will suffice. Scybalæ tend to accumulate in the large intestine, unless its contractility is aroused occasionally by a large injection, consisting of three pints of warm thin gruel, together with half an ounce of spirit of turpentine and an ounce of castor oil.

Where the disease has reached the chronic stage, and when death is not inevitable, the muscles should be faradised or galvanised hree times a week, whilst massage may be employed on alternate days, with a view to maintaining their nutrition as far as possible.

When in the final stages of paraplegia large and sloughing bed-sores have formed, they will require the most constant care and attention. Poultices may be at first needed till the sloughs have separated, and afterwards the wounds must be variously dressed according to their condition. An ointment composed of ten grains of carbolic acid to one ounce of vaselin may be employed; or more stimulating applications may be needed. Sometimes iodoform or the iodide of starch paste forms a suitable dressing.

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10. Infantile Paralysis.—*See* Paralysis, Infantile.

11. Acute Spinal Paralysis of Adults. Synon.: *Poliomyelitis Anterior Acuta*; Acute Inflammation of the Grey Anterior Horns; Acute Atrophic Spinal Paralysis; Fr. *Paralysie Spinale Atrophique Aiguë*; Ger. *Poliomyelitis Anterior Acuta*; *Acute Spinallähmung bei Erwachsenen.*

This is essentially the same disease as that known as infantile paralysis (*see* Paralysis, Infantile), though presenting certain differences from the fact of its occurring in adults. Its existence, however, was not distinctly recognised till about the year 1865, when illustrative cases were published almost simultaneously by Duchenne and Moritz Meyer. Now that observers have been on the look-out for it, it has proved to be one which is by no means uncommon, although it is very much rarer than the similar affection in infancy or early childhood. The disease is more difficult to recognise in adults, because in them other affections occur with which it is quite possible that it may be confounded.

Ætiology.—The ætiology of this affection in adults is just as obscure as it is in children. Sometimes it manifests itself without any assignable cause; whilst at other times there is the possibility that exposure to wet and cold, some shock or blow, or some antecedent acute febrile illness may have had to do with its origin. The causative conditions are, in fact, in part similar to those of multiple neuritis (*see* Neuritis, Multiple), and the two affections in different proportions sometimes co-exist. There exists, perhaps, in some persons a special vulnerability or instability of the motor ganglion cells of the grey matter of the spinal cord. To this view Bernheim inclines (*Rev. de Méd.*, Jan. 1893), in consequence of his having collected nineteen cases in which persons who have suffered from infantile paralysis have in adult age become affected either with acute, subacute, or chronic poliomyelitis—sometimes involving the same and sometimes different regions of the spinal cord.

Symptoms.—It will principally be necessary in this place to point out the manner in which the group of signs and symptoms characteristic of the disease in infancy becomes modified when it occurs in the adult.

The first set of differences is due to the minor irritability of the nervous system in the adult, as compared with that of the young child. The initial febrile symptoms may be so slight as to escape notice; convulsions have never been met with; and preliminary head-symptoms are generally absent or very slight. Still some headache, or mental dulness, may be present; and vomiting occurs not infrequently.

Paralysis then sets in speedily—it may be within a few hours—and is more or less widespread. The muscles are flaccid; reflex actions are abolished or greatly diminished. In the course of a few days, generally, improvement as regards motor power sets in, and very slowly progresses. It may go on continuously to complete recovery in the course of a few months; or, as often happens, such recovery is only partial. In the latter case certain muscles or groups of muscles remain paralysed, and in them a rapid atrophy occurs. When tested electrically, these muscles exhibit the 'reaction of degeneration.' The affected parts are cold, and sometimes more or less cyanotic. There is no impairment of sensibility; and no interference with the functions of the bladder or rectum.

All the characters mentioned in the last paragraph accord with those which present themselves in infantile paralysis, but later on differences again show themselves. One of the characteristic features in the child is arrest of growth in the parts affected, so that the limbs or parts of limbs paralysed remain more or less abortive. This, of course, cannot occur in the adult; and also, owing to the fact that the joints are stronger, the secondary deformities (often so serious in the child) are not met with to the same extent in adults.

Diagnosis.—The mode of onset of the disease; the fact that the paralysis is purely motor, associated with no pain or tenderness, and accompanied by no interference with sensibility; the fact that after the first few days at least the functions of the bladder and rectum are not interfered with; and also that in later stages there is atrophy of muscles, and the existence of the electrical 'reaction of degeneration'—these constitute a group of conditions which, taken as a whole, is thoroughly distinctive.

The disease with which it is most liable to be confounded is that hereafter to be described (*see* 13. Spinal Paralysis, Chronic Atrophic). The points of distinction will, therefore, be given under it. 'Progressive muscular atrophy,' if we bear in mind its very chronic onset, is much less liable to be confounded with the present disease, as also if we recollect that in it atrophy makes its appearance before paralysis rather than after, and that the electrical reactions are, except in the later stages of the disease, notably different.

The fact of the absence of spasms, the diminution of reflexes, the non-interference with sensibility and with the sphincters, together with the abrupt origin of the disease, suffice to separate the acute spinal paralysis of adults from all other affections of the spinal cord, though not from all cases of multiple neuritis. As to this latter difficulty, the reader may refer to the section on Diagnosis in the article on NEURITIS, MULTIPLE.

PROGNOSIS.—This is not a disease dangerous to life. Complete recovery not infrequently takes place, and that too, as the writer has seen, where the paralysis may have been widespread, affecting all the limbs for a time, and leading to marked atrophy in the muscles of the lower extremities. In other cases there is left in particular parts a chronic remainder of paralysis with atrophy, just as we find to be the case in children. In so far as any part of the patient's symptoms are due to some co-existing peripheral neuritis, we are generally entitled to make a more hopeful forecast.

TREATMENT.—This disease must be dealt with on precisely the same principles as those which are applicable to the corresponding affection in young children. Repetition is, therefore, here unnecessary. *See* PARALYSIS, INFANTILE.

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12. Acute Ascending Paralysis.

—SYNON.: *Paralysis Ascendens Acuta*; Landry's Paralysis; Fr. *Paralysie Ascendante Aiguë*; Ger. *Paralysis Ascendens Acuta*.

DEFINITION. — A mysterious affection of the spinal cord, first definitely described by Landry in 1859; characterised on its clinical side by the existence of a progressive paralysis, advancing rapidly from below upwards, so as finally to implicate parts dependent for their innervation upon the medulla oblongata; characterised also on its anatomical side by the absence of any appreciable pathological change.

On account of the latter peculiarity, the disease ought not to be described in the present place, but rather to constitute the first of Class II. (*see* p. 814). But this disease, together with 'acute spinal paralysis' and 'subacute spinal paralysis,' have such an amount of similarity from a clinical point of view, that it seems very desirable for their descriptions to follow one another, so that mutual alliances as well as differences may be the more distinctly appreciated.

ÆTIOLOGY AND PATHOLOGY.—The causes and pathogenesis of this affection are even more obscure than those of the disease last referred to. Exposure to cold, and emotional disturbances (with or without suppression of menstruation in the female) have been observed occasionally as precursors. Occasionally, too, this disease has supervened during convalescence from some previous acute febrile malady, such as small-pox or typhoid fever. Syphilis is thought by a few (but on no sufficient evidence) to have something to do with the pathogenesis of this affection. Westphal, again, who pointed out that the spleen became enlarged in this affection, inclined to believe in the existence of some toxic influence—a view in support of which there is more in the way of evidence. The disease seems principally to occur in persons between the ages of twenty and forty, and to be decidedly more frequent in males than in females. Although the brain and spinal cord of those who have died from this affection have now been frequently examined by skilled observers, the results have hitherto been almost entirely negative, so far as morbid anatomy is concerned. No definite changes have, moreover, been met with in the peripheral nerves with any constancy, though the predisposing influences and the symptoms are such as to have created a strong suspicion that the affection might be due to a multiple neuritis. Further evidence is, however, needed before definite conclusions can be arrived at as to the exact nature of this very puzzling malady.

SYMPTOMS, COURSE, AND TERMINATIONS.—About the prodromata there is nothing distinctive—they may be absent. When present there may, for a few days, or even for a few weeks, be a slight febrile condition from time to time, with a sense of weariness, and more or less numbness in the limbs, especially in the tips of the fingers and in the feet.

The disease then more definitely declares itself, and follows a very variable course as regards rapidity of evolution; sometimes causing a generalised paralysis which may prove fatal on the second or third day, and at other times lasting as many weeks before death occurs, or recovery sets in. The disease commences by a marked weakness of the lower extremities; soon to be followed by actual paralysis, which, as in the 'subacute and chronic spinal paralysis,' shows itself first in the distal portions of the limbs, and gradually approaches the trunk, so that in the course of two or three days, or even much less time, the paralysis of the lower extremities becomes complete.

The trunk muscles are next, and soon, implicated in a similar manner. The patient can no longer sit up or turn in bed. Respiration becomes more and more affected, and defæcation is interfered with, through weakening of the abdominal muscles.

Next, though sometimes after a distinct interval, the upper extremities become implicated; though here again the paralysis first involves the distal portions of the extremities, and thence gradually spreads (after a period in which mere paresis exists), till the whole limbs become completely powerless.

The paralysed limbs, both upper and lower, are lax, and show no trace of contraction. Though the muscles are flaccid, they *do not undergo* a *marked* amount of *atrophy*, as is the case in 'acute spinal paralysis.'

In accordance with this latter peculiarity, there is the further striking characteristic that the *electrical reactions of nerves and muscles continue perfectly normal.* This seems now to be a well-attested fact, and it has been verified by good observers even after complete paralysis (without atrophy) has existed, in the more chronic cases, for several weeks.

Sensibility is scarcely, if at all affected; nor, as a rule, are pains complained of in the paralysed parts.

The reflexes, both superficial and deep, are generally abolished, though in the more chronic cases they may reappear after a time.

The nutrition of the skin is not impaired, so that there is no tendency to the formation of bed-sores. Coldness and cyanosis of the limbs do not seem to be characteristics of this affection.

The sphincters are usually not at all affected. Constipation is often marked, and defæcation may be rendered difficult owing to paralysis of the abdominal muscles.

As a rule, there is no febrile elevation of temperature, though to a slight extent this has been present in some cases.

At the stage above indicated, in nearly one-third of the recorded cases, or it may be even before the arms have become much implicated, the disease becomes arrested, and after a brief interval recovery of power begins to manifest itself—usually in a reverse order, so that power is regained first over the arms, then over the trunk, and subsequently (and perhaps only in the course of several weeks) over the lower extremities.

But in the remaining two-thirds of the cases, after the arms have become paralysed, the disease still progresses so as to affect the cervical muscles, the diaphragm, and finally the muscles innervated by the motor nerves of the medulla. Thus, in its later phases the disease is characterised by a greatly increasing difficulty in respiration; great weakness of voice; extreme rapidity of pulse; and possibly by inequality of the pupils. Finally, increasing paralysis of the muscles concerned with articulation and deglutition sets in; and, owing to the augmenting difficulties of respiration, death may arrive at any moment by asphyxia. This climax of the disease may be reached in the course even of three or four days; on the other hand, it may not be reached until as many weeks have elapsed. Whenever the disease has advanced so far as seriously to implicate the medulla, recoveries are comparatively rare.

In quite exceptional cases the disease may pursue a reverse order throughout; implicating the nerves of the medulla first, then those of the cervical region of the cord, and so on. The celebrated Cuvier is said to have died from the disease progressing in this very unusual manner.

Diagnosis.—So far as the established disease is concerned, we have in this affection, in 'acute spinal paralysis of adults,' and in subacute forms of 'chronic spinal paralysis,' maladies that present certain well-marked points of similarity. In each we have to do with simple motor paralysis, with no fever, no tenderness or pains in the spine, no pains in the limbs or contractions, and with no incontinence of urine or fæces, or tendency to the occurrence of bed-sores.

'Acute ascending paralysis' differs from both these affections, however, in the important fact that rapid atrophy does not set in in the paralysed muscles, and that the electrical reactions in no way differ from those met with in healthy nerves and muscles. In the very acute cases, of a few days' duration only, these distinctions would be worthless, as sufficient time would not have elapsed to make it possible for either of them to occur. In such rapid cases, therefore, the distinctly *progressive* character of the disease is that which will serve to distinguish it from the more severe cases of 'acute spinal paralysis,' in which the paralysis sets in simultaneously throughout the whole of the parts affected (the area of the paralysis subsequently tending to diminish), and often with a pretty distinct initial febrile disturbance. Then, again, there is the fact that this latter disease has no tendency to involve the medulla, and is only very rarely fatal.

It is in the diagnosis of the more slowly evolved forms of 'acute ascending paralysis.' from the similarly progressive cases of 'chronic spinal paralysis,' that the development of rapid atrophy of the muscles, together with the 'reaction of degeneration,' comes to be distinctive of the latter affection. Again, in 'acute ascending paralysis' there is a longer persistence of reflex actions; and a far greater tendency to the manifestation of symptoms showing that the medulla oblongata is involved.

Prognosis.—Nothing can be added concerning prognosis beyond what has been above indicated in speaking of the course and terminations of the disease. It seems the rule that, the more rapid the progress of the disease, and the earlier the medulla is affected, the more is a fatal termination to be feared. Still, even in the most acute cases, improvement *may* take place.

TREATMENT.—The absence of any known pathological substratum for this disease makes it extremely difficult to lay down any directions for treatment. It would appear that we have to do with a simple alteration of the molecular condition of some parts of the spinal motor nerve-centres, unaccompanied by any known inflammation or irregularity of vascular supply.

Under these circumstances, the patient should be put upon a nutritious but easily assimilable diet, with a fair amount of stimulants; and, further, we may endeavour to induce a change in the nutritive and functional activity of the spinal cord, by having recourse to frictions of the skin or gentle shampooing of the limbs, together with brief daily applications of weak faradic currents to many of the affected muscles.

From drugs, perhaps the best chance of beneficial results may be looked for from combinations of iron and arsenic, or from the cautious use of small doses of strychnine. Iodide of potassium would probably be useless. H. CHARLTON BASTIAN.

13. Spinal Paralysis, Chronic Atrophic.—SYNON.: Subacute and Chronic Inflammation of the Grey Anterior Horns; *Poliomyelitis Anterior Subacuta et Chronica*; Fr. *Paralysie Générale Spinale Antérieure Subaiguë*; Ger. *Subacute Spinallähmung Erwachsener*; *Subacute Spinalparalysie*.

NATURE, ÆTIOLOGY, AND PATHOLOGY.—This disease was described by Duchenne in 1853, and then again more completely in 1872, as a more or less rapidly advancing motor paralysis, associated with atrophy of the muscles affected, and loss of their faradic excitability.

He believed the disease to be dependent upon a chronic degeneration occurring in the grey anterior horns, and this view is supported by the examinations which have as yet been made of persons who have been the subjects of this affection. The pathological changes in the anterior horns have been associated with atrophy of the anterior nerve-roots.

The causes of the malady are at present almost wholly unknown; but it occurs principally in individuals between the ages of thirty and fifty years. As with other chronic spinal affections, so here, there has often been one or other of the following events occurring some little time before the onset of the disease: Exposure to cold and damp, some shock or concussion, venereal excesses, or great fatigue induced by other causes. But what share the pre-existence of one or other of these conditions may have had in initiating the disease cannot at present be defined.

SYMPTOMS.—In the subacute cases, paralysis may become developed (usually in the lower extremities first) in the course of a few days or weeks; at the same time there may be some very slight initial febrile disturbance, and possibly some shooting pains in the back and limbs.

In the more chronic cases, the latter symptoms may be absent, and the onset of paralysis is very much slower. There may be at first mere paresis, felt most in the ankles and knees; but gradually (often after many months) this deepens into distinct paralysis of certain groups of muscles, or of the entire limbs. The muscles are flabby and progressively waste; at the same time they cease to respond well or even at all to the faradic current, and become more sensitive to the voltaic. There may also be notable fibrillar twitchings in the muscles undergoing this atrophic process.

Sensibility is unaffected. Skin and tendon reflexes are abolished. The temperature of the affected limbs is lowered; and the feet especially are apt to be more or less cold and cyanotic.

Soon the arms become affected in a similar manner, and here the paralysis may first affect either the extensors or the flexors. It may remain more or less limited to certain groups of muscles, or may gradually extend so as to implicate the whole limb. The distal parts are usually, however, more completely involved than the proximal. In the arms the same kind of phenomena occur as in the lower extremities, and there is a similar absence of rigidities or contractures.

There is no tendency to the formation of bed-sores, and the nutrition of the skin seems to be unimpaired.

The rectum, the bladder, and the sexual organs are usually quite unaffected.

After a time, the excessive reaction of the wasted muscles to the galvanic current decidedly diminishes; though in the earlier stages of this affection the electrical 'reaction of degeneration' often exists with all its characteristic details.

DIAGNOSIS.—This malady bears a closer resemblance to the 'acute spinal paralysis' of adults than to any other affection. The two diseases are naturally distinct in their modes of initiation, but as established diseases (that is, in their later phases) they would be very difficult to discriminate from one another in the absence of definite information as to modes of onset—and such information is often not to be obtained. It is the abrupt commencement of the paralysis over a wide area of the body that is met with in, and which is so distinctive of, 'acute spinal paralysis'; whilst in the subacute forms, and more especially in 'chronic atrophic spinal paralysis,' we have to do with a distinctly progressive spread of the disease from part to part.

In regard to the discrimination of these subacute and chronic forms of spinal paralysis from some other varieties of spinal cord disease, the reader may refer to what has been said concerning the grounds on which the diagnosis of 'acute spinal paralysis' is to be made. *See* 11. Acute Spinal Paralysis of Adults.

In the so-called 'amyotrophic lateral sclerosis' the upper extremities may be paralysed, wasted, and flaccid, as they are in 'chronic spinal paralysis'; but then in the former disease there may be the different combination of paralysis without wasting, but with more or less rigidity in the lower extremities.

For the distinguishing characters of 'acute ascending paralysis,' *see* the account of that affection, in the preceding article (No. 12).

PROGNOSIS, COURSE, AND TERMINATIONS.—In the subacute cases, after a month or two, improvement may gradually begin to manifest itself; and in exceptional instances this may go on slowly, but steadily, to complete recovery. In other of these cases, however, certain muscles or groups of muscles do not undergo the same improvement as the others; they may continue paralysed, and become more and more atrophied.

In the more chronic cases, recovery is scarcely to be looked for; though, after the symptoms have developed to a certain extent, it occasionally happens that no further advance is made. Such patients may remain in much the same condition for years.

In another class of cases the malady proves more continuously progressive, so that, after implicating the upper and lower extremities severely, the morbid process may extend to the upper cervical region of the cord, so as greatly to interfere with respiration; or it may even extend to the medulla, so as to involve the tongue and pharyngeal muscles, and more or less interfere with the functions of articulation and deglutition. In such cases death is liable to occur through asphyxia or slowly progressing exhaustion.

In the majority of cases of this disease, more or less complete recovery occurs, though it may be only after two to four years.

TREATMENT.—Possibly counter-irritation to the spine in the early stages by means of liniment of iodine may do good, and should certainly be tried, where the patient comes under treatment at this period. A nutritious and easily digestible diet, tonics (such as a combination of iron, strychnine, and arsenic), and rest are essential in the early stages, together with a thorough supervision of the general health. Later on, massage and electrical treatment by the voltaic current must be had recourse to, and must be perseveringly continued for long periods, until the muscles again begin to respond to the faradic current. The electrical treatment with massage is what is principally to be relied upon; and except in the subacute cases it may be commenced almost from the first, should the patient happen to come under observation during the early stage of the malady. Sulphur- or brine-baths seem also at times to do much good.

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14. Progressive Muscular Atrophy.

See PROGRESSIVE MUSCULAR ATROPHY.

15. Locomotor Ataxy.—*See* TABES DORSALIS.

16. Spinal Paralysis, Spasmodic.—SYNON.: *Paralysis Spinalis Spastica*; Primary Sclerosis of the Lateral Columns; Idiopathic or Primary Lateral Sclerosis; Fr. *Tabes Dorsal Spasmodique* (Charcot); Ger. *Spastische Spinalparalyse*; *Primäre Sklerose der Seitenstränge des Rückenmarks*; *Primäre Lateralsklerose des Rückenmarks.*

This is one of the most recently recognised of the diseases of the spinal cord. It was described first by Erb in 1875, and within a few months of the same time in a thorough and independent manner by Charcot. Although these observers indicated with precision the probable pathology of the disease, they were not able to verify their anticipations by the examination of any patient who had died from (or whilst suffering from) this complaint. This last step was accomplished in this country by Dr. Dreschfeld.

But even before the disease was distinctly described, its probable existence and principal features were in part anticipated by Türck and by Charcot—both of them being guided more especially by the clinical effects associated with 'secondary degenerations' in the lateral columns of the cord, as they occur in conjunction with hemiplegia.

ÆTIOLOGY.—The disease is distinctly more common in males than in females. It occurs in the majority of cases in adults from twenty to fifty years of age. Erb and others have also described spasmodic forms of paralysis occurring in children, as a result of double cerebral disease, which have several clinical features in common with this affection. The writer has met with the ordinary form of the affection once in a child of about ten years of age, but then the lateral sclerosis seemed only to form a prominent part of what was really a 'multiple sclerosis' of cerebro-spinal type.

In some cases the disease appears independently of any appreciable predisposing or exciting causes; but, in other instances, falls or other traumatic influences, or great fatigue after some very prolonged walk, seem to be connected with its origin. On rare occasions exposure to wet and cold has appeared to have had some influence over the genesis of this, as well as over that of so many other forms of spinal disease.

ANATOMICAL CHARACTERS.—In the first undoubted case which was [illegible] *post mortem*, namely, that of Dr. Morgan, where the spinal cord was examined by Dr. Dreschfeld (*Brit. Med. Journ.*, Jan. 29, 1881, p. 152), the following pathological conditions were observed: 'The cord, when examined in the fresh state, showed to the naked eye no abnormality, except softening in the lowest dorsal region. After hardening in bichromate of ammonium, sections of the cord showed already to the naked eye one light-coloured patch in each lateral column'—and this throughout the cervical, the dorsal, and the lumbar regions of the cord. This band of morbid tissue, presenting all the typical characters of a sclerosis, occupied the greater portion of the lateral columns, but without implicating the grey matter or extending quite to the surface of the cord. The anterior and the posterior columns were perfectly healthy. The microscopical characters of primary sclerosis in the spinal cord are briefly described in the article on 'multiple sclerosis.' *See* 18. Multiple Sclerosis.

The occurrence of the slight softening in this case was an accidental complication, otherwise the lesions actually found agreed very perfectly with Charcot's scientific predictions as to the probable pathological changes peculiar to this affection of the spinal cord. Similar changes have subsequently been encountered in other cases.

Symptoms.—This disease often sets in almost imperceptibly, and the symptoms continue to develop in a very slow and gradual manner.

Patients begin to complain first of mere weakness of the lower extremities, and this continues to increase till a well-marked condition of paresis exists. There is great difficulty in getting upstairs, and the feet begin to drag even when the patient walks on level ground. This paresis may soon be associated with more or less of muscular twitchings, often more marked in the morning, but sometimes more especially at night, and of a painful character. Later, an actual stiffness of the muscles of the legs begins to manifest itself, which becomes apparent principally when passive movements are attempted, or even when the patient seeks himself to move the limbs. At last some amount of rigidity of muscles may be more or less continuously present, so as greatly to interfere with locomotion, or in some cases even to prevent it altogether.

In the early stages of the disease, ankle-clonus can be elicited with the greatest ease, and the knee-jerk is found to be distinctly exaggerated on both sides. When one of these patients is in the sitting posture, commencing pressure on the toes of one foot, as in the act of rising, will often at once initiate the characteristic tremors of ankle-clonus. All such signs, however, will probably diminish as the rigidity becomes more marked.

Whilst the patient is able to walk he often exhibits a typical 'spastic gait.' The legs are generally kept close together, owing to a spasmodic contraction of the adductors of the thighs; the toes are dragged along the ground; and then, when the heel is beginning to be brought down, in some rare cases a spasmodic contraction of the calf-muscles may take place, tending to raise the patient upon his toes and almost throw him forward. In this way a mixed and very irregular kind of walking is necessitated, partly to be accounted for by mere powerlessness, and partly by the occurrence of strong muscular spasms. In some instances, either owing to variations in the amount of the spasms, or, it may be, to the great weight of the patient, this spastic walk is not well-marked. In all cases, however, it is quite different from the ataxic gait; and when standing with feet close together, no increase of unsteadiness or feeling of vertigo is occasioned when the patient closes his eyes.

Sensibility is little, if at all, affected; still, in some instances it is apt to be slightly impaired. In one case, not long since under the writer's care, ability to recognise differences of temperature was for a time greatly lessened; and although tactile sensibility is scarcely at all interfered with, the patient has frequently complained of a diminished power in appreciating the exact positions of his legs. Skin-reflexes are often normal, but occasionally they may be slightly increased.

The muscles do not atrophy, and their electrical reactions continue to be almost normal; whilst, according to Erb, that of the nerves is slightly but distinctly lowered to both currents. Sexual desires are not affected, but sexual disability may be occasioned to a variable extent—partly owing to weakness or actual paralysis, and partly to mere spasms of muscles. Micturition is often scarcely at all interfered with; there is nothing like incontinence of urine or of fæces, though there may be an obstinate amount of constipation.

No vaso-motor or trophic disturbances in the limbs are usually present.

As the disease progresses (it may be very slowly, and in the course of years) the muscles of the trunk become affected, so that weakness and spasms, often of a very painful character, occur in the abdominal and dorsal muscles. After a time the arms also may become implicated, and in the same fashion as the legs, excepting that when permanent contractions of the muscles come on, they mostly fix the arm to the side, whilst the forearm is pronated and half-flexed, and the fingers and wrist are strongly flexed.

In rare cases the disease is limited to one side of the body, beginning, for instance, first in one leg, and then extending to the arm on the same side, so as to present a kind of hemiplegic distribution. Just as rarely, too, the disease may first affect the two upper extremities, and then extend down the trunk, so as ultimately to involve the lower extremities.

During the development of the disease, shivering fits, affecting the muscles of the jaws as well as almost all the muscles of the body, may occur from time to time, lasting for half an hour or more; and though quite unaccompanied by any changes of temperature, they may, nevertheless, be provoked by cold. Sometimes, however, such attacks occur spontaneously; or they may spread from some accidentally initiated ankle-clonus, or other well-marked spasm.

Persons suffering from this malady often remain in an almost stationary condition for a series of years, at any particular stage of the disease that may happen to have been attained. Ultimately, however, there is a tendency to complete paralysis of the parts affected, with permanent contractures—the legs at this stage being often immovably fixed in a condition of rigid extension, though they are sometimes flexed at hips and knees. As a rule, pains are not complained of at any stage of the disease, though some patients suffer much from painful cramp-like contractions, occurring either in the lower extremities, or else in some of the abdominal muscles.

Complications.—So long as the morbid process remains limited to the lateral columns, no other symptoms present themselves. Should it, however, invade the grey matter in particular regions of the cord, then characteristic complications are apt to arise, and it may also be said that the gravity of the disease becomes very distinctly increased. The way for a fatal termination may then be paved through the gradual increase, for instance, of bladder-troubles; or through the occurrence of severe bed-sores, and collateral events to which they may give rise.

Another possible extension of the sclerosis is to the posterior columns, so that we may get a variable mixture of the symptoms pertaining to 'spasmodic spinal paralysis,' and to 'locomotor ataxy.' It should be borne in mind, however, that such a complicated clinical grouping sometimes develops in the reverse order.

Usually in patients suffering from this disease, there is no association with cerebral symptoms, nor is there any tendency to the springing up of cerebral complications. Still, in one case under the writer's care a subacute maniacal condition became developed; whilst in another case diabetes mellitus to a slight but tractable extent has manifested itself. In both instances, however, there happens to have been a marked hereditary predisposition to the occurrence of insanity and of diabetes mellitus respectively.

Diagnosis.—The grouping of symptoms met with in this disease is so characteristic, that there ought in most cases to be no difficulty in recognising it. In no other organic affection of the spinal cord have we the combination of a gradually progressive paralysis beginning in the lower extremities, associated with muscular twitchings and rigidities; greatly exalted tendon-reflexes; no impairment of sensibility and no pains; no wasting of muscles or other trophic changes; and no interference with the functions of the bladder and rectum.

It happens, however, that certain functional diseases of the spinal cord, occurring principally in young women, may present nearly all these characters, and may for a time be excessively difficult of diagnosis from early stages of lateral sclerosis. In other of these functional cases there is an altogether unusual amount of sensory impairment of one or other kind occurring as additional symptoms, and in these the diagnosis is more easy. *See* 30. Functional Paralysis of Spinal Type.

Another difficulty arises in the recognition of the complex forms of the disease, or of combinations of this disease with others, then coming under observation for the first time. This, for instance, is the case where we have to do with a combination of posterior and lateral sclerosis, in which, in order to arrive at a diagnosis of the existing condition, the observer must be able to recognise the respective effects or modifications that may result from the combination of the two diseases. A further difficulty of the same kind arises when the symptoms of the disease are complicated by extension of the sclerosis to the grey anterior horns. Symptoms will then present themselves more or less resembling those which are described under the head of 17. Sclerosis, Amyotrophic Lateral.

Again, when 'multiple sclerosis' affects in the main the lateral columns, the real diagnosis can only be arrived at by the recognition of symptoms which could not be produced by a mere affection of the lateral columns. Thus the writer has recently had under his care a little girl, ten years of age, first brought to him on account of head-symptoms, which suggested the possibility of intracranial tumour, but in whom, after a few months, signs of lateral sclerosis have become developed in a very typical manner. She presented the most characteristic spastic gait, being frequently raised quite upon the points of her toes as she walked. There was also great exaggeration of the tendon reflexes, and no impairment of sensibility. The case seemed clearly one of 'multiple' or 'cerebro-spinal sclerosis.'

Prognosis.—So long as the disease process remains limited to the lateral columns, as it does in the great majority of cases, 'spasmodic spinal paralysis' carries with it no danger to life. Such patients may survive for an indefinite time, even though for years after permanent contractures have become established they may have been absolutely confined to bed. Still Erb speaks of two cures, and of decided improvement in some other cases, and is inclined to think that this affection may prove a little more amenable to treatment than some of its congeners.

Treatment.—In the treatment of 'spasmodic spinal paralysis,' as in that of locomotor ataxy, we must use such means as are most likely to be of avail in checking the process of sclerosis in the columns of the cord which is the cause of the symptoms. The general health of the patient, and the regulation of his mode of life, must receive our most careful attention. Sound sleep must also be ensured, as far as possible.

Nitrate of silver has been praised by some; but the writer believes that, on the whole, more good is to be obtained from iodide of potassium in eight- or ten-grain doses, either with or without liquor arsenicalis. Small doses of cod-liver oil, either alone or in combination with maltine, also seem to do good. There is no particular indication for electrical treatment in this disease; but stimulation of the skin and subjacent parts, by frictions and massage, may be of service in the early stages, and so also may hot brine or sulphur baths. There are mostly no pains to be allayed; but occasionally painful cramp-like contractions of the muscles cause much distress to patients suffering from this disease. These pains are difficult to relieve, though good may be done, in some cases, by the extract of Calabar bean in increasing doses. For the rest, any accidental accompaniments of the malady must be treated upon the general principles applicable to the management of other spinal affections.

H. Charlton Bastian.

17. Sclerosis, Amyotrophic Lateral.

Synon.: Fr. *Sclérose Latérale Amyotrophique.*

This is a combination of symptoms first described by Charcot as a separate disease. Clinically, there is an admixture of the signs of progressive muscular atrophy with those of lateral sclerosis, whilst towards the close there is often the addition of a glosso-laryngeal paralysis. The affection is undoubtedly a rare one, and, after having stated the course of the disease as described by Charcot, we may consider how far this combination of symptoms is entitled to an independent place in our nosology.

Pathology, and Anatomical Characters. The peculiarity of this form of lateral sclerosis is said to lie principally in the fact that it commences in the cervical region, and soon spreads to the contiguous anterior horns of grey matter; thence, after more or less of an interval, it extends in two directions: (*a*) downwards, so as to involve the dorsal and lumbar lateral columns, and also the contiguous anterior cornua of grey matter; and (*b*) upwards, so as to implicate the upper cervical region of the cord and the medulla oblongata in a similar fashion.

Thus it will be seen that three peculiarities are asserted concerning this form of lateral sclerosis: (1) that it begins in the cervical region of the cord, and subsequently affects the dorsal and lumbar portions; (2) that it does not remain limited to the lateral columns, but soon spreads to the contiguous anterior cornua, where it leads to destruction of the great motor ganglion-cells; and (3) that it almost invariably extends upwards also, so as to involve the medulla oblongata, and thus to gradually bring about the death of the patient.

Symptoms, Course, and Terminations.—Being marked by the anatomical characters above described, it will be easily understood that patients suffering from this disease present an admixture of such signs and symptoms as may be met with separately in 'lateral sclerosis,' in 'progressive muscular atrophy,' and in 'bulbar paralysis.' We are said to have, in fact, the following grouping and sequence of symptoms:—

(1) Paresis, gradually increasing to actual paralysis of the upper extremities, and soon associated with distinct muscular atrophy and fibrillar twitchings. Any movements that can be executed are weak, and associated with tremors. More or less marked rigidity of muscles, and finally actual contractures occur, in which the arms are fixed close to the sides of the body; the forearms are semi-flexed and pronated, whilst the hands and fingers are strongly flexed.

(2) After an interval of some months, a similar group of symptoms becomes developed in the lower extremities. Again, we have paresis gradually increasing, with muscular tensions, exaggerated tendon-reflexes, and an increasing amount of rigidity of the lower limbs, which are usually fixed in the extended position. At a later period in the lower extremities, as compared with the arms, a process of muscular atrophy sets in, with development of the 'reaction of degeneration,' and fibrillar twitchings in the affected muscles.

During the whole of this time, there is little or no interference with sensibility. There is usually no implication of the sphincters, and no tendency to the formation of bed-sores.

(3) In the last stage of the disease, there is evidence of extension of the morbid process upwards to the upper cervical region and the medulla. Signs of bulbar paralysis present themselves in the usual way, by paralysis with atrophy of the tongue and lips, and by progressive weakening of the muscles of the palate, pharynx, and larynx. The phrenic nerve has also generally become involved,

and when weakness of the diaphragm is added to weakness or actual paralysis of the other muscles of respiration, this all-important function becomes more and more impaired, and thus a fatal termination may at any time be easily brought about. Increasing difficulty of articulation and deglutition may have existed for some months before death.

Many neurologists are now of opinion that no independent disease such as Charcot has described under this name of 'amyotrophic lateral sclerosis' exists. It is recognised by many to be only a mere variety of progressive muscular atrophy, and this view is in strict accordance with the writer's own experience. It must be admitted, in fact, that more or less of lateral sclerosis almost invariably co-exists in progressive muscular atrophy with the more distinctive degenerative changes in the ganglion cells of the anterior cornua; and in some cases it happens that the clinical signs of the former change are obvious, rather than much dwarfed or non-existent as they are in the large proportion of cases of progressive muscular atrophy. The writer is thoroughly in accord with Dr. Gowers when he says: 'It is probable that the pyramidal tracts are degenerated, if not constantly, at any rate in such a very large proportion of the cases of progressive muscular atrophy, that Charcot's distinction is in effect giving a new name to an old disease. Whether there are indications [clinical] of lateral sclerosis or not depends on the circumstance whether the degeneration of the pyramidal fibres is or is not more extensive than the complete degeneration of the nerve-cells that cause atonic atrophy. If the latter is universal, the pyramidal tracts may be totally degenerated, and yet there may be none of the characteristic indications of such degeneration. On the other hand, both arms and legs may be the seat of the spastic paralysis that indicates pyramidal degeneration, and atonic atrophy may be limited to a few muscles of the hands.'

The writer in his practice has found the atrophy of muscles either preceding or occurring simultaneously with the signs of spastic paralysis, and no regular division into stages such as has been described by Charcot. That bulbar symptoms occur in association with the other signs of progressive muscular atrophy is of course well known; and though their development may be often a late event, it is by no means always so.

The disease being, then, only a variety of progressive muscular atrophy in association with bulbar symptoms, nothing separate need be said concerning its DIAGNOSIS, PROGNOSIS, and TREATMENT, apart from what has been said concerning this disease. *See* PROGRESSIVE MUSCULAR ATROPHY.

H. CHARLTON BASTIAN.

18. **Multiple Sclerosis of the Spinal Cord.**—SYNON.: Disseminated Sclerosis; Insular Sclerosis; Multilocular Sclerosis; Fr. *Sclérose en Plaques Disséminées*; Ger. *Multiple Sklerose des Rückenmarks*.

NATURE AND ÆTIOLOGY.—Nothing approaching to an adequate recognition of the characters and importance of this disease was made anterior to the year 1866. Then, and in the two or three subsequent years, the malady may be said to have been identified and characterised by Vulpian and Charcot, but more especially by the latter and his pupils.

It is a disease produced by the development of patches of sclerosis of varying size and shape throughout the spinal cord, and most frequently also in different parts of the brain. Clinically the disease is met with under the most diverse forms, according to the different sites and sizes of the patches of sclerosis occurring in different cases. These different forms of the disease are divisible into three partially distinct types, according as the morbid changes and symptoms occur in and are referable: (1) to the spinal cord alone (*spinal type*); (2) to the cerebrum alone (*cerebral type*); or (3) to the brain and spinal cord (*cerebro-spinal type*). As the dominant symptoms of the disease are often those of the spinal type, even where there is also an extension of the morbid process to the cerebrum, it will be most convenient to speak here in the main of the 'cerebro-spinal' type. It is, moreover, both more frequent and a more characteristic malady than either of the simpler forms.

In regard to the ætiology of the disease little can be said. It may occur with or without the predisposing influence of a neurotic tendency. It is at least as common in females as it is in males; and though rarely occurring in children under ten years of age, it is perhaps most common between the ages of ten and thirty years. Beyond the age of forty it again becomes very rare.

Amongst the exciting causes, exposure to wet and cold would seem to take the first rank. After this come traumatic influences of various kinds, mental shocks or troubles, great fatigues from mental or bodily labour, and finally the state of convalescence from several acute diseases, such as typhus, cholera, variola, or other specific fevers. The disease has been said to occur sometimes as a sequence to severe and long-continued hysteria; but in some of such cases at least it would seem to be far more probable that the early and obscure symptoms connected with this affection were those which were regarded as hysterical. 'Hysteria' may be produced or simulated in many ways, but as itself a producer of organic changes its *rôle* is assuredly open to grave doubts.

ANATOMICAL CHARACTERS.—The patches of sclerosis which constitute the anatomical basis of this disease do not differ in their essential nature or in their appearance (macroscopic or microscopic) from the similar overgrowths of the neuroglia that occur in locomotor ataxy and in primary lateral sclerosis.

On the cut surface of the spinal cord, medulla, or other portion of brain, the foci of sclerosis mostly reveal themselves as greyish, greyish-red, or semi-gelatinous yellowish patches, differing principally by reason of slight contrasts in colour, from the dead white of the more healthy columns of the cord, and from the natural appearance of the grey matter. The tissue of the patches may either be level with, project slightly above, or sink slightly beneath, the general cut surface of the cord. The same differences also exist in regard to those patches which involve the external surface of the cord—they may at times, when the new tissue is excessive, rise slightly above the surface; whilst later on, when shrinking has occurred in the cirrhotic patch, some amount of superficial depression may be met with.

The patches vary much in size; in the spinal cord they range from a mere pin's head to that of a large pea, or of a bean; whilst in the cerebrum or in the cerebellum they may attain still larger dimensions. In the spinal cord the patches occur in all parts of its longitudinal extent, and they may occupy very variable portions of the transverse area of the cord. Some involve principally the lateral, others the anterior or the posterior columns of the cord; or portions of the grey matter, either alone or in conjunction with one or more of these columns, may be implicated for a variable extent, transversely and longitudinally. Patches of different sizes, and varying in their transverse extent, occupy different levels of the cord, and may thus occur in an irregular series throughout the organ.

These spinal foci of sclerosis, again, may be associated with patches of the same kind distributed through the medulla, pons, and cerebral peduncles, in part superficially and in part within their substance. Similar patches may be found in variable number, and quite irregularly distributed, through other parts of the cerebrum, as well as through the cerebellum.

In regard to the *microscopical characters* of these foci of sclerosis, certain differences are met with in different cases, principally dependent upon the age, or stage of formation, of the patches. Without going into minute details, it may be said that there is in all cases a hyperplasic overgrowth of the neuroglia which naturally exists around and between the nerve-elements. The nature of this change becomes quite distinct when properly prepared sections of the cord have been tinted. The new tissue takes the staining fluid freely, and when the circumference of a patch (especially some small one) is examined, it becomes obvious that numerous thickened processes of neuroglia connect it with the healthy tissue around. It is by the hypertrophy and gradual fusion of these circumferential prolongations that the morbid growth progressively encroaches upon the previously healthy portions of the cord. As this mere intermediate tissue grows, it presses upon and constricts the nerve-fibres and nerve-cells, so as to cause atrophy of the latter and a partial atrophy of the former. For there is reason to believe that the nerve-fibres do not wholly disappear; in these patches of primary sclerosis (as in the case of 'secondary degenerations') it is the white substance of Schwann which disappears, whilst the axis-cylinders, or a considerable number of them, persist. In the new tissue itself we find the usual granular or very finely fibrillar matrix, containing minute spherical or ovoidal plastides, also branched cells, and occasionally a few granulation-corpuscles. The latter are met with especially during the earlier stages of a patch of sclerosis; just as corpora amylacea or colloid bodies may be found in older patches. The walls of the capillaries as well as of arteries and veins are generally greatly thickened, and the vessels in a patch of this kind may be both numerous and large; in other cases, however, the number of vessels existing in the patch is by no means so conspicuous. It is well known that the adventitia or outer coat of the vessels in these patches is specially apt to become thickened, and that this sort of overgrowth may extend inwards, so as to cause fibroid degeneration of the middle coat and even of the intima. It is probable that proliferation also takes place from the inner surface of the intima (an endarteritis), and that occasionally, owing to this cause, a thrombosis may be brought about. Certain it is that the writer has on several occasions found the larger vessels of a patch of spinal sclerosis blocked by an old and firm thrombus.

PATHOGENESIS.—With reference to the starting-point of a patch of sclerosis nothing definite can be said. Not infrequently disseminated sclerosis may be met with in the absence of any cachexia, syphilitic or other; and, moreover, patches of sclerosis may occur in the nervous system only, or to no notable extent in other organs of the body. This, therefore, would indicate the existence of something, or of some process, of an abnormal kind taking place in the spinal cord and brain, and again not uniformly through them, but in foci situated here and there. It is no explanation, as some seem content to suppose, merely to say that the abnormal processes are 'chronic inflammations'; since, whether it is or is not advisable to speak of the changes by this name, we should still have to ask what is the cause of such local departures from healthy nutrition. Does the process begin in the connective-tissue elements themselves? or is there some primary change in the small vessels (possibly of the nature of endarteritis) leading to obstructions and a sequential overgrowth of the neuroglia? It would seem pretty certain, at all events, that the change in the nerve-elements proper follows the overgrowth of the neuroglia—as certain, indeed, as that throughout a band of 'secondary degeneration' the order of these changes is exactly reversed. There fatty degeneration and atrophy of the nerve-fibres are the first events, and these are followed by hyperplasia of the neuroglia. *See* SPINAL CORD, Diseases of: § 5, (13).

One of the most interesting facts, in connexion with these patches of primary sclerosis, is to be found in the circumstance that they themselves rarely lead to bands of descending 'secondary degeneration' in the anterior or lateral columns, or of ascending degeneration in the posterior or lateral columns. The fact itself has been long observed, and always regarded as rather surprising. The writer believes it to be explicable by the fact previously mentioned, that the bulk of the axis-fibres remain, so that the nerve-fibres below the seat of lesion (or above in the case of the posterior and parts of the lateral columns) are not absolutely cut off from the nerve-cells which exercise a 'trophic' influence over them. Some nerve-tremors may still pass along the damaged fibres in the sclerotic patch,[1] and thus the nerves in the parts beyond do not degenerate, as they would do if the fibres had been absolutely cut across. Some fibres may be completely strangled and then absorbed, and in such a case the continuations of these nerve-fibres would degenerate. In the final stages of a sclerotic patch this kind of sequence is apt to occur; so that towards the end there may be the tendency to the occurrence of some amount of secondary degeneration, even though the degenerated fibres may not constitute a very compact band.

SYMPTOMS.—It can easily be understood, from what has already been said, how much the symptomatology of this disease is liable to vary in different cases, according to the varying situation, extent, and order of evolution of the morbid patches. That it is possible to assign anything like a definite symptomatology for this affection, is due to the fact that there are certain seats of election in which the patches of sclerosis are specially apt to occur. The sites affected with special frequency are the lateral columns of the cord, the medulla, and the pons; and it is with the occurrence of patches of sclerosis in these situations that we have the following set of correlated symptoms pertaining to the 'cerebro-spinal' type of the disease.

A slowly ensuing paresis of the lower extremities begins first in one limb, and then after a time involves the other. During this time the paresis develops into a more and more marked paralysis, though the sensibility of the limbs remains almost completely unaffected—nothing more than a temporary numbness being complained of in the majority of cases, whilst lightning-like pains and girdle-sensations are altogether absent. After an interval, first one and then another upper extremity may become weak and subsequently more or less paralysed. During these early stages of the disease more or less distinct remissions of symptoms may occur from time to time.

Meanwhile a most typical sign soon shows itself in the paretic or semi-paralysed limbs, in the form of a marked trembling or shaking of those muscles or parts of a limb which are called into voluntary action with any intensity, although these phenomena immediately subside when the voluntary exertion ceases. The involuntary movements consist either of extremely well-marked tremors, like those met with in some cases of paralysis agitans, or else of movements of greater range, more resembling those of chorea.

Later some paresis of the trunk-muscles may occur, as well as of those of the neck; and this may be followed by a similar affection of the tongue, lips, and facial muscles—possibly, also, of those of the palate, pharynx, and larynx. When a patient affected in this manner, who has been previously lying perfectly still in bed, is told to endeavour to sit up, shakings and tremors begin in almost all parts of the body, and the scene is strangely changed until all voluntary efforts cease, and the recumbent position is again assumed. The same kind of thing is seen when movements of particular parts of the body are attempted: thus when, in the sitting posture, the patient attempts to hold up one leg, tremors of it immediately begin; ask him to take hold of something or to squeeze a dynamometer, and the upper extremity called into action at once begins to shake; request him to put out his tongue, and immediately irregular protrusions of the organ occur, associated with twitchings about the angles of the mouth and even in other parts of the body. The act of walking may cause, in more or less advanced cases, tremors of the legs, arms, trunk, head, and neck—all at the same time.

Movements of slight intensity occasion either no shakings or merely tremors of a very fine kind. The latter are seen in the early stages of the disease when writing is attempted. Almost each letter registers a number of fine tremors, mixed here and there with greater irregularities. In more advanced cases, however, the movements are so disorderly that writing becomes either impossible or wholly illegible.

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[1] In support of this, there is the fact mentioned by Charcot, that an optic nerve which was affected through its whole thickness by sclerosis was yet capable of performing its functions.

Just as there is no loss of ordinary sensibility, so we find that patients often remain fully conscious as to the positions and movements of their limbs, and that closure of the eyes causes no increased uncertainty of their movements unless the posterior columns be distinctly affected; and, except under these latter conditions, when in the standing position, they are not rendered more giddy or more unsteady by closure of the eyes.

Up to this stage there may be no distinct interference with the functions of the bladder or the rectum. The tendon-reflexes are, however, generally distinctly exaggerated: ankle-clonus may be obtained with readiness, and the knee-jerk is often more pronounced than usual. There is no tendency to the formation of bed-sores; no wasting of muscles; nor is any alteration in their electrical excitability met with.

After variable and often long periods, the affected lower extremities, which have become more and more paralysed, may in some cases show signs of commencing bar-like rigidity. The limbs, as the patient lies in bed, are closely drawn together, and in a condition of rigid extension, which is generally increased when any attempts to move them are made. At first this condition of the limbs ensues from time to time, in the form of paroxysms lasting for an hour or two. But, later, the attacks become both more frequent and longer, so that ultimately the condition of rigidity becomes permanent. Contractions of the arms are less common, and when they occur they become fixed at times in a different position from that met with in simple lateral sclerosis (*see* 16. Spasmodic Spinal Paralysis); that is, like the lower extremities, in a condition of extension, and closely drawn to the sides of the body. At this period ankle-clonus can often be elicited with the greatest ease, and the movements set up in the one leg may extend to the opposite lower extremity, and may indeed lead to more or less of general tremor throughout the body. Exposure to cold, or irritation of the skin in various ways, will also often suffice to initiate this general tremor, which, as Brown-Séquard showed, may commonly be caused to cease instantly by a forcible flexion of one of the great toes. With the cessation of the tremors consequent upon this manœuvre, the limbs may also be left for a time in a supple and flaccid condition.

The manifestation of tremors of the tongue, lips, and face is of course a sign that the bulb is affected; and when this occurs, simultaneously or very soon after, other evidences of implication of the bulb and of contiguous portions of the cerebrum may be met with. Articulation may become more or less affected, the speech being rendered slow, hesitating, and measured, syllable by syllable; or it may be jerky in character—becoming especially thick and blurred in the later stages of the disease. The power of swallowing is less frequently impaired, but in advanced stages it is apt to be affected.

Nystagmus is almost invariably met with. Diplopia, or actual paralysis of the ocular muscles, is rare. Amblyopia not infrequently exists; perhaps in one eye only. Actual blindness is very rare.

Vertigo, sometimes to a marked extent, is no uncommon symptom; and as the cerebrum becomes more and more affected, a condition of well-marked hebetude, or actual dementia, gradually becomes pronounced. This betrays itself externally by a blank, expressionless aspect of the face; the patient becomes childish in manner, his memory fails, and he takes interest only in trifles; he may also laugh constantly without adequate cause, or, on the other hand, is very easily moved to tears.

During this condition of things a subacute maniacal condition may supervene; or the patient may develop 'delusions of grandeur' precisely similar to those met with in general paralysis of the insane—examples of which the writer has recently seen in two of his own patients. In other cases persons suffering from this disease may lapse into a profoundly melancholic condition.

At this stage, too, apoplectiform or epileptiform attacks are particularly apt to occur from time to time. After such attacks, of whichever kind, the limbs on one side of the body and the face are left more or less paralysed; and where the attack has been epileptiform in character, the convulsive twitchings are often limited to this one side of the body. As Charcot has pointed out, these attacks are precisely similar to those which occur in general paralytics, or in cases of old hemiplegia with descending sclerosis. They answer to the so-called 'congestive attacks,' but they do not seem to be associated with any new appreciable lesions of a 'gross' order. Such epileptiform attacks may be brief, or they may last for hours; or, off and on, even for days. In all of them the temperature begins to rise almost at once—without any initial period of depression—and may even reach 104° in a few hours, or in a day or two. The temperature then begins to fall again; or, should it continue to rise to a still higher point, the attack is very apt to terminate fatally.

Every attack of this kind leaves the patient in a manifestly worse condition, both bodily and mentally; and perhaps in one of them at last death may occur.

VARIETIES.—The symptomatology of this disease is likely to be considerably modified in different cases, but principally in two directions, productive of complications of the same kind as those which are also apt to occur in 'spasmodic spinal paralysis.' In each disease there may in some cases be a special affection of the posterior columns, in one or other region of the cord, bringing with it more interference with sensibility, and an admixture of other symptoms pertaining to locomotor ataxy. These are some of the cases which have been described under the separate name of 'ataxic paraplegia' (see PARAPLEGIA, ATAXIC). It is, perhaps, principally in these cases that the '*crises gastriques*' (pains, vomiting, and occasionally diarrhœa) are also met with. In other instances there may be an extension of the sclerosis to the grey matter of the anterior cornua in one or other region (as well as to other parts of the grey matter), leading, amongst other phenomena, to muscular atrophy in related regions of the body. In either of these ways the symptoms of the original disease may be complicated, and, to a certain extent, obscured.

Many other differences also present themselves in special cases, owing to the varying situations in which the morbid patches make their first appearance. In a distinct minority of the cases the disease seems to reveal itself first in the brain rather than in the spinal cord.

TERMINATIONS.—After this disease has pursued a very slow course for years (often five to ten), the miserable sufferers from it may at last be carried off in various ways. Death may take place in one of the apoplectiform or epileptiform attacks, occurring either in patients who are merely slightly demented, or in those who are otherwise actually insane; or, at last, in cases in which there is great interference not only with articulation but also with deglutition, the functions of the heart or of respiration may also become affected, and this disturbance may lead on to a fatal termination.

In other cases, after the disease has lasted for years, and when the grey matter of the cord has become seriously involved, accidents may supervene similar to those which occur in the final stages of many cases of paraplegia. The bladder may become paralysed, and after a time inflammation and ulceration may be set up, followed by secondary inflammation of the ureters or kidneys. Or bedsores may form, sloughing may go on extensively, and the patient may at last die exhausted, or from the supervention of blood-poisoning. At other times the patient is cut off by some acute inflammatory disease.

DIAGNOSIS.—In its early stages the diagnosis of this disease may present very considerable difficulties. This is especially the case when the morbid process begins in the cerebrum. Here for a time there may be nothing distinctive, and we have to wait for the further development of the disease before anything like a positive diagnosis is possible. Similarly, where the disease begins only with spinal symptoms, it is often extremely difficult to diagnose it with certainty in its very early stages. The important characters in the more typical forms of the disease are the youth of the patient, the paresis gradually increasing, first in one and then in the other lower extremity, with no alteration in sensibility or in the electrical irritability of the nerves or muscles, but with ankle-clonus and exaggerated knee-jerks. Still it must be borne in mind that all these signs may be met with in the spastic forms of Functional Paralysis of Spinal Type (*see* 80); and, especially when they occur in young women, the diagnosis is often beset with the greatest difficulties. Even the most experienced observer may remain for a time in doubt as to whether he has to do with the beginnings of organic disease, or with mere functional derangements of the spinal cord. But when the peculiar tremors and disordered movements on voluntary excitation of the muscles are met with, together with the absence of any such tremors in the condition of rest, and some amount of paresis or of similar symptoms in one or both upper extremities, the diagnosis of the 'spinal' type of this disease can be no longer difficult or doubtful.

By far the most typical cases, however, are those of the 'cerebro-spinal' type, in which, with such symptoms as are above indicated, there are also some others due to disease of the medulla, pons, or adjacent parts, such as tremors about the lips and tongue, altered speech, and nystagmus. In these cases the disease is really quite distinctive; so that the malady ought to be easily recognised when the patient is seen at this stage for the first time. Chorea is the affection with which such a stage of the disease is most apt to be confounded; but the absolute cessation of all tremors and disordered movements in multiple sclerosis when the patient is at rest, and their immediate reinitiation (mainly in the parts moved, but also often to some extent in others) on the occurrence of voluntary efforts, is a thoroughly distinctive characteristic.

Paralysis agitans ought to be distinguished from disseminated sclerosis with even more ease. It is scarcely ever met with in persons under the age of thirty-five, whilst multiple sclerosis does not very often begin in persons beyond such an age. The movements of paralysis agitans, again, are only to a slight extent exaggerated by voluntary exertion of the parts, whilst sometimes they are actually lessened thereby; and such movements, in the form of fine tremors, do not cease to anything like the same extent under conditions of rest. Again, there is generally no shaking of the head and neck in paralysis agitans.

Mercurial poisoning with tremors can be easily distinguished, on inquiry into the history of the patient, and the mode of onset of the disease.

In those more irregular cases of multiple sclerosis, in which there is either an unusual amount of implication of the posterior columns of the cord, or of the grey matter in some region or regions, the diagnosis of the complex nature of the affection must be based upon the general principles applicable to the regional diagnosis of spinal cord disease.

Prognosis.—Absolute cure of this disease is scarcely to be hoped for. The most that has been done, hitherto, as a result of treatment, has been to help to bring about more or less distinct remissions, and also to delay the progress of the disease. Death usually occurs in from five to ten years, in one or other of the modes already indicated.

Treatment.—Many drugs have been tried, but hitherto with little or no positive result, in the treatment of this affection. Nitrate of silver has seemed to do good in some cases, especially in the early stages. But the writer is much more disposed to trust to iodide of potassium in eight- or ten-grain doses three times a day, with or without moderate doses of liquor arsenicalis, or of perchloride of mercury; combining the use of those drugs with cod-liver oil, alone or with maltine, and a good nourishing diet. From time to time, however, the above medicines should be omitted, and simple tonics taken in their place. In the early stages of the disease, hot brine or sulphur baths and massage of the limbs may be of service; and in all cases it is of great importance to see that the patient obtains sound sleep, since in this, as in all other chronic spinal diseases, the patient's downward course is likely to be hastened where an adequate amount of sleep is not obtained.

No distinct indications exist for the treatment of this affection by electricity, and no advantages have as yet been recorded from its use. The complications of the disease, which may occur in its later phases, must be treated in accordance with the general principles applicable for this as well as for other spinal affections. Every effort must be made to preserve the general health of the patient, as this will probably be found to be the surest means of holding in check the progress of the disease.

H. Charlton Bastian.

19. **Friedreich's Disease.** — Synon.: Hereditary Ataxy; Postero-lateral Sclerosis of the Spinal Cord; Diffuse Sclerosis of the Spinal Cord and Bulb.

This is a disease apt to show itself in several members of the same family, at periods varying mostly between early childhood and the twenty-fifth year. It has been found to be two or three times more frequent in males than in females. It is not an hereditary disease in the strict sense of the term; it is rather a 'family disease,' showing itself in several children of the same parents, although neither they nor their parents may have had the disease. The term 'hereditary ataxy' is therefore misleading.

Nature and Pathology. — When first recognised, this disease was regarded as a form of locomotor ataxy; but, as Charcot and Bourneville have pointed out, some of the cases at least are much more closely related to 'disseminated sclerosis.' Friedreich's disease is, in fact, a malady as it were intermediate between these two affections, having important alliances with each, though, for the most part, the alliance is closer between it and disseminated sclerosis than between it and locomotor ataxy.

The disease is dependent upon the development of areas of sclerosis in the posterior and in the antero-lateral columns of the cord, as well as in some parts of the grey matter; together with an extension of such morbid processes to the bulb, so as to implicate the hypoglossal nuclei and other parts. The disease has, therefore, likewise been named 'Diffuse sclerosis of the spinal cord and bulb.'

Symptoms and Course.—Generally commencing without any special exciting cause, and mostly during adolescence, the malady shows itself first by the occurrence of a gradually progressive weakness in one or both lower extremities, together with an unsteady or uncertain, rather than a distinctly ataxic gait. The legs are often placed wide apart, and the walk is not unlike that of a drunken man. By slow degrees the weakness increases, till even standing becomes impossible. The weakness and uncertainty soon extend to the upper extremities, which also become tremulous during the execution of movements. Most frequently this incoördination is not exaggerated by closure of the eyes.

Later on the trunk and the head become the seat of oscillations, which are exaggerated when the patient executes any movement, but, on the other hand, cease when he is completely at rest in the recumbent position.

In males a condition of impotence supervenes; and in females the menstruation becomes exceedingly irregular. These signs are not long in showing themselves when we have to do with patients past the age of puberty.

After some years the tongue partakes in the trembling, and speech becomes hesitating, thick, and at last scarcely intelligible. Ultimately the tongue may become completely paralysed and motionless.

Nystagmus of a slow horizontal character is apt to show itself, on the occasion of voluntary movements of the eyeballs.

During the final stages of the disease there is often more or less complete paralysis of all the limbs—sometimes associated with muscular atrophy. At this period, also, the limbs are occasionally affected with cramps, or transitory contractures.

Again, it is only during the final stages of the disease that affections of sensibility are prone to show themselves—and that, principally, in the form of anæsthesia of the lower extremities, often so complete as to involve the joints and muscles as well as the skin. Sometimes pains are complained of, but they are rather erratic in character than of the lightning-like or lancinating type.

The special senses and the intellect usually remain intact. The pupil often remains sensitive to light, and may be even rather unnaturally sensitive.

The sphincters are not affected; and there is no tendency for bed-sores to occur.

Sudden attacks of vertigo are apt to supervene (and that quite irrespective of the position of the patient at the time); or towards the close of the disease actual apoplectiform attacks may occur, in one of which the patient may succumb. Such an attack is said to be of the following type: 'It is characterised by a rapid but incomplete loss of consciousness, by resolution of all the limbs and a generalised anæsthesia, by a considerably impeded respiration which is of a jerking and noisy type, by a tumultuous action of the heart and great frequency of pulse (130), together with a notable elevation of temperature' (Brousse).

The progress of the disease is often extremely slow, but always fatally progressive. It may last from five to thirty years.

Diagnosis. — As already indicated, the diagnosis has to be made principally between Friedreich's disease and disseminated sclerosis, or else between it and locomotor ataxy. Such difficulties of diagnosis must, however, present themselves principally in regard to the first case of Friedreich's disease that happens to show itself in a family. If the medical attendant is aware that already one or more of the patient's brothers and sisters have become affected in a similar manner, more than half the difficulty of diagnosis is at once got rid of—supposing the practitioner to be aware of the existence and general nature of such a malady as Friedreich's disease. This is so, because several cases of ordinary locomotor ataxy or of insular sclerosis in the same family must be regarded as events of extreme rarity.

It should, however, be borne in mind that in Friedreich's disease (as well as in locomotor ataxy, and disseminated sclerosis) much variation exists in different cases, in the rapidity and in the order of development of the several signs and symptoms. A similar variability exists in regard to the relative development of these several signs in different cases—the result being that only a generic similarity is likely to exist between any two or three consecutive cases of this disease that may chance to present themselves to the same observer.

Supposing, however, that we have to do with a solitary case of disease, then the question of age becomes of first importance. If the patient should be under twenty years of age, the chances would be decidedly against locomotor ataxy, and in favour of the case being either one of Friedreich's disease or of disseminated sclerosis; while the indications would be still further against locomotor ataxy, if there should be an absence of the peculiar pains characterising this latter disease, or of other affections of sensibility.

The points, in detail, which must be taken into consideration for the diagnosis of these three diseases from one another are given below in parallel columns.

Locomotor Ataxy.	Friedreich's Disease.	Disseminated Sclerosis.
Rarely before twentieth year.	Commonly before twentieth year.	Often before twentieth year.
Affections of sensibility early and constant. Sight and hearing often affected.	Affections of sensibility absent.	Affections of sensibility generally absent, though sight and hearing are sometimes affected.
Double vision, and Argyll Robertson pupil present.	Double vision, and Argyll-Robertson pupil absent.	Double vision frequent, and Argyll-Robertson pupil absent.
No nystagmus.	Nystagmus frequent.	Nystagmus very common.
No oscillations of head and trunk.	Oscillations of head and trunk very common.	Oscillations of head and trunk frequent.
Knee-jerk absent; no ankle-clonus. No rigidities.	Knee-jerk either absent, of medium intensity, or exaggerated. Sometimes clonus. No rigidities.	Knee-jerk commonly exaggerated and clonus present. Rigidities common.
No speech defects.	Difficulties in speech.	Difficulties in speech.
Simple incoördination in arms common.	Tremors of arms exaggerated by movement.	Tremors of arms on movement, gradually becoming choreic in range.
Mental disturbance rare.	No mental disturbance.	Mental disturbance frequent.

Prognosis and Treatment.—The disease is not amenable to any special line of treatment. On the other hand, it is one which is comparatively little dangerous to life. Patients so affected may live for prolonged periods, if due care be taken to maintain their general health.

H. Charlton Bastian.

20. Spinal Cord, Tumours of.—Synon.: Intra-medullary Tumours; Fr. *Tumeurs de la Moelle*; *Tumeurs Rachidiennes*; Ger. *Krankhaften Geschwülste des Rückenmarks.*

Ætiology and Anatomical Characters.—Tumours originating in the substance of the spinal cord may be regarded as belonging to two classes, according as they represent (*a*) mere *local* accidents in the form of perverted tissue-changes; or (*b*) such local accidents developing under the influence of a distinct *general state*, such as syphilis or scrofulosis.

(*a*) Of the purely *local* overgrowths, the most typical, and perhaps also the most frequently occurring, are *gliomata*. The consideration of these growths comes in natural sequence to that of *sclerosis* affecting different regions of the cord. In such a tumour we have an exuberant overgrowth, as Virchow and most other pathologists suppose, starting from the neuroglia of a certain portion of the cord. At first the growth infiltrates and substitutes itself in the place of a certain amount of nerve-tissue; but it soon grows excessive in quantity (spreading in area perhaps at the same time), and thus comes to exercise a more and more marked compression upon the remaining tracts of nerve-tissue composing the cord at the same level, within the narrow and unyielding boundaries of the spinal canal. In extreme cases a spinal cord may, as the writer has seen, become so infiltrated with new-growth throughout the greater part of the cervical and dorsal regions, that it attains almost twice its natural bulk. These gliomata are oftentimes extremely vascular. They are liable to undergo a certain amount of central softening; and into their substance, especially in the softened foci, hæmorrhages are very apt to occur. Softening of nerve-tissue may also, at a certain stage, take place around a more circumscribed growth, and thence may extend for a variable distance above and below.

Other tumours of an allied nature, such as *sarcomata* and *myxomata*, also at times develop, either in their pure types or with blended characters, within the spinal cord. They present few intrinsic peculiarities in their manner of affecting the cord. They rarely attain any large size; indeed the limitations of the spinal canal only permit of much increase in one direction. And elongated growths are occasionally met with. To a considerable extent, such tumours have an infiltrating mode of growth, though their boundaries are apt to be rather more defined than are those of gliomata.

In regard to the causes of these tumours, almost nothing more definite can be said than that they seem, at times, to find occasion and conditions suitable for their initiation after some blow upon the spine or concussion of the spinal cord.

(*b*) Of the growths which tend to occur in the spinal cord (as occasionally in other parts of the body) under the influence of some *general* disease or diathetic condition, two are especially to be named. These are *tubercular growths* and *syphilitic gummata*. The former are generally small, varying in size from a mustard-seed to a pea, and only very rarely attaining the dimensions of a hazel-nut. Next to gliomata, they are the new-growths most frequently met with in the substance of the spinal cord. When small, they may occur in association with a cerebro-spinal tubercular meningitis; but at other times they are found, and especially the larger growths, existing independently of any acute inflammation of the meninges. In this latter case, the tumours may be combined with a certain amount of adjacent and secondary softening of the substance of the cord.

Syphilitic gummata, originating in the cord itself, occur only with the greatest rarity. They are more frequently found starting from the meninges, and then they may press upon or actually grow into the nerve-substance.

Cancer is believed not to occur primarily in the substance of the spinal cord, though it may grow into its substance, or seriously press upon it, when originating either in the meninges or in the vertebræ.

Symptoms, Course, and Terminations.—The difficulties of diagnosis are almost always very great in the case of tumours of the spinal cord, because in their early stages, and occasionally for prolonged periods, they are associated with slight and somewhat vague symptoms.

Independently of the variations in different cases, consequent upon the longitudinal situation or level of the tumour in the spinal cord, the symptoms to which they give rise in various parts of the body may be more or less vague anomalies of sensibility in different regions, associated with a certain amount of weakness, often not amounting to actual paralysis.

Growths from the meninges, or from the vertebræ, pressing upon the spinal cord, are not quite so apt to run a latent course for any length of time, since they are rather more prone to involve the anterior or the posterior roots on one or on both sides—at first irritating them, and subsequently causing paralysis from pressure. Thus localised numbness, pains, or anæsthesia, either alone or associated with twitchings, cramps, or paralysis, confined to certain parts of the body, are rather more common incidents during the growth of extra- than of intra-medullary tumours. Still the diagnosis between these two classes of tumours may be impossible.

Sclerosis, in its 'insular' form, especially when the patches are few or close together, may also present symptoms almost inseparable from the first stage of some intra-medullary tumour. The important fact is, however, that sclerosis in the cord tends to become more and more generalised, and thus gives rise to a proportionately widening range of symptoms; or else it limits itself to special columns, and thus becomes associated with more special sets of symptoms.

With any of these tumours of the spinal cord, the symptoms are, after a time, liable to undergo a sudden and grave increase, owing to the occurrence of a hæmorrhage into its substance and perhaps into adjacent regions of the spinal cord, or else owing to the commencement of a process of secondary transverse softening. Beyond these possibilities of sudden grave augmentation of symptoms, the course of intra-medullary tumours is also apt to be marked by peculiar exacerbations and remissions from time to time, in association with periods of altered growth or vascularity of the tumour itself.

Diagnosis.—The very gradual onset of the symptoms in cases of tumour of the spinal cord is a point of great importance in the diagnosis of these conditions. Thus, for instance, we eliminate arachnoid or intra-medullary hæmorrhages, and also the numerous class of cases of softening of the spinal cord, with other affections having a more or less abrupt origin. The diagnosis of tumour of the cord as distinct from its compression by disease of vertebræ (where there is also generally a slow evolution of paralytic symptoms) must be based in part upon the absence of distinct pains and of any evidence of vertebral disease. The diagnosis from meningeal tumours has already been referred to under the head of Symptoms; and so also has the diagnosis from mere sclerosis of the spinal cord, in which the connective-tissue overgrowth is not sufficiently bulky to amount to an actual tumour.

If the arrival at a diagnosis as to the existence of a tumour of the spinal cord is a process beset with difficulties, these by no means cease when, passing from the primary, we have to approach the secondary question as to the *nature* of the growth presumed to exist. But little is possible in this direction. It is true that, with a history of pre-existing syphilis, even without the evidence of other simultaneous manifestations, we should be warranted in assuming it to be even more than possible that an existing growth was syphilitic in nature, and in treating the patient accordingly; and that all the more because this is about the only kind of new-growth as to which we have distinct evidence of its amenability to the influence of remedies. The presumptions in favour of the tubercular or scrofulous nature of a supposed new-growth in the spinal cord would rarely carry with them more than a moderate amount of cogency. Still, occasionally the general habit of the patient, together with the fact of the existence of scrofulous enlargement of glands, or of some forms of phthisis, might give more or less probability to such a conclusion. Beyond this, not much can be done in the way of diagnosing special kinds of tumours. We might be guided in our opinion as to the possible existence of a sarcoma by the presence of one or more of such growths in other parts of the body; or, failing this, we may recollect that primary cancer affecting the spinal cord is almost unknown, and that gliomatous tumours are, next to the tubercular or scrofulous, those which are most frequently met with in the cord itself.

Prognosis.—The prognosis in all these cases is bad. Life, it is true, may last for months or even years, but the tendency is for the primary affection to set up other secondary accidents, in the form either of hæmorrhage or of softening. Thus, paralysis is rendered more complete, and the way is paved for an ultimate fatal termination, through the intervention of cystitis and renal mischief; by way of bed-sores with exhaustion and blood-poisoning; or by extension of softening upwards to the cervical region, and the supervention of respiratory paralysis.

Treatment.—In the case of the existence of a syphilitic tumour in the spinal cord, we may attempt (and with some expectation of success) to treat the causal morbid condition with large doses of iodide of potassium (gr. xv.–xxx.) in combination with perchloride of mercury. But in almost all other cases little can be done in this direction, and we are reduced to the necessity of dealing with the paraplegic state and its attendant conditions as best we can, and also of attending to the general health, with the view of arresting the progress of the disease and keeping its possible complications in check. *See* 9. Spinal Cord, Softening of.

H. Charlton Bastian.

21. **Syringomyelia.**—Synon.: Syringomyelitis; Hydromyelia; *Hydrorhachis Interna*; Central Gliomatosis; Fr. *Myélite Périépendymaire*; Ger. [illegible].

This condition has been long known on its pathological side, but it has been only of late years connected with anything like a definite symptomatology. Formerly, therefore, the disease was never diagnosed during life; the morbid condition was only recognised after death as the cause of previously obscure and little-understood symptoms. During recent years, however, it has been otherwise—diagnoses have been made during life and subsequently verified.

Ætiology and Pathology.—There are two principal conditions in which cavities are found in the spinal cord; and though in their typical forms they may be quite distinct from one another, in many other cases they exist in combination and are not separable conditions. The simpler condition is known as *hydromyelus* or *hydromyelia*—a state in which there is a dilatation of the central canal of the cord, and in which this canal is distended with fluid; this being either a congenital condition, or perhaps a result later in life of the pressure of a tumour on a portion of the central canal, which obliterates it at the seat of pressure, and leads to the dilatation above. The more complex condition is what is known as *syringomyelia*, in which, though there is dilatation of the canal of the cord as before, there is also a gliomatous overgrowth or new-formation around this dilated canal, which extends more or less into different parts of the posterior half of the cord.

It is commonly supposed that there is some congenital defect in the structure of the cord in these latter cases, so that the central canal remains large, and has around it a variable amount of the unaltered embryonal tissue of the organ, closely allied in structure to the neuroglia, some amount of which always exists at the surface of the cord as well as around its central canal. At some variable period in the life of the individual (but mostly between puberty and the twentieth year) growth seems to take place to a more or less marked degree in this embryonal tissue, resulting in the production of a gliomatous new-formation, which infiltrates to a variable extent the grey matter, and also the posterior and postero-lateral columns. The symptoms of the disease are thus gradually produced by the increase and invasion of the new-growth, and they will naturally vary in their rapidity of evolution with the rapidity or otherwise of increase in the new tissue itself. Cavities other than the enlarged central canal are frequently found co-existing with this gliomatous new-formation, which have probably been formed therein by degenerative changes.

The dilatation of the central canal sometimes exists throughout the entire length of the cord, and there may likewise be a dilatation of the *iter* between the third and fourth ventricles of the brain. In other cases—and this is the most frequent condition—the cavity only involves the cervical and the upper dorsal region of the cord, or perhaps a still more limited longitudinal area. The transverse section of the cavity may be oval or circular, whilst in other cases there are narrow chink-like extensions into one or both posterior cornua. Other independent more or less chink-like cavities are also frequently found, which are supposed to have resulted from degenerative processes or from hæmorrhages occurring in the new gliomatous tissue.

In brief, the condition seems to be due in the first place to a congenital arrest of development, supplemented most frequently somewhere between the fifteenth and the thirtieth year, without assignable cause, by an overgrowth of gliomatous tissue of varying extent and rapidity around the dilated central canal and into contiguous regions of the cord; the symptoms being due in the main to this latter process, to pressure occasioned by the fluid or by the new tissue itself, as well as to the subsequent changes taking place in the infiltrated regions of the cord.

Symptoms.—The symptoms of the disease often begin between the fifteenth and the twentieth years (rarely later than the thirtieth), and they may continue for ten to twenty years before a fatal termination occurs.

Patients complain of variable pains in the cervico-scapular region, and some amount of muscular atrophy soon shows itself about the arms or shoulders. Occasionally there may be atrophy also of some of the muscles of the leg.

The arms, or arms and legs, also become more or less weak; the deep reflexes are exaggerated; and some amount of rigidity may likewise show itself in the lower extremities.

With these symptoms there are very characteristic modifications of sensibility. Tactile sensibility and the muscular sense may be little if at all impaired, but painful and thermic impressions (which are conducted to the brain through the central regions of the cord) are lost in one or both arms and in contiguous parts of the trunk. The distribution of the areas affected by this loss of sensibility varies much in different cases; sometimes they are unilateral and sometimes bilateral. In one case under the writer's care the whole of the trunk and the two upper extremities were involved, except for a broad band about six inches wide which encircled the body just above the level of the umbilicus. Less frequently, and mostly in the later stages of the disease, there may be complete anæsthesia of the skin and mucous membranes over the whole or part of one side of the body. The special senses are generally unaffected, and power over the sphincters is also unimpaired. Some of the ocular muscles may be weakened or paralysed where the dilatation of the central canal extends upwards so as to affect the *iter*, and is so great as to lead to pressure upon some of the contiguous nuclei for the ocular nerves. Under similar conditions nystagmus may also not infrequently be present.

Trophic troubles, other than the muscular atrophy, are not at all uncommon in the course of this disease. In the first place it may be said that such patients frequently burn themselves about the upper extremities, owing to the loss of painful and thermic sensibility. Other changes, however, occur spontaneously, such as alterations of the joints of the tabetic type, or ulcerations of the skin. In these cases it may be suspected that affections of the peripheral nerves are associated with the changes in the spinal cord—a combination which has been proved to exist in a remarkable variety of syringomyelia, first recognised in Brittany, and known as 'Morvan's disease,' which is characterised by neuralgic pains, cutaneous anæsthesia, and painless but destructive whitlows.

Diagnosis. — The diagnosis of syringomyelia is now fairly easy in the majority of cases. It is the combination of loss of painful and thermic sensibility, without loss of tactile sensibility, in association with muscular atrophy in the upper extremities more especially, which is characteristic of the disease.

Formerly this affection was sometimes confounded with anomalous cases of disseminated sclerosis, though such a mistake is much less likely to occur now. It bears most resemblance to certain cases of 'hypertrophic cervical pachymeningitis' (*see* Meninges, Spinal, Inflammation of), though these latter cases may usually be distinguished by the greater amount of pain in the nape of the neck and in the upper extremities, together with a certain amount of spasm, and the loss of tactile as well as other modes of sensibility, instead of the dissociated anæsthesia so characteristic of syringomyelia.

Prognosis.—The prognosis is hopeless as regards cure or control of the disease, but the affection is a very chronic one, and therefore not specially dangerous to life till a rather long series of years has elapsed.

Treatment. — Treatment can only be directed to the maintenance of the general health, and to the alleviation of pains where they are distressing by means of acetanilide or of morphine. Massage and electrical treatment may also be of some use during the early stages of the disease.

H. Charlton Bastian.

22. Spinal Cord, Malformations of.

Various conditions are comprised under this head which are of little or no interest to the practitioner. The spinal cord may be absent, imperfectly developed, or double. Again, cases occur in which the spinal cord is either unduly long or unduly short, or in which it may present some trifling lack of symmetry. One of the most interesting of these latter conditions is due to the fact recently discovered by Flechsig of the possible non-uniform distribution of the pyramidal tracts upon the two sides of the cord, so that the amount of decussation of the motor fibres, not only in different individuals, but also in the two halves of the same cord, may be quite unequal. In the latter case a slight asymmetrical development of the antero-lateral columns on the two sides would be met with.

Congenital Dilatation of the central canal of the Spinal Cord (Hydrorachis interna, or Hydromyelus) has already been referred to as constituting one side of the disease described as 'Syringomyelia'; in which, however, other cavities are frequently found resulting from the breaking-down of the gliomatous new-growth.

Congenital dilatation of the central canal in its most developed form is apt to be met with also in some cases of *spina bifida*; whilst in others the canal in the lumbar region is open posteriorly, and the halves of the posterior columns are more or less widely separated; there is, in fact, a congenital arrest of development in the spinal cord very similar to that which exists in the spinal canal. *See* Spina Bifida.

H. C. B.

II. Diseases of the Spinal Cord dependent upon unknown, or very imperfectly known, organic changes.

23. Tetanus.—*See* Tetanus.

24. Tetany.—*See* Tetany.

25. Torticollis.—*See* Wry-Neck.

26. Writer's Cramp, &c.—*See* Writer's Cramp.

27. Spinal Irritation. — *See* Spinal Irritation.

28. Reflex Paraplegia. — Synon.: Urinary Paraplegia (in part); Fr. *Paraplégie Reflexe*; Ger. *Reflexlähmung.*

General Remarks.—Some practitioners believe that paralyses of various kinds are brought about purely by reflex influences. They would include under this category some of the cases of paralysis of separate muscles, such as the ocular; some cases of paralysis of one or both arms; or some of the cases of paralysis of one or both lower extremities. It is the latter class of cases with which we are now specially concerned, though most of what is to be said in the present article may, *mutatis mutandis*, be considered applicable to the whole class of so-called 'reflex paralyses.'

Those who believe in the frequent existence of this form of paralysis are considerably less numerous than they were about thirty years ago, when the notion of its frequency and importance was warmly espoused by Brown-Séquard (*Lects. on Paral. of Lower Extremities*, 1861), at a time when the morbid anatomy of the spinal cord was still very imperfectly known. The number of competent observers was then smaller, and the difficulty in detecting morbid changes in this organ was also much greater than it is at the present time, when we are accustomed to employ more elaborate methods for its preservation and for its examination. Yet one of the strongest of the arguments brought forward in favour of the existence of 'reflex paraplegia' was the absence of discovered lesions in the spinal cord in a class of cases reported upon by Stanley in 1833 (*Med.-Chir. Trans.*, vol. xviii., p. 260), in which paraplegia was associated with various morbid conditions of the urinary organs—cases, in fact, of the so-called 'urinary paraplegia.' And one of the main supports for the opinion of those who still believe in the existence of a class of reflex paraplegias would even now lie in the absence, in certain cases of paraplegia terminating fatally, of any actually discovered lesion.

ÆTIOLOGY AND PATHOGENESIS.—The interpretation of the paralyses of this class put forward by Brown-Séquard was as follows: That an irritation, operating upon certain sensory nerves, produced impressions which, after impinging upon the properly related grey matter in the spinal cord, are thence in part reflected along vaso-motor nerves regulating the calibre of certain blood-vessels which supply either (*a*) the portion of the spinal cord in relation with the paralysed parts, or else (*b*) the great nerves or the muscles themselves of the paralysed parts. In either case this reflection of impressions resulting from irritation of sensory nerves, upon such special groups of vaso-motor nerves, is supposed to lead to a persistent spasm of the vessels which they innervate, so as to cause a continuous anæmic condition, either of certain vascular territories in the spinal cord itself, or else of the related nerve-trunks and muscles. In either case, too, the nutrition of the parts involved in this anæmia is supposed to suffer—so that their functions can no longer be carried on, or only in a very imperfect manner—and thus a more or less complete paralysis results, which is capable, however, of being mitigated from time to time, of actually intermitting, or indeed of being abruptly cured, according as temporary diminutions or a complete disappearance of the original exciting cause may lead to a diminution or to an actual cessation of the supposed profound anæmia produced by the postulated spasms of vessels. These are the theories upon which the doctrines of 'reflex paraplegia' are based.

Among the sources from which the initial irritation is supposed to proceed, almost all parts of the body, internal as well as external, are included. Thus irritative impressions, it is thought, may emanate from almost any part of the urinary tract—from the urethra to the kidney; in other cases similar impressions may emanate from some portion of the female genital organs; in others from the intestinal canal, owing to the presence of worms or some such persistent causes of irritation; in others from some portion of the thoracic organs; or, as it seems to be held, from irritated sensory nerves in almost any part of the body, whether situated near the surface or deep amongst the tissues.

The assemblage of symptoms supposed to characterise these forms of reflex paralysis presents nothing like a distinctive mode of grouping. And of the several components of the group put forward by Brown-Séquard in 1861 (*loc. cit.*, p. 33), as pertaining to one of the most typical varieties, namely, 'urinary paraplegia,' none can now have any pretensions to be regarded as distinctive, excepting the alleged tendency of the paralysis to vary in degree with variations in the malady on which it is supposed to depend, together with its tendency to spontaneous or easy cure coincidently with or soon after the cessation of the urinary troubles, whatever they may have been. In harmony with this latter character also are the alleged facts that speedy cures have been brought about of cases of paraplegia, especially in children, after the expulsion from the alimentary canal of tapeworms or round-worms; or of cures of the same disease in adult females after the cessation of some uterine inflammation; or of cures of a paralysis of ocular muscles after the removal of some carious tooth which had previously been exercising an irritative influence upon branches of the dental nerve.

It would be useless to attempt to deny the existence of such cases; they are theoretically possible. On the other hand, the writer is compelled to believe, after a very extensive experience, that, if they exist, they can only occur as extremely rare events.

Although it is theoretically possible that an irritation of a sensory nerve may be reflected on vaso-motor nerves, so as to lead to arterial spasms in certain territories of the spinal cord, or in certain groups of muscles, it is difficult here, as it is when postulated in explanation of other functional diseases of the spinal cord, to imagine that such a condition of spasm could be maintained for weeks or even months. Nor, if it could occur for these prolonged periods, and to such an extent as to annul some of the most important functions of the spinal cord during this time, is it at all clear that the nutrition of the cord in the affected regions would not be seriously interfered with by such prolonged anæmia; and, if so, the assumed speedy resumption of healthy functions *pari passu* with the diminution or disappearance of the vascular spasms would constitute another difficulty, since such speedy recovery would be scarcely compatible with the theory upon which the explanation of the disease is based.

Again, it is almost certain that many of the cases formerly supposed to belong to this category of 'reflex paralysis' had no right to figure therein. Cases of diphtheritic paralysis have been proved to belong to a different category; and there is good reason to believe that in other instances the morbid conditions really existing as causes of the paralysis have simply been overlooked, either because the appreciable changes were only slightly advanced at the time of the patient's death (owing to the brief duration of the illness); or because of the want of a thorough examination of the cord, conducted with all needful aids, care, and expenditure of time; or, finally, because the disease may have been in the peripheral nerves rather than in the spinal cord itself.

It seems clear, therefore, that the opinions of those who believe in the existence of 'reflex paralysis,' and of 'reflex paraplegia' in particular, stand much in need of further support and definition. Well-observed and well-recorded instances of the disease are urgently wanted, if reflex paraplegia' is to retain its claim to a place in our nosology.

H. Charlton Bastian.

29. Intermittent Paraplegia.—Synon.: Intermittent Spinal Paralysis; Fr. *Paralysie Spinale Intermittente*; Ger. *Intermittirende Paralysis Spinalis.*—Very few cases of paraplegia of this type have been recorded, and it must also be a condition of extreme rarity.

The earliest recorded example was made known by Romberg, and as this, both in its nature and its course, seems to have been a typical instance, it may be cited here. 'A woman, sixty-four years of age, after being quite well the day before, was suddenly attacked with paralysis of the lower extremities and of the sphincters. Sensibility was unchanged, consciousness clear, the temperature cool, pulse 80, small and empty, no pain in the spinal cord. The next day there was an astonishing change in the condition. The patient could walk again and void urine voluntarily, and only complained of weakness in the legs. The following morning there was paraplegia again, which had set in at the same hour as it had done two days before. A third paroxysm was awaited, which also set in at the appointed time, although without paralysis of the sphincters. Quinine effected a rapid cure.'

Additional cases have since been recorded by Erb, Hartwig, and other observers; and the view now entertained concerning them is that they are due to multiple neuritis or to a multiple peripheral neurosis, rather than to any disease of the spinal cord itself. *See* Neuritis, Multiple.

Any future cases deserve to be observed and recorded with the greatest care. Meanwhile it should be remembered that those already observed seem to have proved extremely amenable to the influences of quinine and of arsenic.

H. C. B.

30. Functional Paralysis of Spinal Type. Synon.: Hysterical Paraplegia.

It is generally admitted that paralyses of the 'hysterical' type more frequently belong to the paraplegic than to the hemiplegic variety. Even good observers, however, are rather too prone to look upon the terms 'functional' and 'hysterical' as interchangeable. This is apt to create confusion. Surely there may be functional paralyses which have no right, merely as such, to the appellation 'hysterical.' Certain it is that in a considerable proportion of cases, which we seem justified in regarding as functional, there may be, apart from the paralysis, no symptoms or mental peculiarities which could be described as 'hysterical.'

This whole subject bristles with difficulties, for, as the writer has recently endeavoured to point out (*Various Forms of Hysterical or Functional Paralysis*: London, 1893), the different forms of functional paralysis must be dependent upon faulty nutrition and faulty functioning (apart from gross organic disease) of this or that territory of the brain, and probably also of this or that region of the spinal cord. This being so, functional paralyses should closely accord in their characters with the forms of paralysis caused by actual gross lesions in different regions of the brain and spinal cord; though the two classes may differ in severity and in curability—one or both.

'Some appear to think (or their language seems to imply) that all cases of paralysis not due to a structural cause must be of a hysterical order; and, as they believe hysteria to be due to a perverted activity of the brain, it perhaps never occurs to them to consider whether some of the cases of functional paralysis coming before them may not have their origin in a depressed or perverted activity in some portion of the spinal cord. For one or other of these reasons, it happens that up to the present time almost nothing has been said upon this subject; so that no rules of any kind are laid down in our text-books to help us in distinguishing spinal from cerebral cases of functional paralysis.'

Symptoms.—It seems clear, however, that if there are in reality cases of functional paralysis of *spinal type*, they at least could have no sort of right to be spoken of as 'hysterical,' seeing that hysteria is now generally admitted to be a functional disease of the brain. The writer believes that such cases are to be met with not infrequently, and for the present he is disposed to range them tentatively in two classes, viz.:—

A. *Cases of the Spastic Type, due to functional perversion or defect in some part of the pyramidal system of fibres in the spinal cord.*

B. *Cases of the Flaccid Type, due to functional defect in the anterior cornua in certain segments of the spinal cord.*

In both sets of cases there is mostly a complete absence of ordinary hysterical symptoms. Instances of Class A approximate somewhat in their symptoms to those of 'spasmodic spinal paralysis'; that is, there is paresis or actual paralysis, with more or less of rigidity and of exaggerated reflexes in the lower extremities. Defects of sensibility may or may not be present in the paralysed parts and over the trunk to a certain level, though the distribution of anæsthesia is often unequal on the two sides of the body.

In Class B we have to do with cases of paralysis of flaccid type unassociated, it may be, with any diminution of muscular sense. But in other of these cases, where the functional defect is more diffused over the grey matter rather than limited to the anterior cornual regions, there may be a more or less marked impairment of common modes of sensibility, and possibly also some amount of diminution of muscular sense owing to interference with its afferent channels. It may, perhaps, be assumed that the functional defect in the anterior cornua of the cord is adequate to bring about a more or less definite paralysis, even though the defect may not be sufficiently severe to entail any special muscular atrophy.

Diagnosis.—The characteristics of hysteria and of hysterical paralysis have been set forth elsewhere (*see* Hysteria); it must suffice, therefore, to say here that true hysterical paralysis (whilst it may be hemiplegic or paraplegic) is very frequently associated with a hemianæsthesia of cerebral type (in which the special senses are more or less involved), whilst there may be the association of hysterical convulsions, and more or less special mental peculiarities. In the cases of functional paralysis of spinal type, however, with which we are now concerned, there is an absence of these associated symptoms; anæsthesia is not always present, and when it is it does not affect the head and face, with the special senses. Future investigation will probably lead to the recognition of other more definite differences between these two classes of functional paralysis.

In the diagnosis of these cases, reliance is always to be placed principally upon the absence of distinct evidence of organic disease such as would be furnished by muscular atrophy together with the electrical reaction of degeneration, by incontinence of urine or of fæces, and by the occurrence of bed-sores. The diagnosis has, in fact, to be made by way of exclusion; we must be satisfied that the symptoms in the case before us are not explicable by supposing the existence of any known organic disease of the spinal cord.

It may be said, moreover, that the cases of organic disease which are most likely to be confounded with functional paralyses, whether of cerebral or of spinal type, are spasmodic spinal paralysis, disseminated sclerosis, subacute or chronic spinal paralysis, Friedreich's disease, or the paralysis associated with Pott's disease. In many cases, however, such mistakes are made as much from the want of a sufficiently thorough examination of the patient, as from defective knowledge of the respective characteristics of the organic diseases just named.

Prognosis.—The prognosis is of course always very much more hopeful in functional cases than it would be in anything like corresponding cases due to organic disease. The ultimate establishment of a cure may be considered the rule in cases of functional paralysis, of this as well as of other types, provided the cases come under systematic and efficient treatment; though the duration of the disease must be considered to be altogether uncertain. Sudden cures are not to be expected in this class of cases as frequently as they are in the functional paralyses of cerebral type. For the most part they will require many weeks or months of continuous treatment before the patient slowly recovers.

Treatment.—This must be conducted upon very much the same principles that are applicable to the treatment of functional paralysis of cerebral type, so that details need not be here recapitulated. *See* Hysteria.

H. Charlton Bastian.

31. Paraplegia Dependent on Idea.

Nature and Ætiology.—This is a form of paralysis, of purely 'functional' type, occasionally occurring in neurotic impressionable persons, and yet not dependent upon any ordinary hysterical condition. Attention was first called to such cases by Dr. Russell Reynolds, who cited, amongst others, a typical instance in which a young lady, whilst attending to a paraplegic father, amidst the additional anxieties consequent upon straitened circumstances and the fatigues incident to teaching in order to obtain the bare necessaries of life, became at last, under the influence of long-continued strain, together with an abiding fear (inspired by actual physical weakness) that she herself was becoming paralysed, reduced *de facto* to this condition, as the final outcome of a slowly increasing weakness (see *Brit. Med. Journ.*, Nov. 6, 1869).

PATHOLOGY.—Such a condition may occur quite independently of hysteria, and be just as free from anything like conscious simulation or desire to exaggerate. We cannot say positively that the state is induced by what is called 'inhibition,' or by definite vascular spasms such as are supposed to form one of the pathological bases of the class of so-called 'reflex' paralyses, and yet both these modifying influences over the functional activity of the spinal cord *may* be in part operative when imagination, continuously excited in some one direction, has a tendency to pervert the functional activity of this portion of the nervous system.

The same conditions that exist as more lasting states in these cases probably exist temporarily, under the influence of suggestion, in hypnotised persons. *See* MAGNETISM, ANIMAL.

SYMPTOMS.—There is a paralysis of motion in the lower extremities, more or less complete, often partial, and generally without implication of sensibility. There is unabated control over the bladder and rectum.

Dr. Reynolds points out that, while such patients may be wholly incapable of lifting a foot from the bed, they often find themselves able to turn or sit up without any assistance. And in slighter cases, though they may be unable to stand for a moment, such patients may yet be able to move the legs in any direction while in the recumbent position.

DIAGNOSIS.—The character of the paralysis, and its limitation in range, is thought to be of importance. But still more important is the establishment of the fact of the pre-existence of long-continued fears or fancies (in a person of delicate or neurotic temperament), of such a nature as to be in accordance with the patient's now-present condition, combined with the absence of all signs positively indicative of any structural defect in the spinal cord.

Where such a condition exists (as it may) as a mere complication of an actually existing structural disease, the diagnosis becomes either impossible or extremely difficult. It is, in fact, only possible after prolonged observation and experience as to the course of the symptoms.

PROGNOSIS.—The prognosis is extremely good if the nature of the malady be divined, and a right course of treatment adopted. Under such circumstances, an almost complete cure may easily be brought about in a week or ten days; but, failing this recognition, the morbid condition may, it is said, under ordinary treatment, persist for an almost unlimited period.

TREATMENT.—The practitioner must inspire the patient with confidence that the malady is curable, and surround her (or him) with cheerful, hope-inspiring attendants and influences. At the same time, with the view of supporting her confidence (if for no other reason), he should faradise the muscles of the apparently paralysed limbs daily, or have recourse to frictions or massage combined with passive movements. He must make the patient attempt to stand or walk, with the necessary support; administer opiates, or bromide of potassium with chloral, to procure sleep, if necessary; and carefully seek to restore the patient's general health and nutrition. In this class of cases, especially, it would seem probable that the influence of 'suggestion,' if hypnotism could be induced, might be capable of producing an almost immediate cure.

H. CHARLTON BASTIAN.

32. **Neurasthenia Spinalis.**—SYNON.: Functional Nervous Weakness of the Spinal Cord.

NATURE AND ÆTIOLOGY.—Under this name, descriptions have been given of a combination of symptoms not infrequently met with in males as well as females, but more especially in the latter. They are supposed to represent a condition of extreme nervous debility, coming on obscurely, or at all events not as a sequence of some previous severe illness or shock. Still the symptoms met with often approximate closely to those pertaining to a state of convalescence from some serious febrile illness; and are not at all unlike some of those which may follow concussion of the spinal cord.

Such symptoms, when occurring independently, are most prone to show themselves in those who are naturally of a neurotic temperament. They may be excited by over-fatigue of various kinds, especially when this has been coupled with disturbed sleep for some time. Prolonged exercise or mental overwork may have been the particular exciting cause of fatigue; though perhaps much more frequently this is to be found in sexual excesses (of a natural or unnatural order), either extending in the form of habitual indulgence over a considerable period, or as more isolated but marked excesses. At other times, symptoms of neurasthenia spinalis set in without obvious provocatives of either type.

PATHOLOGY.—Concerning the actual cause of spinal neurasthenia little or nothing can be said. Sometimes there may be the co-existence of distinct cerebral symptoms of an analogous type; though on other occasions the symptoms are more purely spinal. This malady is perhaps capable of being induced by mere altered molecular states and actions of the tissue-elements of the spinal cord. A kind of persistent 'fatigue condition' exists. Although some may imagine the existence in these cases of a more than usually anæmic condition of the spinal cord, of this, as a fact, there is no evidence. To speculate upon other modes in which such a set of symptoms might be brought about would, in the present state of our knowledge, be of little service. There is, however, the possibility that this morbid condition may be due in the main to a functional disease of the cerebellum—especially if the views of Rolando and others, as to the functions of this great organ, should prove correct even in part.

Symptoms.—A feeling of utter weakness and prostration, induced by even the smallest amount of muscular exertion, is the central symptom, though this is usually associated with coldness and more or less numbness of the extremities. Pains, too, may be felt in the muscles of the limbs and in some parts of the back, though there is commonly no tenderness over any part of the spine. These symptoms may be unusually distinct after any activity of the genital function, and they may then be associated with extreme wakefulness, or sometimes with protracted inability to sleep. Occasionally, and especially when this latter symptom is not present, the patients may present a florid and fairly healthy appearance, strangely at variance with the extreme debility complained of.

Diagnosis.—The points of greatest importance are the existence of extreme weakness, with no evidence of anything like actual paralysis, or indeed of any symptoms which would indicate an actual structural disease of the spinal cord. This being so, and diabetes being also eliminated, we may oftentimes (and especially where the existence of one or other of the above-mentioned exciting causes has been established) pretty confidently conclude that we have to deal with what is here named 'neurasthenia spinalis.'

Prognosis.—A relief of this condition is ultimately to be looked for under the influence of rest and suitable treatment; but in regard to the rapidity with which any such amelioration of the patient's symptoms is to be brought about, great differences exist in different cases. Weeks, months, or even years may be required before a natural amount of vigour is restored.

Treatment.—Rest, especially in the direction of previous excesses, is the first and indispensable requisite. Every effort should be used to obtain regular and sound sleep. The action of these potent restoratives should be supplemented by a generous and easily assimilable diet, together with a moderate amount of stimulants. Hypophosphites of the alkalis with iron and small doses of strychnine (which may be conveniently given in the form of a syrup) often prove decidedly beneficial. An abundance of fresh air is desirable, and especially that of elevated and bracing mountain situations. Daily frictions and massage, aided by stimulating saline baths, may also prove to be of much use; whilst in the more severe cases a complete course of Weir-Mitchell treatment is indicated.

H. Charlton Bastian.

33. **Toxic Spinal Paralysis.**—Under this name it will be right to refer to a class of cases of paraplegia produced by poisons of various kinds. It constitutes a somewhat heterogeneous group, concerning which our knowledge is still very defective.

Of the toxic agents taken into the body, and capable of entailing a paraplegia, some are minerals such as arsenic and lead; others are of vegetable origin, such as aconitine, conine, veratrine, prussic acid, ergot, and alcohol; whilst others again are of animal origin. In the majority of cases, their action as 'causes' is not sufficiently potent to lead to paralysis as anything like an invariable effect. They need the concurrence of other favouring circumstances, probably in the main intrinsic; but under the combination of conditions thus resulting a paraplegia may be induced. It is only in this attenuated sense that the above-mentioned poisons are to be regarded as 'causes' of paraplegia. They ought perhaps, from this point of view, to be considered as predisposing rather than as exciting, and in no case as proximate, causes of paraplegia.

Moreover, investigations that have been made during the last few years have shown that these various poisons act more powerfully upon the peripheral nerves than upon the spinal cord itself. So that cases of paralysis due to lead, arsenic, or alcohol, may be in the main occasioned by changes in the peripheral nerves (*see* Neuritis, Multiple), although some changes in the spinal cord may also co-exist, which vary in their nature in different cases. They mostly take the form of atrophy of the ganglion-cells in the anterior cornua, with some amount of surrounding sclerosis, though occasionally minute foci of softening may be met with.

Besides the more specific effects of lead in producing the above-mentioned changes in the peripheral nerves and spinal cord, it commonly induces a condition of lowered vitality which favours the development of degenerative conditions in the spinal cord. In such cases it can generally only be considered as one among other determining conditions, tending to bring about some form of paralysis. In this way it has seemed to the writer to be occasionally one of the concurrent causes in the production of primary lateral sclerosis or of progressive muscular atrophy.

These considerations will help to account for the fitful and irregular manner in which arsenic, lead, or alcohol (and probably to a similar extent other toxic substances) give rise to *paraplegic* symptoms in those who have taken them to excess. Thus, according to Tanquerel des Planches, out of 200 cases of lead-poisoning, in only fifteen did the paralysis implicate the lower extremities; and in only one of these did it occur as a distinct paraplegia. This case might, therefore, have been a coincidence rather than a definite result of the taking of lead. Again, in regard to arsenic, it is true that in certain cases Orfila observed paraplegic conditions in dogs which had taken large quantities of this drug; but such symptoms would seem to be met with only occasionally as a result of acute arsenical poisoning in man, and with equal rarity in those who habitually consume large quantities of this substance.

The notion was advanced by Moxon that a certain class of poisons, which own the common property of being 'depressants of the circulation,' have a tendency to paralyse the hind-legs rather than the fore-legs of animals. In this group are included aconitine, conine, and possibly also veratrine, chloral hydrate, and prussic acid. He was of opinion that these drugs act by causing further impediments 'to the exceedingly and peculiarly difficult blood-supply of the caudal end of the spinal cord' (*Brit. Med. Journ.* April 2, 1881, p. 498). It should be borne in mind that extreme feebleness of blood-current is of itself a common cause predisposing to the occurrence of thrombosis both in arteries and in veins, and that such a condition may intervene in some of these cases of poisoning, and lead to the development of paraplegia. This would enable us to account for the otherwise inexplicable fact of the maintenance of the paralysis long after other effects of the poison have passed away.

Prognosis and Treatment.—The prognosis in this class of cases is generally good. Often, indeed, the mere cessation from the consumption of the poison, aided by favourable conditions for the maintenance of the general health, suffices to restore the patient to health. In the more severe cases, however, the treatment has to be prolonged, and we must avail ourselves of all the local measures indicated in the article Neuritis, Multiple, in order to bring about a very gradual restoration of the patient's strength.

H. Charlton Bastian.

SPINAL IRRITATION.

—Synon.: Rachialgia; Fr. *Rachialgie*; Ger. *Rückgratschmerz.*

Definition.—Notwithstanding the doubts that have been entertained by many authorities, both British and foreign, spinal irritation is an affection which has a real existence and deserves a special name. Although spinal irritation may be, like other affections, allied with, or caused by, various organic or functional nervous diseases, the name ought to be kept for a special spinal complaint, chiefly characterised by a morbid excitability of the sensitive nerves of the spine, manifesting itself by spontaneous pains, and by tenderness under pressure or when the affected parts are moved.

Ætiology.—Rachialgia is more common in certain countries than in others—more so, particularly, in Great Britain, Ireland, and the United States than in Continental Europe. This probably accounts for the fact that this affection was first studied and described by a number of Irish and American writers. Sex is an important ætiological element: out of 304 cases collected by the two Griffins and by Hammond there were only forty-two men. The writer has seen it in five men only out of more than eighty cases. It occurs chiefly in girls between fifteen and twenty-five. As regards other causes, the most important are excessive walking or driving; violent movements of the spine, or a blow upon it; abuse of sexual intercourse; masturbation; and severe diseases, such as typhoid fever, scarlatina, fever and ague, dysentery, and diphtheria.

Anatomical Characters and Pathology. In simple rachialgia there is no organic alteration that the naked eye can see, or the microscope can show. At most a congestion is sometimes found. Still, organic affections of the spine and its fibrous tissues may give rise to this neurosis, so that a necropsy may show pathological alterations of various kinds in these parts. As regards the physiological pathology of spinal irritation, the symptoms belong to two distinct groups, one composed of local morbid manifestations, and the other of distant ones. As regards the first of these groups, it includes tenderness and the various kinds of pain; there is, in a measure, some similitude between these symptoms and those of neuralgia. The tenderness especially is often similar to that which is detected in some points of a nerve attacked with neuralgia. But there are differences (especially as regards the kinds of pain) which prevent a complete assimilation of rachialgia with a common neuralgia. The group of symptoms appearing at a distance from the spine is composed of reflex or direct effects of irritation of the spinal nerves. Among these symptoms we find referred sensations, muscular spasms, increased tonicity, contraction or dilatation of blood-vessels, trembling, alterations of secretion and nutrition, palpitations or inhibition of the heart, disturbances of breathing, and various others.

Sir Richard Quain communicates to the writer his conviction that spinal pain and tenderness exist more often as transmitted or referred phenomena connected with morbid states of mucous membranes than is generally recognised. Thus he finds pain present over the posterior cervical region in cases of congestion or follicular disease of the mucous membrane of the pharynx and adjacent parts. In the dorsal region the like pains and tenderness are constantly found in cases of gastrodynia, associated, it may be, with morbid states of the mucous membrane of the stomach. In the lumbar and sacral regions similar conditions are traceable in connexion with disordered states of the mucous membrane of the intestines, or of the urinary and genital organs. As we find extreme sensitiveness of the retina in cases of disease of the conjunctiva, or as we find pain at the end of the penis in cases of stone in the bladder, so may we have many of these other reflex or referred troubles in connexion with distant disorders.

Symptoms.—*Spinal tenderness.*—This is the essential and only constant feature of rachialgia. Its existence, however, might not be found out if questions were merely asked, or a cursory examination were made, as the symptom may be slight and localised in, or rather around, one vertebra, and the patient may not be aware of its presence. It may be found in any part of the spine, and correspond to only one, to many, or even to all of the vertebræ. When very limited, tenderness exists more frequently at the lower part of either the dorsal or the cervical region, less often in the latter. The symptom is elicited in two ways—by pressure or by movement. When the tenderness is slight, pressure will succeed in showing its existence, while a movement might prove ineffectual. It is essential to be extremely cautious in making pressure, as not only a considerable and lasting pain may result from sudden and great pressure, but very serious convulsive, paralytic, or psychic manifestations may be produced. The writer has seen cases in which attacks of catalepsy, of tonic, clonic, or choreic movements, of temporary (and in one case of prolonged) paralysis of the lower or upper limbs, of exophthalmos with mental disorder, and the like, had been caused by heavy pressure on the cervical or dorsal vertebræ. Usually the place where pressure gives rise to the greatest pain is the spinous process. Sometimes, however, the disorder is unilateral, and then the seat of greatest tenderness is the transverse process. Very frequently myalgia co-exists with rachialgia, and then the muscular masses so attacked, on one or on the two sides of the spine, are very tender under pressure. There is often hyperalgesia of the skin itself; and the writer found this so great in one case, that any unexpected touch, or even a gentle breath of air on the skin, made the patient (a strong and courageous man) scream out. The tactile hyperæsthesia in that case was also so great that the two points of the æsthesiometer, which on the spine are felt by a healthy person only when distant one from the other at least an inch and a half, were distinctly recognised when distant less than a line, that is, when almost touching each other. In a number of cases sensibility is morbidly increased in every nerve-fibre of all the tissues of one or more vertebræ and of the neighbouring parts. There is no absolute relation between the pain caused by pressure and the constant spontaneous pain existing in many cases, as there may be considerable tenderness without any, or with very little, spontaneous pain, and there may be only moderate tenderness although a constant or almost constant severe pain is complained of.

Tenderness is often discovered by movement of the spine performed voluntarily or involuntarily by the patient, or produced, for diagnosis' sake, by the physician. Generally, however, the pain thus generated is somewhat different from that due to pressure on the spinous processes, and is chiefly, if not only, an increase of the constant spontaneous pain.

Pains referred to the periphery of the body or to internal organs are often associated with local tenderness developed by pressure. These transmitted pains, as well as the local pains caused by pressure, may last for hours, or even for days, showing how carefully the examination for tenderness should be made. It is well, when we have to deal with hysterical or timid patients, to judge of the degree of tenderness more from the sudden and involuntary movement of the spine, when we press upon it, than from the patient's statements as regards the degree of local or referred pains felt. The amount of blushing of the face when a tender spine is pressed upon is also a means of appreciating the degree of tenderness, especially when the affected part is in the lower third of the cervical region, or the upper third of the dorsal region.

Spontaneous spinal pain.—This symptom is less important than tenderness, because it is not constant, and also because it often exists in organic spinal complaints. It is increased in most cases by pressure on the spine or by movement of it. According to Dr. Hammond's observation, it is found in about one case out of three of spinal irritation. The writer believes that its frequency is much greater. It is quite variable in its character and degree. It may consist only or chiefly in a feeling of heaviness, of coldness, of heat, of pricking, or of itching. In many cases it increases, in some cases it decreases, when the sitting or standing posture is assumed. Lying flat on the back usually diminishes it, but sometimes increases it. Its seat is generally at the point where the spinal nerves emerge from the spine, resembling in this respect a neuralgic pain.

Functional disturbances of the viscera.—Rachialgia is often followed or accompanied by various functional disorders, more or less directly caused by it. The stomach and the heart are the parts chiefly affected; but other viscera (the liver, the kidneys, or the bowels) are also sometimes affected.

Vaso-motor disturbances.—These may appear anywhere, but the face exhibits them more often and more intensely than other parts. They consist chiefly in alternations of great paleness and flushing.

Motor disturbances. A fixed contraction of some muscles, especially in the forearm, has been pointed out by Mr. Teale. The late Dr. C. B. Radcliffe said that this contraction does not disappear during sleep. This slight rigidity increases when an effort is made to loosen it. A great variety of other motor disturbances may appear in this affection, as will be mentioned hereafter.

The symptoms of rachialgia necessarily vary with the different regions of the spine.

1. **Cervical Region.**—Spinal irritation is very frequent in this region, although less so than in the dorsal. More than elsewhere, pressure on the spine, when the disorder is in the neck, will produce referred sensations. For instance, pressure on the two upper vertebræ may cause pain in the forehead; pressure on the third and fourth vertebræ a pain in the pharynx; and on the last cervical a pain behind the sternum. According to the best observers, the following symptoms have been noticed in cases of cervical spinal irritation: vertigo, headache, psychical disturbances, insomnia, nightmare, neuralgic pains in the head, face, neck, shoulders, chest, and upper limbs, contraction of flexor muscles in the forearms, clonic spasms, fibrillary movements in the shoulders and arms, disturbances in phonation and deglutition, dyspnœa, spasmodic cough, fainting, and palpitation of the heart.

2. **Dorsal Region.**—This is the region most frequently attacked. The stomach is the principal seat of disturbance in dorsal rachialgia. It shows its irritation by pain, pyrosis, eructations, nausea, and vomiting. Palpitation of the heart is not rare; but dyspnœa and cough are less frequent than in cervical rachialgia. So are neuralgic pains, involuntary movements, and tonic spasms.

3. **Lumbar Region.**—Rachialgia is rarely localised in the lumbar region. It manifests itself or is accompanied by the following symptoms: neuralgia in the lower limbs, myalgia in the lumbar and abdominal regions, painful spasms of the vesical or anal sphincters, uterine and ovarian pains, with or without menstrual disturbances, and disorders of motility, such as tonic or choreic movements in the lower limbs and pseudoparaplegia.

4. **General Rachialgia.**—It is assuredly quite rare to find every vertebra tender. The writer has seen it but twice. But it is not so rare to find cases in which almost every part of the spine is affected. Hyperæsthesia is then usually greater than in localised rachialgia. The pains produced even by the gentlest pressure on one spinous process usually extend to the whole vertebral column. The various symptoms pointed out as due to localised spinal irritation are present here together, and show themselves in the four limbs, the head, the neck, the trunk, and the internal organs—especially, however, in the heart and the stomach.

DIAGNOSIS.—The symptoms of spinal irritation are so characteristic that it is only in cases of complication of this affection with another that doubts might arise. A sprain of the spine, intense congestion of the cellular tissue and of the muscles, and inflammation of the parts close to the spine, involving the fibrous tissue binding together the vertebræ, and due to some traumatic cause, will certainly give origin to the local and sympathetic symptoms of spinal irritation, together with those due to inflammation or considerable congestion. There cannot be a mistake. Two distinct morbid states, then, follow a blow or some other traumatic agency affecting the spine. In the same way we find hysteria coexisting with spinal irritation. Indeed, it is extremely rare to find that hysteria, beginning by any symptom, will not soon be accompanied by some degree of spinal irritation; and, on the other hand, in almost all cases of genuine spinal irritation, more or less marked hysterical symptoms will appear, so that these two affections almost always are, at least partly, blended together. The singular and rare affection described by Trousseau under the name of tetany can hardly be mistaken for rachialgia, not only because the most important symptoms of spinal irritation are absent or very slight in tetany, but also because in this last affection the muscular contraction is generally accompanied by trembling, anæsthesia, and a feeling of great fatigue. Tetanus, and the organic affections of the spinal cord and its meninges, may be put aside, as, although there may be spinal tenderness in some of those affections, especially in meningitis, the other symptoms clearly establish their existence, and not that of mere rachialgia. The same may be said of Pott's disease, or other morbid structural alterations of the vertebræ.

PROGNOSIS.—It is impossible to agree with those physicians who take a light view of spinal irritation. Although a cure can often be obtained, and sometimes very quickly, this affection, when at all severe, will frequently resist treatment, or reappear after a temporary cure. The writer would say, however, that many patients refuse to submit to the most energetic means of treatment, and that, therefore, we cannot know what would have been their fate under better means than those used. Still, death is never caused in a direct way by this affection. Its worst feature is that it renders the patient most miserable, from pains, weakness, and the various functional disorders it produces.

TREATMENT.—In this affection the cause ought first to be removed, if possible. Anæmia exists so frequently, and participates so certainly in the production, or at least in the persistence, of the symptoms, that the writer can easily accept the statement of [illegible] physicians, that certain remedies, such as iron, quinine, the mineral acids, alcoholic stimulants, cod-liver oil, arsenic, and nux vomica, have been used successfully against rachialgia. Indeed, some of these means—one or another, according to special circumstances—ought almost always to be used. The writer's own experience does not confirm that of Dr. Hammond as regards the beneficial effects he attributes to zinc. Internal remedies taken by the mouth are certainly less important than external ones, or medicines used by subcutaneous injection.[1] Hypodermic injection may be used in certain cases, but with great discretion, as the habit should not be encouraged. When the pain or tenderness is localised in a small part of the spine, the writer has obtained great relief from the use of frictions with an ointment composed of aconitine, two grains; veratrine, four grains; and lard, two drachms. Every counter-irritant, including galvanism (if we can look upon it in such a way), has been used with benefit in some cases. Applications of ice and of the actual cautery will be found to be the best. Ice may be employed, finely pounded, as a kind of poultice, applied on a large surface and on the bare skin, or in frictions on the two sides of the spine, and by either process only for three to six minutes, twice a day. If there be no success by these means, the application of a very hot piece of flannel on the principal seat of pain is advisable, followed after five minutes by the application of ice according to one or other of the preceding methods. When the whole spine is tender or painful, each of its three regions should be treated, one after the other. Next if not first in importance is the use of the actual cautery, after the following rules: First, the instrument must be at *white* heat; secondly, its terminal part must have a very small surface; thirdly, it must be applied quickly although firmly; fourthly, on each day of application, three or four cauterisations must be made on each side of the spine, and these irritations must extend over two or three inches in length; fifthly, the operation is to be repeated every day for eight or ten days, care being taken that the instrument be passed each time on unaltered skin. The writer uses a Paquelin cautery, with which there is, when the above rules are strictly adhered to, neither great pain nor a sore produced. The outer layer of the skin dries up and becomes brown, but there is no blister or ulcer or purulent discharge. This is a most valuable means of treatment, especially when the pain and tenderness of the spine are intense.

If all the means already mentioned have failed, or even when they have not been tried, and when the affection occupies a great part of the spine, if the patient is quite submissive and willing to do as she is told, *absolute rest* of the tender and painful parts is to be employed. In Hilton's valuable work on *Rest and Pain*, the rules are given which must be followed in such cases. The words *absolute rest* express exactly what is needed. It would be worse than useless to make a patient with spinal irritation lie down, and stay in bed for two, three, or four weeks, if he or she were allowed to turn in bed, or to move the spine at all at the affected part. If the rest of the part is really absolute and constant, a cure is almost always obtained after a few weeks. So long as this difficult treatment lasts, every attention must be paid to the nourishment, to the state of the bowels, and to the occupation of the mind of the patient. It need not be said that other means of treatment (especially subcutaneous injections against pain) are to be used during the period of rest. Fresh air must be admitted to the room as far as the season allows. The muscles of the limbs (which are to be left without voluntary movement) are to be gently galvanised daily, so as not only to improve their nutrition, but to act also on the general circulation of the blood. On getting out of bed, when it is ascertained that both pain and tenderness have disappeared from the spine, the patient must for a time (a week or more) be most careful to avoid moving much the parts which have been affected.

The writer cannot conclude this article without referring the reader to a lecture by Dr. Weir Mitchell of Philadelphia, in which rules not essentially different from the above are given. *See* 'Rest in the Treatment of Nervous Disease,' in *A Series of American Clinical Lectures*, vol. i. No. 4; New York, 1875.

C. E. Brown-Séquard.

SPINE, Diseases and Curvatures of.

—Synon.: Fr. *Maladies et Corbures du Rhachis*; Ger. *Krankheiten und Krümmungen des Rückgrates.*

General Remarks.—The vertebral column is a complex anatomical structure, consisting of large masses of bone, chiefly cancellous, forming the bodies of the vertebræ; large flat discs of fibro-cartilage placed between the bodies of the vertebræ; and connecting ligamentous structures. On either side of and behind the vertebral canal, in which the spinal cord is placed, are the oblique articulating, and the spinous processes, with which are connected the large group of muscles, whereby the various movements of the spinal column are regulated, and the erect position of the body is maintained.

All these structures are liable to special forms of disease, such as are met with in other parts of the body where similar structures exist. Hence a certain analogy may be traced between the most ordinary forms of disease which occur in the spinal column, and the joint-diseases of the extremities; but the absence of articular cartilage and synovial membrane between the bodies of the vertebræ destroys much of the analogy. Nevertheless, in the ordinary form of disease of the spinal column, or 'Pott's disease,' we have, as its chief characteristics, *caries* and *necrosis* of bone, with *ulceration* of the intervertebral cartilage, accompanied by *suppuration*. The ligaments are, as in other parts of the body, especially liable to the *rheumatic* form of inflammation. The muscles are especially liable to *paralytic* and *spasmodic* affections, such as occur in the muscles of the extremities, and other parts of the body. The spine is also very liable to various forms of *curvature*. Other forms of disease, such as *tubercular deposits*, *cystic* and *malignant growths*, are occasionally met with, but do not require special description in connexion with the spinal column. The diseases of the spinal cord and its membranes are described in other articles. The only affections, therefore, which demand special consideration in this place are (1) Pott's Disease, with its resulting angular curvature; and (2) Lateral Curvature.

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[1] To this general statement an exception ought to be made in the case of remedies directed to the cure of the morbid state of the mucous membrane which may be the origin of referred spinal pains—such as nitrate or oxide of silver, bromides and alkalis combined with belladonna.—Editor.

1. Pott's Disease of the Spine.—SYNON.: Kyphosis; Spinal Caries; Fr. *Mal Vertébral de Pott*; Ger. *Die Pott'sche Krankheit*.

DEFINITION.—A destructive disease of the spinal column, depending upon ulceration of the intervertebral cartilages; generally associated with caries and necrosis of the bodies of the vertebræ; and named after the distinguished surgeon Percival Pott, who first described its pathological characters.

ÆTIOLOGY AND ANATOMICAL CHARACTERS. Pott's disease of the spine may be either of *local* or of *constitutional* origin. When *local*, it results from injury; and the violence may be either *direct* or *indirect*.

The disease may commence either in the intervertebral cartilages, or in the bodies of the vertebræ. In the majority of cases ulceration of one or more intervertebral cartilages occurs, as the result of subacute inflammation; and the adjacent surfaces of the bodies of the vertebræ become destroyed by caries and necrosis. When the disease commences in the bones, primary necrosis occurs in one or more of the bodies of the vertebræ, as it is observed to do in other situations where cancellous bone exists in large masses. In a later stage, the osseous and cartilaginous structures are all involved in the destructive process, abscess may develop, and a chasm is formed in the anterior part of the spinal column, which subsequently becomes bent upon itself, the spinous processes projecting posteriorly so as to produce the distortion described as *angular curvature of the spine*. The angular form of the projection is most marked in the dorsal region, in consequence of the natural curve of the spinal column in a posterior direction, and also from the length of the spinous processes. In the cervical and lumbar regions an opposite condition obtains, and an obtuse posterior, rather than angular, projection occurs; and this may be absent, even in cases of extensive disease.

If the case proceed favourably towards a curative termination, the destructive processes become arrested, and a healthy reparative process is established, terminating in bony ankylosis between the bodies of the vertebræ, which have become approximated after the loss of structure. Ossification also proceeds along some of the ligamentous structures passing between the laminæ, as well as between the spinous processes. Thus the resulting angular, or posterior, projection becomes a persistent deformity—a deformity essential to the cure of the case.

Cases traceable to *direct violence* are of more frequent occurrence in adult life—for instance, the fall of earth from the roof of a tunnel upon the back of a man, in the stooping position; the fall of a sack of wheat upon the back of a person passing under it; or a fall from a ladder. The evidence of direct injury is not so easily obtained when the disease occurs in childhood, but occasionally we see spinal curvature developed in robust and healthy children, who have never had any previous illness, and whose family history is exceptionally good. In such cases we can hardly doubt that some slight accident, met with in boisterous play, must have been the immediate cause of the disease; and in some instances the writer has obtained undoubted evidence to this effect. The immediate symptoms are slight and transient, but in the course of a few months conclusive evidence of the existence of disease is developed.

Indirect violence frequently gives rise to Pott's disease of the spine, and in all probability lays the foundation of the mischief in the greatest number of cases, although the accident, as a producing cause, cannot be traced in every instance, especially when the disease occurs in childhood, as it most frequently does. The kind of accident alluded to is a rick or twist of the spine, as, for example, when a child, imitating the clown in a pantomime, turns head over heels, or when a boy is taken up by the arms and swung round by a man on to his back in play. The latter occurred to a boy who was for several years under the writer's care; the immediate symptoms were not severe, and passed off in a short time, but disease of the spine was gradually developed, with external abscess, through which portions of necrosed bone came away; the boy ultimately recovered.

A fall out of bed has frequently been known to lay the foundation of spinal disease, and in many of these accidents there is no evidence of direct injury to the spine. In young adults, a rick or twist of the spine received in wrestling, and in the rough game of football, or by a fall from a horse, has been known to precede the development of disease without any direct blow upon the spine. In all these cases, the injury done to the articulation is in all probability by laceration of the ligaments, just as in severe sprains at the knee and ankle-joint; and when such an injury occurs in a person of markedly strumous constitution, the destructive inflammatory processes of ulceration and caries usually follow, as they do at other articulations, when local and constitutional causes are combined.

When of *constitutional origin*, disease of the spine is generally developed in children in whom we have sufficient evidence of a strumous constitutional condition, frequently associated with a consumptive family history; still cases are often met with where we have no such indications, but in which the disease has been developed during a condition of induced constitutional debility, that is, after an attack of scarlet fever, measles, or whooping-cough. In this class of cases we have the absence of any history of a local injury, either direct or indirect, and the disease appears to depend essentially upon the constitutional condition of the patient.

Symptoms and Diagnosis. — (1) **Early stage.**—During the early stage of Pott's disease of the spine, that is, before the production of angular curvature—a stage which usually occupies a period of from six to nine months—the symptoms are often so ill-defined that an accurate diagnosis cannot be formed. Two symptoms, namely, pain on motion, and pain on percussion over the spinous processes, have been too generally relied upon as indicating the existence of disease; but both these symptoms are frequently absent when disease exists, and are also present in an exaggerated form when there is no disease, so that their diagnostic importance is uncertain. Still, when present in conjunction with other symptoms, they are often of material diagnostic value. A certain amount of fixity in a portion of the spinal column, that is, a want of flexibility in the stooping position, is of importance as showing a condition of reflex muscular contraction, similar to that which exists at the hip and knee joints, in the early stage of disease.

There are some *regional peculiarities* of importance in reference to diagnostic symptoms; and the special symptoms present, with more or less distinctness in different regions, may be grouped in two classes, namely :—

(*a*) Pain occasioned by certain movements in which particular muscles, attached to the vertebræ which are the seat of disease, are called into play; and pain occasioned by percussion over one or more spinous processes.

(*b*) Attitudes assumed by the patient to avoid pain on motion.

In the *upper cervical region*, a constrained and fixed position of the head, to avoid pain on motion, always exists in the early stage of spinal disease; and the child finding a difficulty in keeping the head in the erect position, acquires the habit of supporting the chin by the hands, the elbows frequently resting on a table or chair. This attitude is of great diagnostic value. Occasionally in this region the disease is ushered in by obscure cerebral symptoms, resembling those of subacute meningitis.

In the *lower cervical* and *upper dorsal regions* there are no very distinctive symptoms, but in children there is not infrequently a troublesome cough, sometimes supposed to be a mild form of whooping-cough, probably depending upon irritation of the recurrent laryngeal nerve.

In the *middle dorsal region* the absence of symptoms in the early stages of Pott's disease is most marked, probably from the comparative immobility of this portion of the spinal column, motion in any direction being very limited; and probably also from the absence of any muscular attachments to the bodies of the vertebræ. Local pain, and pain on percussion, are sometimes present. The patient moves about slowly and cautiously, and generally sits with the arms extended, the hands resting on the chair, to relieve the spine of the superincumbent weight and the effect of pressure at the seat of disease, as well as to assist in breathing.

In the *lower dorsal* and *upper lumbar regions* the early stage of the disease is characterised by pain experienced in the various movements in which the psoas muscles are brought into play, such as the stooping position, putting on stockings, lacing boots, or lifting even a light weight from the ground; the act of going up and down stairs; any attempt to rise suddenly from the horizontal to the sitting or standing position, especially in the morning after a night's rest; any attempt to twist the body round suddenly when lying down, as in the act of turning suddenly from the back to the abdomen. In this region also may be mentioned as a diagnostic symptom the attitude assumed by the patient in the sitting position, as described when disease exists in the middle dorsal region.

(2) **Advanced stage.**—In the second stage of Pott's disease, that is, when angular curvature is developed, any previous difficulties of diagnosis which may have existed are cleared away, and we know the disease

has existed probably from six to nine months, and that a loss of substance in the intervertebral cartilage and bone has occurred. But exceptional cases, in which diagnosis may be doubtful, occasionally occur in two situations, namely, when a posterior projection of the spinous processes takes place, either of the seventh cervical and first dorsal vertebræ, or of the eight or ninth dorsal vertebræ—situations in which it may be said that a spurious form of angular curvature may exist, as an exaggerated condition of the naturally prominent spinous processes existing in these situations. The projection of the spinous processes, when occurring in the lower cervical and upper dorsal region, may be accompanied with such symptoms as local pain on pressure or percussion, and pain extending along the shoulders and down the arms, leading to the suspicion of the existence of disease. When occurring in the lower dorsal region, as it more frequently does in girls, the symptoms in these cases are generally due to muscular debility and hysteria; but as in some cases disease is subsequently developed, the diagnosis should be cautiously given, and any treatment based upon it cautiously followed out. The projection of the spinous processes of the seventh cervical and first dorsal vertebræ may often be traced to a natural conformation and family peculiarity, as we see in some short-necked and round-shouldered persons. This condition often occurs, in a more marked degree, in adults, and is increased by a thickening and hypertrophied condition of the cellular tissue, possibly also by fluid in a bursa; in such cases the neuralgic pains which accompany it are due to a gouty or rheumatic-gouty tendency.

Course, Duration, and Terminations.—The progress of Pott's disease of the spine is extremely variable, but as a general rule, within a period of from six to nine months from the commencement, angular curvature is produced. If the case proceed favourably, without external abscess or paralysis, the disease becomes arrested, and bony ankylosis takes place in about three years. When abscess and paralysis occur, the period of recovery is frequently prolonged to five or seven years. Paralysis from Pott's disease is fully described in another article (*see* Spinal Cord, Special Diseases of: 4. Slow Compression). The subject of psoas and lumbar abscess will be found treated of elsewhere. *See* Lumbar Abscess; and Psoas Abscess.

Recovery from the incomplete form of paralysis which occurs in these cases usually takes place in about two years. When the disease does not terminate favourably in bony ankylosis, death occurs; usually preceded by abscess, paralysis with meningitis, and inflammatory softening of the cord. In children the mortality is probably about one in twenty, and in adults about one in five cases.

Prognosis.—The prognosis in Pott's disease of the spine will be much more favourable in children than in adults, but in both it will be unfavourable in proportion to the rapidity with which the disease pursues its course, and also in proportion to the evidence of a strumous or tubercular diathesis.

Treatment.—The treatment of this disease must be both *constitutional* and *local*. The *constitutional* treatment is of importance. Evidence of a strumous or tubercular diathesis indicates sea-air, abundant feeding, and the exhibition of cod-liver oil with hypophosphite of calcium, iron, and other drugs of the same class.

The *local* treatment, especially, varies very much according to the age of the patient, and the region in which the disease is seated, the principles being essentially recumbency, counter-irritation, and mechanical support. With regard to the local treatment in the *first stage*, absolute recumbency should be insisted upon; and counter-irritation in some form or other, such as by blisters, the actual cautery, issues, or moxas, is also generally useful. Mechanical support to the spine in any form is not indicated in this stage.

In the *second stage* of the disease, that is, when angular curvature has taken place, absolute recumbency should still be insisted upon, for a period of from one to two years at least from the probable date of the commencement of the disease. This is more especially necessary when disease occurs in the cervical or upper dorsal regions, as not only is there a greater tendency to paralysis, and danger to life in this situation; but when disease takes place in the upper and middle dorsal region, and recumbency is not carried out, the ultimate deformity is always much greater than it need be. Absolute recumbency contributes not only to the arrest of disease, but to a diminution of the ultimate deformity.

When this disease occurs in infancy, or in young children, in any region, absolute recumbency must be insisted upon, the child living and being carried about in a spinal tray made of basket-work with a mattress inside. This may be necessary for three or four years. When disease occurs in the cervical or upper dorsal region, extension by the head may be combined with absolute recumbency; and this was first introduced by Mr. Fisher, who used a rack-and-pinion extension movement. The writer has adopted this principle with great advantage in a case of cervical caries, with partial paralysis, but he at first employed the weight and pulley attached to the upper extremity of the plane on which the patient was kept day and night. In other cases the writer has employed extension for the head by a rack-and-pinion movement, attached to a movable couch, so that the child can be placed in a spinal carriage and kept in the open air as much as possible. This must be continued for periods varying from two to four years, with the result of complete recovery from the paralysis, with very slight deformity.

As the case improves, in the course of one or two years, partial recumbency, with mechanical support, that is, recumbency for about half the day, may be substituted for absolute recumbency, and this is especially applicable to cases of disease occurring in the middle and lower dorsal regions, when the disease is not extensive, and appears to be running a slow or chronic and favourable course. As to the kind of support, a piece of thick gutta-percha applied and moulded to the back, whilst the child is lying on the abdomen, and retained by a bandage passed round the body, answers very well for hospital practice. A better kind of support is made of thick leather, blocked on a plaster-of-Paris cast of the back, with elastic in front. The plaster-of-Paris jacket applied during suspension, introduced into this country by Professor Lewis Sayre, of New York, in 1877, is very useful, especially in out-patient practice, where any rules laid down are certain to be disregarded. The principle of applying a form of support to the spine during the progress of disease, whilst the patient is suspended by the head, is novel, and has been very useful, but must be employed with caution. It secures immobility, relieves undue pressure, and diminishes the consecutive or compensating curves, in many cases to a greater extent than can be accomplished by horizontal extension; and plaster of Paris is a very useful material for the purpose, easily obtained, and can be applied by any surgeon. The disadvantages of not being able to remove it for washing purposes, and the liability to the production of sores from pressure and friction, which at first existed, have now been removed by Professor Sayre's improvement in making the jacket to open in front, and fasten by lacing. The material which has now to a great extent superseded the plaster of Paris is the poroplastic felt, which is applied when softened by steam, either when the patient is lying down, or suspended, according to the case; and which, being buckled on in front, can be removed as often as required.

Partial recumbency with mechanical support, in some modified form, must be continued in all cases occurring in childhood long after disease has ceased; and in some cases, in which the resulting deformity threatens to be considerable, even until the completion of growth.

2. Lateral Curvature of the Spine.—Synon.: Skoliosis.

Definition.—A deformity or contortion of the spine, in which the bodies of the vertebræ deviate laterally in a horizontal direction, with or without a corresponding deviation of the apices of the spinous processes.

Ætiology.—The causes of lateral curvature are both *local* and *constitutional*; and as one or other of these causes may predominate, so the cases admit of being arranged in three classes: (1) Cases in which the constitutional largely predominate over the local causes. (2) Cases depending upon constitutional and local causes in about equal degree. (3) Cases essentially depending upon local causes acting mechanically, so as to disturb the equilibrium of the spinal column.

(1) In cases belonging to the first class the spinal curvature generally occurs under twelve years of age. Occasionally it is met with as a congenital affection. Many cases occur in infancy or early childhood, that is, under three or four years of age; but the majority between seven and ten years of age. When congenital, spinal curvature is sometimes associated with osseous malformation, but it also occurs without any such complication. The cases included in the first class can frequently be traced to an hereditary predisposition, lateral curvature occurring in two or three generations, and several members of the same family frequently being affected. The children usually exhibit signs of constitutional debility, and the local causes of curvature cannot be traced, except in infancy, when the children are nursed always on one arm.

(2) In the second class the spinal curvature generally occurs between the ages of twelve and sixteen. Hereditary tendency is not usually traceable. These cases may be arranged in two subdivisions—(*a*) *Cases depending upon induced constitutional or general debility, combined with local causes acting mechanically*; and (*b*) *those clearly of a rickety character.*

(*a*) The local causes are the long continuance of certain unfavourable postures or positions, such as standing on one leg; the sitting position, as in writing or drawing; sitting cross-legged; occupations which render the long continuance of some particular position necessary, such as needlework, book-folding, ironing, nursing children, and carrying heavy weights.

(*b*) The second series includes cases of lateral curvature of a rachitic character, associated with the general rachitic conformation of the skeleton.

(3) In the third class spinal curvature generally occurs previous to the completion of growth. These cases are essentially unconnected with any constitutional affection or hereditary predisposition, and frequently coexist with the natural amount of muscular strength. As local causes, in addition to habits and occupations above referred to, may

be mentioned the effects of a wooden leg, and inequality in the length of the legs from any cause, such as would disturb the equilibrium of the spinal column.

Anatomical Characters.—In the so-called lateral curvature of the spine, *the spinal column* does not yield in a purely lateral direction, as a flexible column would bend; but presents the appearance of a spiral twist, owing to the bodies of the vertebræ turning round in a direction of *horizontal rotation*, so that their anterior surfaces are directed laterally along the convexity of the curvature.

In a severe case this rotation commonly extends to a quarter of a circle in the centre of the curve, and diminishes from this point to the two extremities, so that the vertebræ, unequally turned upon themselves, cease to correspond in their natural relations to each other. This deviation of the bodies of the vertebræ does not necessarily correspond to, nor is it always indicated by, any lateral deviation of the apices of the spinous processes, although such deviation generally exists to some extent. In all cases, however, the internal deviation of the bodies of the vertebræ is much greater than the deviation externally of the apices of the spinous processes.

In all cases of confirmed lateral curvature, whether slight or severe, structural changes exist, varying in degree according to the severity and duration of the curvature. The structures affected are the intervertebral fibro-cartilages, the bodies of the vertebræ, and the oblique articulating processes. All these suffer simply from mechanical pressure, arising from the unequal distribution of the weight of the body. The fibro-cartilages and the bodies of the vertebræ suffer from unequal compression in the concavity of the curve, and become more or less wedge-shaped. The articular facets on the oblique articulating processes, which form the only direct articular connexions between the separate bones of the vertebral column, undergo important structural changes at an early period of the formation of lateral curvature, that is, as soon as it becomes confirmed. These articular facets become altered in their direction and aspects, according to the extent of the lateral deviation, or rotation, of the bodies of the vertebræ. In the lumbar region, where the articular facets are naturally nearly vertical in direction, looking inwards and outwards respectively, they gradually assume, in a severe case of lateral curvature, an oblique direction, looking obliquely upwards and downwards. Mr. Alexander Shaw first directed attention to these changes in the oblique articulating processes, which, as he observes, receive the weight of the body in the act of leaning to one side and are the only bony structures which check the lateral movements of the trunk; and when any such position is long persisted in, the articulating processes, which are soft and imperfectly formed at the age of puberty, become wasted by absorption, as [illegible] pressure. The joints of the articulating processes being situated posteriorly as well as laterally, the spinal column cannot yield in their direction without wheeling partially round. Hence the rotation of the bodies of the vertebræ becomes confirmed, together with the other structural deviations described.

The ligamentous structures, including chiefly the short ligamentous bands passing between and connecting the bodies of the vertebræ and the invertebral cartilages, and also the short articular ligaments connected with the oblique articulating processes, become adapted to the alterations in the bones, and in the articulating surfaces. It is an error to assume that in confirmed curvature the ligaments are relaxed and elongated on one side, and contracted on the other, as generally described; although in the physiological condition described as 'weak spine,' with an inclination to lateral curvature, a condition of muscular debility and general ligamentous relaxation undoubtedly exists.

The muscles have not been shown to exhibit any structural changes in the early stage of lateral curvature of the spine, except in those rare instances in which the curvature depends upon partial paralysis. In the late stages, or in adult cases of long standing, the spinal muscles have been found much wasted, pale in colour, and in more or less advanced stages of fatty degeneration. In the early stages of curvature an increased prominence of the spinal muscles is observed on the convexity of the curve, whether in the dorsal or in the lumbar region; but this does not depend upon any spasmodic or active muscular contraction. The muscles are simply displaced, or pushed outwards, by the angles of the ribs in the dorsal region, and the transverse processes of the vertebræ in the lumbar region, which are thus displaced as a part of the rotation movement described.

Deformity of the Chest.—Other structural changes exist in the ribs, which become distorted and altered in shape, so as to lead to deformity of the chest, characterised by a prominence and flattening of the ribs, which become bent at their angles on the side of the convexity—usually on the right side—and a depression of the ribs on the side of the concavity.

Anteriorly, the symmetrical form of the chest is completely altered; the sternum becomes very oblique, its lower extremity projecting; and the cartilages of the ribs corresponding to the side of the concavity of the curve—usually the left—are prominent, and bent upon themselves. The oblique diameter of the chest, therefore, is increased, but its capacity is altogether diminished, causing considerable disturbance in the relative position of the heart and lungs, and giving rise to functional derangement of these organs.

The pelvis also becomes distorted in lateral curvature, but only in one class of cases, namely, those of rachitic origin, in which the evidence of general rickets is unmistakably present. In all other cases of lateral curvature of the spine, the pelvis is of its full natural size, and well-formed.

Symptoms and Diagnosis.—Lateral curvature of the spine is generally supposed to be indicated by a lateral deviation of the apices of the spinous processes, but such deviation may exist either as a functional or as a structural condition. It may be seen in a case of weak spine with muscular debility and ligamentous relaxation, such as is frequently met with in quickly growing girls; or it may co-exist with rotation of the bodies of the vertebræ in confirmed lateral curvature. The evidence of rotation of the bodies of the vertebræ precedes the lateral deviation of the apices of the spinous processes in many cases, whilst in others the two conditions co-exist, and appear to take place simultaneously; but rotation of the bodies of the vertebræ may proceed to a considerable extent, the bodies moving horizontally through a quarter of a circle, with only very slight deviation laterally of the apices of the spinous processes. It is therefore the evidence of rotation we must look for in cases of commencing structural curvature, and not the lateral deviation of the apices of the spinous processes. Rotation of the bodies of the vertebræ is always evidenced by a posterior projection of the angles of the ribs on the one side, and depression on the other, in the dorsal region; and a corresponding posterior projection of the transverse processes of the vertebræ on the one side, and depression on the other, in the lumbar region. By these conditions alone can the existence of rotation of the bodies of the vertebræ be determined.

Course, Duration, and Terminations.—The progress of lateral curvature is extremely variable, tending naturally towards a process of spontaneous arrest in some cases, and in others to a progressive increase, with proportionate deformity. The course depends very much upon the form and situation of the curvature, especially whether it assumes the character of the so-called 'single' or of the 'double' curve; descriptive terms which, though not anatomically accurate, are sufficiently so for practical purposes. The cases which naturally lead to spontaneous arrest are those in which a double curvature exists, the one in the dorsal, the other in the dorsolumbar region, the two curves being about equal in length; whilst the cases in which a progressive increase of curvature and deformity is certain to occur, are examples of the so-called long single curve, frequently involving the whole of the dorsal, together with a portion of the lumbar region, or the whole of the lumbar and a considerable portion of the dorsal region. In cases of double curvature with a marked irregularity in the length of the curves, increase will also certainly occur, but to a less extent than in the long single curves. The duration and terminations of lateral curvature have already been indicated.

Prognosis.—The prognosis will be unfavourable in proportion to the early age at which the spinal curvature commences, and the evidence of constitutional causes with hereditary tendency; and also in proportion to the inequality in the length of the curves, when double, or in cases of so-called long single curves. The prognosis will be favourable in proportion to the absence of these conditions.

Treatment.—For therapeutical purposes all cases of lateral curvature of the spine may be arranged in three classes: (1) *physiological curves*; (2) *commencing structural curves*; and (3) *confirmed structural curves*.

(1) With regard to the treatment of cases in the first class, *physiological curves*, no mechanical treatment by any form of spinal support should be employed, but reliance placed entirely upon physiological means, such as gymnastic exercises, partial recumbency, and attention to the general health. In some cases an elastic brace attached to stays may be of use.

(2) The second class, *commencing structural curves*, form the only curable cases of lateral curvature, and in their treatment the writer recommends a combination of mechanical support, gymnastic exercises, and partial recumbency. By this combination of physiological and mechanical means, the further progress of curvature will be arrested, and the best opportunity afforded for recovery from such slight structural damage as may have already occurred.

(3) In the third class, *confirmed structural curves*, mechanical support of some kind must be resorted to, and continued during the period of growth, with the hope of preventing increase, and obtaining some improvement in the curvature; but confirmed lateral curvature, whether slight or severe, with its adapted series of structural changes, is essentially an incurable affection. The most efficient retentive spinal support is that form of instrument made with a pelvic belt, and spring plates attached to vertical bars at the back, without any mechanism requiring alteration by the surgeon. In some favourable cases, the stronger spinal instrument, with steel plates attached to levers, and adjusted by rack-and-pinion movements, may be used with advantage. Sayre's plaster-of-Paris

jacket has been largely employed in these cases; but, from what the writer has observed in the practice of others, he disapproves of its application, on the following grounds: That it fails as a curative agent, the gain in height by extension being quickly lost; that it weakens the spinal muscles by its constant use, and hinders gymnastic exercises; that it restrains respiratory movements, and prevents active exercise. These disadvantages have, however, been diminished by the improvement of making the jacket to open in front. Another form of support now in common use is the poroplastic jacket, which when softened by steam is applied in the same way as the plaster-of-Paris jacket during suspension, but is free from the disadvantages of the latter, while it can be removed at any time for the purpose of gymnastic exercises. It acts as an efficient and light retentive support in many cases of incurable curvature. In this class of cases mechanical support, in whatever form it may be employed, must be combined with partial recumbency and gymnastic exercises during the period of growth; but after this period little good will be derived, except from mechanical support, when a disposition to increase of curvature exists. When there appears to be no disposition to increase of curvature, all mechanical support should be discontinued, attention being paid only to the general health.

William Adams.

SPIRILLUM (dim. of *spira*, a twist, a curl).—*See* Micro-organisms.

SPIROCHÆTE. — *See* Micro-organisms.

SPIROMETER (*spiro*, I breathe; and *μέτρον*, a measure). Synon.: Fr. *Spiromètre*; Ger. *Spirometer*.

Definition.—An instrument for measuring the vital capacity of the chest.

Description.—The object of the several instruments that have been designed for this purpose, is to measure the total amount of air expelled from the chest by the deepest expiration following upon the deepest inspiration.

All our knowledge of spirometry is derived from Dr. Hutchinson's exhaustive paper in the *Medico-Chirurgical Transactions* of 1846. The instrument designed by Hutchinson consisted of a mouth-piece and tube communicating with a gasometer of registered and graduated capacity, into which the patient breathed.

A very convenient and accurate spirometer has within the last few years been introduced by Mr. Lowne, which works on the principle of the anemometer. The advantage of this instrument is its portability.

Dr. Waldenburg describes and figures, at p. 202 of his work, *Die pneumatische Behandlung, &c.*, a spirometer similar in principle with Hutchinson's, but more elaborate, and capable of being employed for the purpose of inhalation of compressed or rarefied air.

Dr. Denison, of Denver, Colorado, advocates the use of a modification of Hutchinson's spirometer to test the vital capacity, in association with that of a manometer to test the elastic tension of the lungs, and urges their use especially in life assurance work, and as an aid to selection of suitable climates.

Results.—The chief results of Dr. Hutchinson's labours may be thus summarised. The vital capacity varies according to *height*, *weight*, *age*, and *disease*.

1. *Height.*—There is an increase of 8 cub. in. in vital capacity for every inch in height between 5 ft. and 6 ft. Thus the vital capacity of a healthy person at 5 ft. to 5 ft. 1 in. being 174 cub. in., at 5 ft. 4 in. it would be 174 + 32 = 206 cub. in.; at 5 ft. 8 in., 238; &c.

2. *Weight.* — Excess in body-weight is associated with diminished capacity, in the proportion of about 1 cub. in. per lb. excess.

3. *Age.*—From thirty to sixty years the vital capacity decreases nearly 1½ cub. in. per year.

4. *Disease.*—The spirometer furnishes a very accurate standard of health or of the extent of disease, as regards the chest, the vital capacity in lung-disease diminishing from 10 to 70 per cent.

R. Douglas Powell.

SPITTING OF BLOOD.—A popular name for hæmoptysis. *See* Hæmoptysis.

SPLEEN, Diseases of.—Synon.: Fr. *Maladies de la Rate*; Ger. *Krankheiten der Milz*.

Introduction. — In the *Nomenclature of Diseases* published by the Royal College of Physicians of London, in 1885, the diseases of the spleen are classified under diseases of the lymphatic system. It is now generally admitted that the functions of the spleen are intimately connected with the work of sanguification, through certain special chemical processes (metabolic) giving rise to an assemblage of transformations of proteids, associated in some way, still unknown, with the metamorphoses of the blood-corpuscles. The spleen is most probably one of the seats of formation of the white blood-corpuscles, and of destruction of the red. It contains more *iron* than corresponds to the amount of blood present in it; and its juice contains salts similar to those which occur in the red blood-corpuscles. In pernicious anæmia there is evidence of blood-destruction in the spleen (*see* ANÆMIA, PERNICIOUS). In July 1889, Sir Spencer Wells published a case of successful splenotomy, the hypertrophied spleen weighing over 4 lbs. The interest of this case is enhanced by a report of an examination of the blood of the patient made by Dr. Dreschfeld one year after the operation, when, as in similar cases reported by Credé and others, the blood appeared microscopically to be quite normal. The red corpuscles were of normal size and appearance, and the leucocytes were present in normal proportion.

The most important indications of splenic disease are derived from the constitutional state due to extreme anæmia. This anæmia is characterised by the mucous membranes appearing pale and bloodless, the complexion and general surface waxy, earthy-like, or sallow; there is great debility and gradual wasting, characteristic dyspnœa, a tendency to hæmorrhages, general anasarca and dropsy—phenomena which are due to the poverty of the blood, justly referable to some morbid condition of the spleen, and now generally recognised by the name of *splenic cachexia.*

Another important function of the spleen, in connexion with the other ductless glands, ought not to be lost sight of in the study of its diseases, namely, that it acts as a diverticulum for the accommodation of a relatively large quantity of the blood, upon which those active metabolic processes take place which constitute a special function of the spleen. Its anatomical structure eminently fits it for this. After every meal it is in a state of more or less congestion or hyperæmia, which reaches its maximum about five hours after the taking of food; and it then returns to its normal bulk. Its yielding capsule and its veins, remarkable for their large calibre and great distensibility, even when the distending force is small, sufficiently explain the rapid physiological and morbid congestions with which the organ is affected, as well as the rapid subsidence of splenic enlargements. The ductless glands, and especially the spleen, vary so much in magnitude within healthy limits, that it is difficult to state their usual weight and dimensions. The spleen may, however, be stated to range in weight in the adult from four to ten ounces avoirdupois; but in cases of enlargement weights as high as 18 lbs., 20 lbs., and even 40 lbs., are on record. In atrophic states the writers have weighed it as low as half an ounce. In relation to the body its normal weight is about 1 to 350 or 400 up to the age of forty; and as age advances, the relation becomes as 1 to about 700. It usually measures about 5 inches in length; $3\frac{1}{2}$ inches from the front to the posterior edge; and $1\frac{1}{2}$ inch in thickness. Its bulk averages from $9\frac{3}{4}$ to 15 cubic inches; and its specific weight is about 1·060.

In the following paragraphs the diseases of the spleen will be shortly noticed, mainly in the order in which they are specified in the *Nomenclature* of the Royal College of Physicians of London—namely: (1) Acute Inflammation; (2) Enlargement; (3) Lardaceous Disease; (4) Cancer; and (5) Rare Diseases.

1. **Acute Inflammation.** — SYNON.: *Splenitis.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS. As a *primary* affection, acute inflammation of the spleen is of rare occurrence in this country. It has been known, however, to result from blows, or other kinds of accidental violence; but such injuries are more apt to cause rupture of the organ. It is mainly to the occurrence of hæmorrhagic infarctions that splenitis, with more or less consecutive suppuration, is due. These infarctions occur during the course of infectious fevers; in blood-poisoning, such as pyæmia; and in valvular diseases of the heart, where vegetations of fibrin form on the valves, leading to ulcerative endocarditis, to embolism, or to both. Such infarctions are generally well-defined, more or less rounded masses when limited and in the substance of the organ, but generally wedge-shaped when involving larger portions. The base of the wedge is towards the periphery, where it may cause an elevation of the capsule, the apex being directed towards the hilus of the spleen. The infarctions vary in size from a pea to a hen's egg; and are at first of a dark brown or brownish-red colour, and quite hard. Colour, however, is soon lost, and they become yellowish-white. A margin of acute inflammatory reaction is often well-marked round their boundaries. Under such circumstances the spleen is enlarged, and of a deep purple colour; its tissue so soft as to be easily broken down—about the consistence of coagulated blood. Pus may form, generally in one or more abscesses of variable size; or the whole spleen may be converted into a bag of pus.

Suppurative splenitis has been seen under three forms: (1) As a diffuse infiltration—a splenic gangrene. (2) Cases in which one or more large abscesses are found in the splenic pulp—the result of injury (such as fractured rib); or phlebitis of the splenic vein —from purulent infection, enteric, or other acute febrile affections. (3) Metastatic abscesses from septicæmia, puerperal fever, or ulcerative endocarditis. These are generally situated towards the periphery of the spleen. Splenic abscesses have been known to open externally, into the left thoracic cavity, the stomach, the transverse colon, and the cavity of the peritoneum, where circumscribed peritonitis generally forms a limiting sac for the pus.

Splenitis may also terminate by the in

farction caseating, or becoming a mass of fibrocellular substance, which, gradually shrinking up, leaves a cicatrix-like contraction on the capsular surface, in which calcification may occur. These infarctions in the spleen correspond to the areas which mark the terminal divisions of the branches of the splenic arteries, the change commencing beyond where the vessels break up into the hair-pencil-like small twigs known as *penicilli*.

Secondary splenitis is generally the result of pyæmia, or blood-poisoning, ending in abscess. Such pyæmic blocks or infarcts resemble the simple infarcts in shape, but they are more irregular, because the process tends to extend beyond the limits of the area of the terminal twigs of the blood-vessels; moreover, they rapidly proceed to suppuration, with inflammation of the superjacent capsule, this rapid progress and extension of inflammation being probably due to the very septic properties of the pyæmic infarct. In such cases there seems to be some spontaneous local coagulation of the blood in the splenic vessels—the blood itself being morbid, as in infectious fevers such as typhus—without any evidence of embolism.

Symptoms and Physical Signs. — The symptoms and physical signs of splenitis are mainly due to the presence of infarcts, and changes associated with them. The hyperæmia and inflammation cause the whole gland to swell. In cardiac diseases, with emboli from valvular vegetations, these infarcts are generally numerous, and the swelling is therefore proportionally great, with tumefaction and some pain in the left side; and probably there is ascites and dropsy. Such splenitis may go on even to suppuration, without marked local symptoms. The enlargement of the spleen—sometimes called 'splenic tumour'—can generally be recognised by palpation, aided by percussion. Its form is that of the spleen exaggerated; and the lobulation or notching of its swollen anterior edge can sometimes be felt through the wall of the abdomen, if the patient be thin. The enlarged gland, growing, as it were, out from beneath the ribs on the left side, can sometimes be traced extending low down, as far as, and even into the pelvic region, well over beyond the right side of the *linea alba*, and backwards towards the spine, where its margin can be separated from the mass of the dorsal muscles. Its lower border can also generally be felt as a rounded edge. The tumour is movable in all directions by manipulation, by change of posture, and by the act of respiration, when adhesions do not fix it. Weight and uneasiness, rather than local soreness, are present. The splenic cachexia exists; and there may occur hæmorrhages from the stomach and bowels towards the fatal end of such cases, often so profuse as rapidly to hasten dissolution.

Diagnosis.—The diagnosis of enlarged spleen, resulting from splenitis due to one or other of the causes referred to, requires the exclusion of lardaceous disease; malignant or other tumours about the cardiac end of the stomach or tail of the pancreas; such swollen conditions of the spleen as exist in Hodgkin's disease; an enlarged left lobe of the liver; and renal, omental, and suprarenal growths.

2. **Enlargement.**—Ætiology and Anatomical Characters.—Simple enlargement of the spleen occurs under a great variety of circumstances; but true, uncomplicated *hypertrophy*, in its simplest form, in which nothing abnormal is to be seen in the spleen or in the blood, is a rare occurrence.

Enlargement with hyperæmia (*congestion* of the spleen) occurs as a result or concomitant of pyrexia in many specific fevers—notably in enteric and malarious fevers, erysipelas and puerperal fever, septicæmia, anthrax, and acute tuberculosis. The capsule of a spleen so enlarged appears very tense. The gland feels plump and elastic; but on section its substance is generally soft, pulpy, almost liquid, very full of blood, and of a dark colour. Sometimes, however, it is so firm that a more or less smooth or coarsely granular surface is shown on section, with an abundant new-formation of small lymph-cells and nuclei, many of them contained in large mother-cells (compound splenic corpuscles), and seen especially in the splenic pulp and vein. This condition constitutes the nearest approach to true hypertrophy, in which, with an increase in the quantity of diffuse granular matter, the enlargement is due less to hyperæmia simply than to increase of normal structural constituents. Thus the organ may attain two or three times its natural size; but the enlargement is only temporary, and subsides as the pyrexia subsides. An acute but temporary congestion is observed in many other infective diseases, such as the exanthemata, cholera, and erysipelas; and it is the first stage of most of the diseases of the spleen. It thus occurs in a number of morbid conditions, which differ widely from each other. This splenic congestion obviously affects the proper function of the spleen in relation to the destruction and formation of blood-corpuscles. In all the infective diseases the enlargement of the spleen seems to be intimately related to the presence in the blood of micro-organisms peculiar to these various diseases; and the blood, arrested for a time in the spleen, undergoes changes in its composition. The micro-organisms, being also arrested in the spleen, cause more or less marked disturbance there. Typical accumulation of micro-organisms in the spleen occurs in malarial fevers, in anthrax, and also in enteric fever. In malarial fevers, the various forms of the malaria parasite, together with its product—the characteristic black pigment — enclosed in leucocytes, abound in the spleen, and give rise to the pigmentation of the organ so constantly associated with these diseases. In anthrax, the blood-vessels, particularly the veins of the pulp, are filled with the *bacillus anthracis*, lying in the direction of the blood-current.

Simple enlargement sometimes results from long-continued *mechanical congestion*, following any obstruction to the portal circulation, or obstructive valvular disease of the heart. But cardiac diseases are less frequently the cause of splenic enlargements than are chronic diseases of the liver, and especially cirrhosis. In hepatic cirrhosis the spleen is generally double its normal size, with its capsule thickened and with numerous peritoneal growths on its surface—a perisplenitis — intimately related to the acute and subacute peritoneal inflammation so generally accompanying cirrhosis.

Chronic congestion of the spleen, especially in cirrhosis, ends in induration of splenic tissue.

Enteric fever is one of the infective diseases in which the spleen is always affected, when it may be found to be enlarged to more than double its normal size—an enlargement less marked in the adult than in children. It is then also less firm than in health, greatly infiltrated with blood, and the colour of its parenchyma is brown or pink. In extreme cases it may be almost diffluent, and between the tenth and fifteenth day it is always soft and granular, when tumefied lymph-cells, often multinucleated, and containing one to eight or ten red blood-corpuscles, may be counted in a single protoplasmic lymph-mass. Towards the end of the fever the spleen again diminishes; its parenchyma becomes less rich in blood; the lymph-cells contain fat-granules, with red pigment; and pigment-granules are found free in its pulp. As in malaria and anthrax, so in enteric fever the specific organism tends to accumulate in the spleen. In a considerable number of cases rupture of the spleen has been found in enteric fever. Hence the necessity of great caution in percussion over the spleen, and manipulation of the abdomen over this organ, in such patients.

The enlargement consequent on *malaria* is fully described in another article. *See* MALARIA.

There only remain to be noticed two special forms of splenic enlargement—one classified by the College of Physicians as a sub-variety, namely, *leucocythæmia* or *leukæmia*; the other a peculiar enlargement originally described by Dr. Hodgkin—*lymphadenoma*. *See* LEUCOCYTHÆMIA; and LYMPHADENOMA.

3. **Lardaceous Disease.**—Albuminoid disease is rarely limited to the spleen, but usually also affects the liver, kidneys, and sometimes the intestinal villi in the same patient. The trabecular interspaces, but more commonly the Malpighian sacculi, are filled with the new material, so that each corpuscle looks like a sago-grain. The spleen so affected is usually enlarged, and is specifically as well as absolutely heavier than in health. It tends to assume a globular form, with rounded, blunt, and thickened edges. While the central artery of the glomerulus may be intact, the walls of the arterioles and capillaries, and most of the elements of the splenic corpuscles, the lymph-cells, and the retiform tissue, are the sites of infiltration of the new amyloid material, which is readily stained of a reddish-violet colour with methyl-aniline violet, or of a mahogany-brown with a watery solution of iodine in iodide of potassium. *See* ALBUMINOID DISEASE.

A lardaceous spleen implies a long-standing cachexia, and in its most intense form is seen after protracted caries and necrosis of bone, especially when associated with scrofula or syphilis; or even after external injury which leads to protracted bone-disease. Hence the question is still undecided whether lardaceous disease arises from such local sources, or is a constitutional or general disease.

4. **Cancer.**—Cancer of the spleen is extremely rare as a primary lesion. It chiefly occurs as an infective process following cancer of the stomach or other viscus; or as generally disseminated encephaloid growths.

5. **Rare Diseases.**—Here it is only necessary to mention hydatid disease, tubercle, and the splenic enlargement occasionally occurring in congenital syphilis. Tubercle of the spleen is frequent in children, but rare in adults, and is usually in the form of miliary granules disseminated in the splenic pulp. It is always secondary to tubercle elsewhere, and commences in the reticulated tissue of the pulp. The centres of the nodules become caseous and the cells atrophy; while characteristic giant-cells may be found in the centres of tuberculous nodules. The bacilli of tuberculosis have also been demonstrated in the nodules by Ehrlich's method. In artificially produced tuberculosis in the guinea-pig and rabbit, by injection of tuberculous matter into the peritoneal cavity, the spleen (as in anthrax and enteric fevers) is almost always profoundly altered. It is enlarged and large quantities of bacilli accumulate in the nodules and in the cells of the splenic pulp.

TREATMENT.—Treatment of these diseases of the spleen by medicinal remedies is extremely uncertain, as can readily be understood from what is known of their pathology. All sources of mechanical congestion must, if possible, be removed or relieved. Saline purgation may be useful for this purpose; also compound jalap powder, with rhubarb and sulphate of iron, may be taken in such quantities as will produce three or four stools in the twenty-four hours. In employing measures of this description, regard must be had to the anæmia so usual in splenic disease, and care must be taken not to aggravate this by depletory means of too violent a character. Should abscess form and be considered surgically accessible, it must be opened and drained. The diagnosis of abscess of the spleen is by no means an easy matter, however, for rigors and other hectic symptoms have not always the same significance when they occur in connexion with splenic disease as in the case of most other organs. Nor, when in doubt, may we use the aspirator with the freedom we can employ in hepatic disease. In not a few instances fatal intraperitoneal effusion of blood has followed exploratory puncture of the spleen—a proceeding, therefore, which must not be lightly undertaken. The iodides and bromides of potassium have been recommended in splenic tumour. The biniodide of mercury, in the form of an ointment, rubbed into the skin so as to produce irritation, has also a reputation for reducing simple enlargement when not otherwise complicated. It is a question, however, if the same effect is not brought about by simpler counter-irritants, such as the liniment of iodine, which, while less troublesome to apply, expose the patient to no such risks as ptyalism or an aggravation by the mercurial of the anæmia so commonly associated with splenic disease. In the chronic enlargements of leucocythæmia and Hodgkin's disease, improvement of the general health is the most that can be permanently effected, by the employment of tonics, change of air, and attention to the hygiene of the patient. *See* LEUCOCYTHÆMIA; and LYMPHADENOMA.

WILLIAM AITKEN. PATRICK MANSON.

SPLENIC FEVER.—*See* PUSTULE, MALIGNANT.

SPLENISATION.—A morbid state of the lung, in which it somewhat resembles the spleen in colour and consistence. *See* LUNGS, Compression of.

SPORADIC (σπείρω, I scatter).—This term is used in connexion with diseases which occur occasionally, and in an isolated manner, amongst individuals; as distinguished from those which prevail endemically or epidemically. *See* DISEASE, Classification of.

SPORADIC CHOLERA.—*See* CHOLERAIC DIARRHŒA.

SPOTS.—A popular name for certain forms of eruption on the skin. *See* ERUPTIONS; EXANTHEMA, EXANTHEMATA; and MACULÆ.

SPOTTED FEVER.—A popular name for typhus fever. *See* TYPHUS FEVER.

SPRAYS, Therapeutical Uses of.—*See* INHALATIONS.

SPRUE.—*See* PSILOSIS.

SPUTUM.—SYNON.: Fr. *Crachat*; Ger. *Auswurf*; *Sputum*.—This article deals with the diagnostic indications afforded by a microscopical examination of the sputum, and with the requisite methods of preparation. The pathological constituents of the sputum to which definite diagnostic importance can be attributed are comparatively few in number. These will be considered under the following heads: (1) Micro-organisms; (2) Elastic tissue; (3) Curschmann's spirals.

No special description will be devoted to the rare instances in which hooklets derived from hydatid cysts in the lung, or portions of laryngeal or pulmonary new-growths may be discovered in the expectoration, inasmuch as these structures require no special preparation for their identification.

1. **Micro-organisms.**—*Tubercle bacillus.* In order to detect the presence of this microbe, it is important to secure a suitable specimen of the sputum for examination. The morning expectoration, representing a gradual accumulation formed during the hours of sleep, is most likely to contain a mixture of the secretions of the respiratory tract, and is therefore most suitable for the purpose. Moreover, the sputum expelled at this time is less likely to be contaminated with particles of food. The expectoration, having been collected in a clean vessel containing no disinfectant solution, should be poured out into a flat glass dish in order to facilitate the preliminary examination. Search should be made for the yellowish streaks or specks which can generally be recognised even in sputa which seem to be purely mucous. Where the secretion is more or less opaque throughout, the thickest and most curly parts are to be selected. With the help of a scalpel, needle, platinum-wire, or, as Ehrlich suggests, a fine steel pen with one of the nibs broken off and fixed in an ordinary penholder, a very small portion of the sputum is transferred to a clean cover-glass, and another cover is placed on the first, the two slips being gently pressed together with a pair of forceps. By this means the sputum is distributed in a thin film on the two glasses. A difficulty sometimes occurs with very viscid gelatinous sputa, which resist all attempts to spread them out. In this case, the secretion on the cover-glass should be allowed to dry partially, when there will be no further difficulty

in obtaining sufficiently thin and uniform layers on the two surfaces when the glasses are pressed together. The cover-glasses are now separated by a slight sliding movement, and allowed to dry thoroughly, after which they are passed rapidly face upwards three times through the flame of a spirit-lamp or Bunsen burner to coagulate the albumen. They are then ready for staining. The following reagents are required:—

A. A solution of fuchsine. Several different formulæ have been proposed, but either of the two following may be adopted:—

(1) Ehrlich's solution, consisting of 11 c.c. of a saturated alcoholic solution of fuchsine added to 100 c.c. of a saturated watery solution of aniline oil. This fluid is very unstable, and should be made freshly each time it is required. Small quantities may be prepared by pouring five or six drops of the alcoholic solution of fuchsine into a watch-glass full of aniline water.

(2) Ziehl's solution, or carbol fuchsine, consisting of 10 c.c. of a saturated alcoholic solution of fuchsine added to 90 c.c. of a 5 per cent. watery solution of carbolic acid. This solution has the advantage of being much more stable than the first, and may be preserved for several months.

B. A 25 per cent. solution of sulphuric acid.

C. A concentrated watery solution of methylene blue.

The staining fluids must be filtered each time they are used.

The cover-glasses on which the sputum has been dried are placed in some of the fuchsine solution (A) in a watch-glass or glass capsule, and the fluid is heated cautiously over a spirit-lamp or on a sand bath until bubbles begin to rise. The solution is then allowed to cool for two or three minutes, after which the cover-glasses are removed with forceps and dipped into some of the acid solution (B) for two or three seconds, and then quickly washed for about ten seconds in a fine stream of water flowing from a tap. The preparation has a deep red colour when removed from the fuchsine, but assumes a yellowish-grey appearance in the acid. When subsequently washed in water, the specimen again turns red. Next the cover-glass is stained with the blue dye (C) for about a minute, and again washed for five or six seconds in a stream of water. The excess of water is then drained away, and the cover-glass is allowed to dry. The process may be shortened by drying the cover-glass cautiously between two pieces of filter-paper. When the specimen is thoroughly dry, it is mounted in a drop of Canada balsam dissolved in benzol or xylol.

For the recognition of the tubercle bacilli, a magnifying power of 250 to 300 is sufficient in most cases, if the illumination be brilliant. Abbé's sub-stage condenser greatly facilitates the detection of the bacilli; and in all doubtful cases, where the microbes are scanty, the combination of Abbé's condenser with a one-twelfth oil-immersion lens is indispensable. With the method of staining above described, the bacilli appear as delicate crimson rods, in length from one-quarter to one-half the diameter of a human red blood-corpuscle. The rods may present a uniform bright red appearance, the staining may be unequal, or the microbes may present a beaded appearance resembling a string of red granules. The last result of staining has been attributed to the presence of spores in the bacillus. No clinical importance can be attributed to these morphological differences. Various other bacilli and micrococci contained in the sputum, as well as the nuclei of cells and filaments of mucin, take the blue stain, contrasting sharply with the red tubercle bacilli.

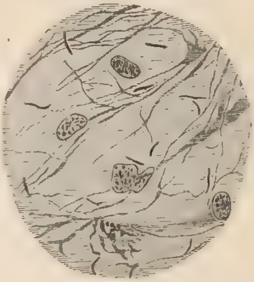

Fig. 158.—Tubercle Bacilli in Sputum. × 550.

The bacilli are seen as dark rods, lying amidst threads of mucus and a few pus-corpuscles.

The clinical recognition of the bacillus is based on the staining reactions involved in the foregoing process devised by Ehrlich. The bacillus of tuberculosis is distinguished from all others, with the exception of the leprosy bacillus, by the fact that it retains the stain of certain aniline dyes when exposed to the action of strong mineral acids, other bacilli becoming decolorised by this process.

The following is Ehrlich's explanation of the results of his method:—

In order to stain the tubercle bacillus successfully, a combination of a salt of aniline with aniline itself, or with phenol, is required. The double compound thus formed is an oily, comparatively insoluble, substance of a brilliant colour, which becomes deposited in the protoplasm of bacilli and cells generally. The tubercle bacillus takes up watery solutions of the aniline dyes with great difficulty, but is readily stained when certain of these dyes are combined with aniline or phenol. This peculiarity probably depends on the existence of a special sheath enclosing the bacillus. The sheath resists the passage of watery and acid solutions, but is readily permeated by oily substances like aniline or phenol, and by alkalis.

In Koch's original method, an alkaline solution of an aniline salt was employed to stain the bacilli.

Aniline, or phenol, therefore, has a twofold function: it combines with an aniline salt—fuchsine (hydrochlorate of rosaniline)—to form a pigment of extreme brilliancy; and at the same time it moistens or alters the bacillary sheath in some way so as to allow of the diffusion of the dye into the protoplasm of the bacillus, where it is deposited in fine particles. When the pigment is exposed to the action of a strong acid it becomes converted into a highly soluble but colourless tri-acid salt, in consequence of which the cells, mucin, &c., are decolorised; but, owing to the resistance offered by the sheath of the bacillus, the acid does not come into contact with the dye deposited in the substance of the microbe for some time, and the staining therefore remains. Prolonged exposure to the action of the acid results in decolorisation of the bacilli also; but for a certain period of time, which is liable to variation, the addition of water causes the red colour to reappear. This depends on the action of water decomposing the tri-acid salt into the mono-acid pigmented salt and free acid. Ehrlich supposes that the prolonged action of a strong acid on the delicate sheath so alters the latter that it permits the diffusion of the comparatively small molecule of mineral acid, but resists the passage of the highly complex and large molecule of rosaniline hydrochlorate. Thus the pigment is retained in the protoplasm of the bacillus.

SIGNIFICANCE.—The discovery of tubercle bacilli in the sputum is a decisive proof of the existence of tubercular disease of some part of the respiratory system. In cases of tuberculosis of the air-passages, bacilli are discharged from the surface of the ulceration; but the number derived from this source is insignificant as compared with the quantities that come from cavities in the lungs. If we exclude the extremely rare cases of primary tubercular ulceration of the main air-passages, it may be affirmed that a large number of bacilli in the sputum is a certain sign of pulmonary excavation. The size of the cavity or cavities is immaterial, but free communication between a vomica and a bronchus is a necessary condition.

The number of the bacilli is no certain index of the severity or extent of the disease, and may be said to be largely a question of discharge. In some acute pneumonic forms of tuberculosis the microbes may for a time be very scanty, whereas in cases of the most chronic and limited disease the sputum may teem with tubercle bacilli. It has been asserted that where tubercular ulceration of the larynx exists the number of bacilli is always large. This statement is incorrect, as numerous observations have convinced the writer. Complete and permanent disappearance of the bacilli from the sputum is a most favourable sign; but, on the other hand, persistent expectoration of these micro-organisms is not incompatible with a favourable and chronic course of the disease.

Actinomycosis.—In the rare instances in which this disease attacks the respiratory system, the characteristic ray-shaped organisms may be discharged in the expectoration. These appear as minute yellowish granules visible to the naked eye in the purulent discharge. When a drop of the pus is examined without any staining, the rosettes of clubs can readily be recognised with a moderately high power. If dried cover-glass preparations be stained by Gram's method, combined with rubine or eosine as a counter-stain, the mycelial threads and clubs may be demonstrated. The presence of the ray fungus is pathognomonic of actinomycosis. *See* ACTINOMYCOSIS.

Pneumonia.—Among the various microbes that may be found in the sputum of croupous pneumonia two varieties occur with great frequency, namely, short thick rods (Friedländer) and diplococci (Fränkel), both commonly provided with a definite capsule. Diplococci are far more often present than the rod-shaped forms. In dried cover-glass preparations these organisms may be stained by Gram's method, methylene blue, and other dyes.

SIGNIFICANCE.—As similar microbes are sometimes met with in other diseases, such as bronchitis, and in healthy saliva, no definite diagnostic significance can at present be attributed to them. *See* MICRO-ORGANISMS.

2. **Elastic Tissue.**—In destructive pulmonary disease of all kinds, portions of the elastic framework of the lungs are from time to time expectorated, and can be recognised with the microscope. In some cases the elastic tissue may be detected without any special preparation. The sputum is poured out into a flat glass dish, and some of the most opaque parts are selected and transferred to a glass slide; a cover-glass is then pressed lightly on the sputum, and the specimen can be at once examined.

But for general use Dr. Fenwick's solvent method is much more satisfactory. Equal quantities of the sputum and a solution of caustic soda (twenty grains to the ounce) are boiled for a few minutes until the mixture becomes liquefied. It is important not to continue the boiling too long, as the elastic fibres themselves ultimately become much altered in appearance. The fluid is now set aside for two to twelve hours in a tall conical glass, to allow the elastic tissue to sink to the bottom. A drop of the sediment is then withdrawn with a pipette, and examined with the microscope in the usual way. A magnifying power of 90 to 100 diameters is sufficient in most cases; but when the fibres are isolated or much broken up, a higher power may be required. In the latter case, difficulties are apt to arise from the fact that the sputum commonly contains adventitious fibres closely resembling elastic tissue. In some cases the curled-up ends and branching fibres may serve to distinguish the elastic tissue of the lung; but unless some trace of the characteristic alveolar arrangement be recognisable, it is unwise to hazard a positive diagnosis. *See* Microscope in Medicine.

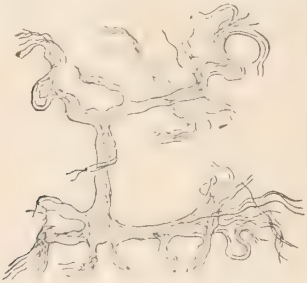

Fig. 159.—Elastic tissue of the lung in Sputum. × 550.

Significance.—The discovery of elastic tissue in the expectoration may be regarded as definite evidence of destructive disease of some portion of the respiratory tract. With rare exceptions, the elastic fibres come from the lung, though at times they may be derived from the larynx or bronchi, in which case no alveolar grouping will be found. Tuberculosis, by far the commonest ulcerative disease of the lung, may generally be suspected when elastic tissue is found in the sputum; but in non-tubercular destructive affections the same discovery may be made. Hence elastic fibres do not possess the pathognomonic significance of the tubercle bacilli. In acutely progressing excavation, large groups of alveoli are often expectorated; whereas in cases of chronic disease the fibres are usually more isolated, and are not uncommonly encrusted with lime salts.

In the sputum of pulmonary gangrene the elastic fibres are generally scanty or ill-defined, and sometimes cannot be recognised at all. It has been suggested that this is due to the presence of a ferment in the gangrenous secretion, which dissolves the lung-tissue.

3. **Curschmann's Spirals.**—In the sputum expelled towards the close of an asthmatic attack, small gelatinous sago-like lumps of mucus are generally present. If these masses be gently pressed out between a cover-glass and a glass slide, certain spiral structures may commonly be recognised. The spirals vary much in size, often being visible to the naked eye, whereas at other times they can only be discovered with the help of the microscope. These structures consist of gelatinous threads of a mucoid substance, coiled in the form of a corkscrew. In many cases a central bright wavy or twisted thread occupies the hollow of the coil. v. Jaksch believes the central fibre to be chemically allied to fibrin, the spiral coil being composed of mucin.

Significance.—These spirals are to be regarded as casts of the bronchioles. Curschmann considers that they are the result of an exudative bronchiolitis, and are causally related to the paroxysms of asthma. The spirals are not pathognomonic of asthma, as they are occasionally found in the sputum of bronchitis and croupous pneumonia. But, as v. Jaksch suggests, their presence in a case of asthma of doubtful nature would stamp the bronchial nature of the attack. Charcot-Leyden crystals (*see* Microscope in Medicine) are often found adhering to the spirals, and sometimes seem to develop after the sputum has been allowed to stand for some hours. v. Jaksch believes that the crystals are products of chemical decomposition of mucin. Percy Kidd.

SQUAMÆ (*squama*, a scale).—Scales. A synonym for scaly diseases of the skin. *See* Pityriasis Rubra.

SQUINTING.—A popular name for strabismus. *See* Strabismus.

STADIUM (Lat., a stage).—A period or stage in a disease, as in fever; for example, *stadium incrementi*, *stadium convalescentiæ*.

STAGNATION OF BLOOD.—Local arrest of the circulation. *See* Circulation, Disorders of; and Inflammation.

STAINS.—This word, as applied to the skin, is synonymous with 'maculæ.' *See* Maculæ.

STAMMERING.—Synon.: Fr. *Bégaiement*; Ger. *Stottern*.

Definition.—Under the head of stammering, in its broadest sense, are included many different forms of defective articulation, such as the inability, congenital or acquired, to pronounce certain letters or certain combinations of letters, the tendency to hesitate or stumble in utterance or to transpose letters or syllables, and the habit of interjecting meaningless sounds or words into the pauses which occur in the course of continuous speech. But the term is generally used, at any rate in English, as synonymous with *stuttering*, to imply a spasmodic affection of the organs concerned in speech, in virtue of which the enunciation of words becomes suddenly checked, and a painful pause ensues, not infrequently marked by a prolongation, or a repetition in rapid sequence, of the particular literal sound at which the check arises.

Ætiology.—Stammering is to some extent hereditary, although a large number of stammerers are certainly free from hereditary taint. It is sometimes imitative. The defect rarely, if ever, shows itself before the age of four or five years. Usually it comes on from this time up to the period of puberty; but it may originate at any age. Sometimes it occurs after febrile disorders; sometimes in connexion with nervous affections, such as epilepsy, hysteria, and tabes dorsalis; sometimes it attends mere temporary failure of health; sometimes it appears in connexion with soreness or irritation of the mouth; sometimes it is induced by simple nervousness or excitement. In many of these cases the stammering is temporary only, and disappears with its cause; and as a general rule confirmed stammerers have their infirmity aggravated under similar circumstances. Occasionally, on the other hand, stammering ceases during the presence of illness. It is a curious fact that men stammer in much larger proportion than women. Cases of persistent stammering, arising in childhood, sometimes recover in the course of time; and, as a general rule, some improvement takes place after the attainment of maturity, and especially as age advances.

Description.—It has often been maintained that stammering occurs only in connexion with the enunciation of the explosive consonants, that it never attends the utterance of the vowels, and that it never manifests itself during the acts of whispering and of singing. All these statements, however, though founded on fact, are more or less inaccurate. For though it is at the explosive consonants *b*, *p*, *d*, *t*, hard *g* and *k*, that stammerers for the most part come to grief, stammering is by no means uncommon during the articulation of the continuous consonants, such as *v*, *f*, *th*, *z*, *s*, *sh*, *y*, *w*, *m*, *n*, and even occurs when vowel-sounds are being produced; and though it is certainly rare for patients to stammer when whispering or singing, there are exceptions to this rule.

When stammering takes place in connexion with the explosive consonants, the barriers by the sudden opening of which after complete closure the several consonantal sounds are produced, instead of separating, as they should do, remain spasmodically closed; and the patient, struggling to overcome the spasm, either remains, for a variable but short time, absolutely voiceless, or, overcoming the resistance fitfully, utters the consonantal sound in a series of two or more successive puffs. In the utterance of *b* and *p* it is the lips which remain closed; in the utterance of *d* and *t* it is the barrier formed by the tongue, whose tip is pressed against the superior incisors or anterior part of the palate; in the production of hard *g* and *k* it is the barrier formed by the pressure of the dorsum or root of the tongue against the posterior part of the palate.

In pronouncing the continuous consonants, the barriers at which the distinctive sounds are produced are not in absolute or uniform contact; and the consonantal sounds are continued during the passage of air through the constricted oral channel or through the nose. When, therefore, stammering attends their pronunciation, it is not due to any spasmodic closure of the parts engaged, but rather to their fixation in the natural position they have assumed, and to the frequent association therewith of more or less rhythmical attempts to close them or to separate them more widely from one another. The resulting sounds therefore either come to a full stop, or are simply prolonged or drawled, or are repeated.

In the utterance of the vowels the mouth and its appendages play only a subordinate part, and a free passage is maintained for the passage of air through the mouth. It is at the rima glottidis that the fundamental sound is produced, and it is mainly to spasm of this part that vowel-stammering is due.

But the hitch in utterance may also originate in the respiratory apparatus, and not infrequently stammering depends on a sudden inspiration or expiration, or on an arrest of the respiratory movements.

It will thus be seen that stammering may be caused by spasm of either of the three mechanisms concerned in the mechanical production of speech, namely, the mouth, wherein words are articulated; the larynx, where phonation is effected; and the respiratory apparatus, which regulates the supply of air to the organs of speech and of music. At the same time there is no doubt that stammering is far more frequently connected with spasm of the muscles of articulation, than with spasm of the larynx or of the respiratory muscles, and that, of the three, respiratory spasm is the least common. Not infrequently, however, the different varieties of spasm are associated in a greater or less degree.

The degree and character of stammering differ largely in different cases. Sometimes it is nothing more than a scarcely perceptible hitch in the enunciation of a particular letter; sometimes it is so severe and continuous that the patient becomes almost unintelligible. The most distressing cases are those in which the spasm extends to parts unconnected with speech, it may be to nearly the whole muscular organism. In such a case the spasm commences, let us assume, at the base of the tongue; the mouth opens widely, and remains in that position; the muscles of expression work convulsively; the glottis contracts; respiration becomes arrested; the face becomes congested and the veins dilated; violent spasmodic movements involve the trunk and limbs; and only after some time, either when the patient becomes exhausted or resolutely restrains the attempts to articulate, does his paroxysm come to an end. A stammerer of this kind is a truly pitiable object. Fortunately for him, however, these severe paroxysms are not always present; they increase in number and intensity under excitement or nervousness; and, on the other hand, may be replaced to a large extent in ordinary quiet conversation by merely slight hitches or drawls or reduplications of letters. A condition allied to stammering, to which the name *Aphthongia* has been given by Fleury, has been occasionally observed. It seems to be the product of intense excitement, and of temporary duration only; and to be characterised by powerful spasm of the muscles supplied by the hypoglossal nerves, including the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles, which comes on whenever an attempt to speak is made, and totally prevents speech.

Pathology.—The pathological explanation of stammering is obscure. There is no reason to believe that it depends on any discoverable material lesion, either of the organs concerned in speech, or of the nervous mechanism which controls them. It appears to be allied to a series of spasmodic affections, which have been especially studied by Duchenne, in which complex coördinated movements (facility in the execution of which is only attained by long practice) are concerned; such, for example, as scrivener's palsy, and the recurrent spasms which occasionally compel the skilful pianist or violinist, or the practised swordsman, to give up his pastime or avocation. Speech is pre-eminently an art of this kind. It is slowly and laboriously learnt in early childhood; and ease and accuracy of articulation are the result only of long and continuous practice. We are born with the capacity for speech, but articulate speech itself is the outcome of careful education. For its successful performance it is necessary that three distinct and complex mechanisms—the respiratory, the phonetic, and the articulatory—shall act with precision and in exact concordance; that the lungs shall be expanded at suitable intervals, and to a suitable degree, and that the force of expiration shall be regulated with nicety; that the rima glottidis shall be opened or closed according as surd or sonant letters are to be produced, and that the tension of the cords shall be accurately adjusted to the pitch of the musical tones required to be produced; and that the movements of the lips, jaws, tongue, and soft palate shall be accurately adjustable for each literal sound, and capable of passing from one set of adjustments to another with rapidity and smoothness. Of all these coördinated movements, those connected with articulation are the most various in their grouping, the most rapid in their changes, and the latest learnt. It is natural, therefore, that the hitch or spasm interrupting speech should occur mainly in connexion with these, and mainly, if not exclusively, at the instant of passing from one literal sound to another; that is to say, at the moment of transition from one set of muscular combinations to another set. It is natural too that the laryngeal or the thoracic spasm should occur rather in association with articulation than at other times; inasmuch as the movements are more various and intricate during articulation than they are during ordinary respiration, or even than they are in the production of musical notes, as in singing. In the last case the laryngeal changes, though extremely delicate and exact, are mainly of one kind only, dependent, namely, on variations of tension in the vocal cords.

Treatment.—In dealing with cases of stammering it is necessary in the first place to counteract, or cure, if possible, any affection of the mouth or throat, or any general disorder that may be present, which are frequent causes of temporary stammering, or of aggravation of habitual stammering. Assuming, however, that the patient is in other respects in absolutely good health, what can be done? Many kinds of medical treatment have been practised, and even operative measures; but, as far as the writer knows, without beneficial result. The only methods, indeed, of any real efficacy are educational methods. The patient should be taught to practise slow and deliberate utterance, and, whenever the tendency to stammering occurs in connexion with any letter, to check himself momentarily by voluntary effort, and then to try again, rather than to struggle against his defect. He should, moreover, be taught to accustom himself so to regulate the admission of air into his chest during speech, that his utterance may never fail for want of breath. Further, considering that excitement and nervousness always aggravate stammering, he should learn, as far as possible, either to avoid speaking under these conditions, or to restrain excitement and nervousness, or so to control himself as to speak with special care and deliberation when he is thus affected. These measures should not only be observed in ordinary conversation, but be habitually and systematically practised in reading aloud; and especially those sounds, or those combinations of sounds, or those transitions from one sound to another, which are most difficult for him, should be made the subject of careful and constant study. By such means habitual stammering is sometimes cured, or, if not cured, so far kept in abeyance that an occasional momentary pause in speech is the only surviving indication of it that the practised ear can detect. More frequently, however, the stammerer remains a stammerer, either because he has never had the patience and determination which are necessary to carry out the line of treatment above indicated, or because his infirmity is one for which treatment is unavailing. By taking advantage of the well-known fact that stammering almost always disappears during singing, many stammerers have been able to counteract their defect by intoning. This method has proved of special efficacy in the cases of clergymen and other public speakers.

J. S. Bristowe.

STAPHYLOMA (σταφυλή, a bunch of grapes).—Synon.: Fr. *Staphylôme*; Ger. *Staphylom.*—This word was applied by old writers, in the jargon which was once supposed to be scientific, to any limited protrusion of the tunics of the eyeball. It was first used to denote the protrusion which occurs in the circumcorneal sclerotic zone, as a consequence of localised inflammation of this region. The tissue affected by the inflammation in such a case becomes softened, yields to the intra-ocular tension, and projects; but being restrained by bands of lymph, or by thicker portions of its own structure, from projecting uniformly, the prominence becomes more or less sacculated; and the most prominent portions, being thinner than the rest, and permitting the dark pigment of the interior of the eye to show through, present an appearance which may be compared to that of a miniature bunch of purple grapes—a real or fancied resemblance from which the term 'staphyloma' was derived. This form has more recently been termed ***staphyloma of the sclerotic***, to distinguish it from ***staphyloma of the cornea***, which is the protrusion left when the corneal tissue has been destroyed by ulceration, either wholly or in part, and the resulting cicatrix, formed of iris-tissue coated over by lymph, yields to the pressure of the fluids within the eye and becomes prominent. Corneal staphyloma is described either as partial or complete, according to the amount of cornea which is replaced by cicatrix.

Staphyloma posticum is a phrase applied to that protrusion of a circumscribed portion of the sclerotic, in the immediate vicinity of the optic nerve, which occurs in some cases of myopia; and which, by increasing the elongation of the eyeball, increases also the degree of the short sight. It would be highly desirable to abandon the term 'staphyloma' in favour of 'protrusion,' with such appended words as might serve to indicate the place and nature of the change. *See* Eye, and its Appendages, Diseases of.

R. Brudenell Carter.

STARVATION (Sax. *steorfan*, to perish).—This term is generally applied either to deprivation of food, or to the series of phenomena to which such want gives rise. The word is often used synonymously with *fasting*, which, however, may be more accurately applied to voluntary starvation. *See* Fasting.

STASIS (στάω, I stop).—Local arrest of the circulation. *See* Inflammation.

STATISTICS, MEDICAL.—This term signifies the collection of numbers respecting healthy and morbid processes, and respecting disease and death; the application of arithmetical and algebraical operations to such numbers; and the deduction of conclusions therefrom.

But little use of statistical methods was made in medicine before the present century; and much of the progress that science has recently made is largely to be ascribed to the direct use of such methods in pathology, ætiology, and therapeutics, and to the indirect influence they have had in promoting accuracy of thought.

The value of statistics depends upon the complete uniformity of the facts observed, and upon the accuracy with which the observations are made. It may be well here to remember the words of Rousseau, quoted by M. Louis: '*Je sais que la vérité est dans les choses et non dans mon esprit qui les juge, et que moins que je mets du mien dans les jugements que j'en porte, plus je suis sûr d'approcher de la vérité.*'

In England much use of statistics has recently been made in the investigation of the causes of disease among communities. *See* Morbidity; Mortality; Periodicity in Disease; Public Health; and Vital Statistics.

G. B.

STEARRHŒA.—Synon.: Seborrhœa; Steatorrhœa; Fr. *Stéarrhée*; *Séborrhée*; Ger. *Talgdrüsenausschwitzung*.

Stearrhœa is an affection of the skin which is far from common in an idiopathic form, but often met with as an attendant on other skin-diseases, such as folliculitis, acne, gutta rosea, and lupus.

Description.—Two varieties of this disease are described: (1) *Stearrhœa sicca*; and (2) *Stearrhœa oleosa*.

1. *Stearrhœa sicca.*—This form is usually associated with folliculitis, and constitutes common pityriasis capitis, or dandriff of the scalp. A similar affection is often met with as a ringed eruption on the back between the shoulder-blades, and on a corresponding part of the chest. This eruption is a variety of follicular inflammation involving the sebaceous glands as well as the follicles, in which stearrhœa is a constant feature; it is very often associated with stearrhœa capitis,

so that it is impossible to dissociate the two diseases.

Stearrhœa sicca is usually met with on the scalp and eyebrows, and in adults is characterised by the formation of dirty-white or yellowish scales. The outermost of these become dry and fall off as a scurf. At the same time the hairs are shed, and those which replace them are imperfectly developed, so that partial baldness is caused. In uncomplicated stearrhœa there is no inflammation of the skin, and little itching; but it generally happens that the affection is associated with folliculitis, and then itching becomes a troublesome feature. This condition of the scalp is commonly known as *pityriasis capitis* or *alopecia furfuracea*, in which the skin becomes covered with great quantities of fine, pearly-white, glistening scales, which are constantly shed and fall upon the shoulders, giving the appearance of the hair having been powdered. There is, in fact, an excessive desquamation of cuticle; and when the hairs participate in the changes, as they often do, the vertex becomes bald. The degree of itching depends on the amount of folliculitis present. Stearrhœa capitis may be mistaken for dry eczema or psoriasis; but these diseases are rarely limited to the hairy part of the scalp, and the changes in the skin are much more marked.

2. *Stearrhœa oleosa.*—This variety of the disease is usually confined to the face, and is a very common complication of acne rosacea. It consists of an excessive secretion of sebum, which is changed in character into an oily fluid. This oil is poured out on the surface of the skin, and gives it a shiny appearance. When dabbed with a piece of blotting-paper, the fluid is absorbed and its greasy nature at once becomes evident. From the ready adhesion of dust, the skin assumes a dirty look which is very characteristic. This affection is especially prevalent in spirit-drinkers.

Treatment.—The treatment of stearrhœa is chiefly local, and consists, in the first instance, in removing any crusts which may have formed from the accumulation of sebum. These should first be softened by a thorough application of oil, and then well washed with hot water and soap. The subsequent treatment consists in the daily use of the white precipitate, or nitrate, or red oxide of mercury ointment, well diluted with vaseline. At the same time the skin should occasionally be washed with a lotion containing a little borax and ether. Before any local treatment is adopted, it should be carefully explained to patients that the process of rubbing off the crusts is always attended with the removal of a large number of loose hairs, otherwise they are apt to think that the loss of hair is caused by the treatment rather than by the disease.

Robert Liveing.

STEATOMA (*στέαρ*, fat; and the termination *oma*, adopted to indicate a tumour). Synon.: Fr. *Stéatome*; Ger. *Steatom.*—An atheromatous cyst. *See* Cysts.

STEATOZOON (*στέαρ*, fat or sebum; and *ζῶον*, an animal).—The names *Steatozoon* and *Entozoon folliculorum* were given by Erasmus Wilson to the microscopic animalcule called by Gustav Simon *Acarus folliculorum*, and by Owen *Demodex folliculorum. See* Acarus.

STENOSIS (*στενόω*, I constrict). — A constriction, narrowing, or stricture of an opening or a tube; for instance, *mitral* or *aortic stenosis*, in the heart; and *stenosis of the œsophagus.*

STERCORACEOUS (*stercus*, dung).—Fæcal; a term generally applied to vomited matter when it presents the characters of fæces. *See* Vomit: Examination of Vomited Matters.

STERILITY IN THE FEMALE. Synon.: Barrenness; Fr. *Stérilité*; Ger *Unfruchtbarkeit.*

Definition.—Want of the power of reproduction in the female.

Frequency.—In the general community the proportion of childless marriages seems to be about 1 in 8 or 8·5; among members of the peerage 1 in 6·11. Whether Kehrer be correct in estimating that the husband is in fault in at least one-fourth of the cases of *sterilitas matrimonii* remains to be proved. Doubtless he is nearer the truth than those who attribute the sterility in nine cases out of ten to some fault in the wife, because whilst the comparatively rare cases of male impotence are readily enough recognised, and also the rarer cases of *aspermatism*, the cases of *azoöspermatism*, where an azoic semen is ejaculated, are for the most part altogether overlooked. The possibility that the cause of the childlessness may be found in the male must, therefore, always be borne in mind. But we confine ourselves here to the consideration of sterility in the female. *See* Impotency; and Sterility in the Male.

Ætiology.—For generation the essential product in the female is the ovum; and in her reproductive apparatus we find (i.) *oviparous organs* for its production; (ii.) *oviducts* for its transmission; (iii.) an *ovigerent organ* or nest in which the ovum is hatched; and (iv.) *copulative organs* for the reception of the semen, the spermatozoa of which constitute the essential contribution of the male. In a married woman in whom the generative function is in abeyance, the sterility may be either primitive or acquired. In the former case we have to do with a female who has never borne a child; in the latter the woman may have borne one or more children, but has for some years ceased to conceive. In either case we search for the fault in one or more of these four planes of her sexual apparatus.

I. **Faults in the Ovaries.**—The ova are developed in the ovaries, and the conditions which interfere with ovulation—that is, the regular ripening of an ovisac, and the discharge of an ovum—diminish or destroy the possibility of conception. Such conditions are found in:—

(1) *Absence* or *imperfect development.*—Cases of absence or defective development of the ovaries are rarely met with, except in women in whom the rest of the sexual apparatus is also anomalous.

(2) *Displacements.*—One or both ovaries may be found displaced. Instead of lying at the level of the pelvic brim, they have fallen into the pouch of Douglas. In this position, though the ripening and dehiscence of the ovisacs may be duly taking place, the discharged ova are not received into the free extremity of the Fallopian tube. The displaced ovary, moreover, is extremely likely to be the seat of some degree of inflammation.

(3) *Inflammation.*—Oophoritis, acute or chronic, lessens the conception-power in various ways. It may lead, first, to destruction of the follicles, so that no ova are produced; secondly, to condensation of the stroma, so that the regular ripening of the ovisacs is impeded; thirdly, to deposits on the surface, which prevent the dehiscence of the ovisacs; or, fourthly, to adhesions of the ovary in situations which hinder the entrance of the discharged ova into the oviducts.

(4) *Degenerations.*—The neoplastic degenerations to which the ovaries are most liable are the cystic; and all the varieties of cystomata, as well as the fibromata, the sarcomata, and the carcinomata, are commonly attended with sterility. Where both ovaries are affected the sterility is absolute, from the complete loss of function in the organs; and even where only one is affected, the disturbance in the relations of the pelvic organs, caused by the growing mass, is likely to prevent impregnation. *See* Ovaries, Diseases of.

II. **Faults in the Oviducts.**—The Fallopian tubes or oviducts serve not only for the reception of the discharged ova, and their transmission downwards to the uterus; they may serve also for the upward transit of the spermatozoa. Lawson Tait maintains that the entrance of spermatozoa into the tubes is pathological; but most authorities are of opinion that in them the male and female elements come into union.

(1) *Absence.*—Defective development of the Fallopian tubes is usually associated with other abnormalities of the sexual apparatus, especially with rudimentary conditions of the uterus.

(2) *Inflammation.*—Inflammatory changes may be found affecting either the external serous covering, or the internal mucous lining. In the former case sterility results from adhesions, which lead to displacements of the free extremities, so that they are not in a position to receive the ova discharged on the bursting of an ovisac; or from bands which constrict the tubes, and so occlude their canal. In the latter, changes in the secretion may prejudice the vitality of the spermatozoa or ova; or the thickenings, polypoidal or other, may obstruct the canal; or complete atresia may be produced, and their permeability be thus entirely lost. *See* Fallopian Tubes, Diseases of.

(3) *Degenerations.*—The tubes are rarely enough the seat of neoplasms; but when such do develop in their walls, occlusion of their canal and consequent loss of function may ensue.

III. **Faults of the Uterus.**—In the process of reproduction, the uterus serves as the receptacle or nest, in which the fertilised ovum is carried during the period of incubation. In its proliferating mucous membrane the chorionic villi take root; through its expanded blood-vessels the fœtal blood is brought into relation with the maternal; its walls grow in correspondence with the increase in size of the ovum; and its largely developed muscular fibres are the main agents in the expulsion of the ovum when it is finally hatched. It plays such an important part in the female economy that the name of it is often used as synonymous with the sexual apparatus; and some of its morbid conditions are among the commonest causes of sterility.

(1) *Defective development.*—First, the uterus may be *absent* altogether, or represented merely by a fibrous nodule. Secondly, it may be *small*, having undergone arrest at some stage of its growth, and remaining infantile, juvenile, or adolescent. Thirdly, it may be *bicornuous*—retaining the trace of its original duplicity by the presence of a septum running through the body alone, or running through both body and cervix, perhaps through the vaginal canal as well. Fourthly, it may be *unicornuous*—only one of the halves of the organ having been developed, while the other tube may be obliterated, or attached as a rudimentary byhorn to the better-developed tube. Fifthly, a more frequent malformation is found in a *conical* form of the *cervix*, which is not infrequently complicated with, sixthly, *narrowness of the os.* This last condition may exist by itself, forming a well-recognised cause of sterility, and furnishing some of the cases in which a most satisfactory cure can be accomplished.

(2) *Displacements.*—First, [illegible] uterus is found as the predominant morbid condition in some cases of acquired sterility, but this is more frequently associated with

the deviations anteriorly or posteriorly. Of these, secondly, the *antrorsions*, flexion and version, are very frequent among women who have never conceived at all; thirdly, the *retrorsions*, flexion and version, are more common in women who have given birth to one or more children, and have subsequently remained sterile. The flexions, in particular, form a very clearly recognisable and often remediable cause of sterility.

(3) *Changes in size.*—The retrogressive changes which occur in the uterus after labour sometimes go on morbidly, and in one group of cases leave the organ in a condition of, first, *super-involution.* The uterus may be reduced to a little tube which only admits the sound for half an inch. Even when the degree of super-involution is less, and the uterus still measures two and a quarter inches in length, it is apt to cause amenorrhœa and sterility. In another group of cases the uterus remains hypertrophied in a condition of, secondly, *sub-involution*, which is inimical to conception; and when conception does take place in such a uterus, abortion is liable to occur.

(4) *Inflammation.*—Among the commonest causes of sterility must be ranked the inflammatory changes to which the uterus is so liable, whether the process have affected mainly the external, middle, or internal coat: and in many of the cases where some other condition tending to sterility is present, inflammatory changes come in to increase the difficulty, and to cloud the prospects of recovery. First, *perimetritis* is usually only an element of a more general pelvic peritonitis, which often leaves behind it fixations and displacements of the uterus, preventing conception or promoting early abortion. Secondly, *mesometritis*, leading to thickening of the walls of the organ, produces an expansion of its cavity and disturbance of its function. It is rarely possible to dissociate this from, thirdly, *endometritis*, which is attended also with dilatation of the cavity, but which is further mischievous from the deleterious influence of its abnormal secretions on the life and progress of the spermatozoa, and from the difficulty with which a fertilised ovum gets healthily engrafted on its surface. Moreover, in certain cases of long standing, some of the uterine orifices may become more or less occluded, a result which is more especially apt to ensue in the external orifice when caustics have been applied to the cervical canal.

(5) *Degenerations.*—First, *myomata*, or fibroid tumours, are found in a considerable proportion of barren women. Whether subperitoneal, intra-mural, or sub-mucous, they interfere in many ways with conception, and give a proclivity to miscarriages or dangerous labours when conception has occurred. Secondly, *sarcomata* have usually their seat in the uterine cavity, and seem to be an absolute bar to impregnation. Thirdly, *carcinomata* have been sometimes met with in the pregnant uterus; but these are commonly seated in the cervix, and it is usually only in an early stage of the mischief that conception can occur. *See* Womb, Diseases of.

IV. Faults in the External Organs.—In various ways the organs which serve for the reception of the spermatic fluid may be so affected that their copulative function is disturbed or destroyed, and the patient remains sterile.

(1) *Malformations.*—Occlusions of the labia are rare; but the vaginal canal may be impervious, firstly, from abnormal conditions of the *hymen*; secondly, from *atresia* in some part of its course; or, thirdly, from complete *absence.* Even it will be found that in certain cases where the rest of the generative apparatus seems to be well-developed, a preternatural *shortness* of the canal is found in some sterile women, from whom the semen escapes immediately after it is thrown into the cavity.

(2) *Injuries.*—The injurious influences of a bad labour on the reproductive power of a woman may be found, first, in an undue *patency* of the canal, usually from extensive rupture of the perinæum; secondly, more frequently from *atresia*, partial or complete; or, thirdly, from *fistulous* formations, leading to communication with the neighbouring cavities.

(3) *Inflammation.*—In its acute stages, inflammation of the pudenda and vagina produces, first, *dyspareunia*; in its more chronic forms it may be productive of, secondly, *unhealthy discharges*, which endanger the vitality of the spermatozoa; or it may lead, thirdly, to *occlusions* of the labia, or of the vaginal orifice or canal. Partly of inflammatory origin is the condition, fourthly, of *vaginismus*, which is not an uncommon cause of impossible connexion.

(4) *Degenerations.*—The various neoplasms occur with rarity in the vaginal canal; but in the pudenda—sometimes from their bulk, sometimes from their sensitiveness—they interfere with connexion, as in cases of elephantiasis labiorum or of urethral caruncle. *See* Vagina, Diseases of.

Diagnosis and Prognosis.—Investigation into a case of sterility may require that we satisfy ourselves as to the fertilising powers of the male, and the due fulfilment of the marital function. Occasionally some concurrent disturbance in the functions of the sexual apparatus of the female, or of the neighbouring organs, may enable us to make a close guess at the cause of her barrenness; but we can only arrive at a true conclusion by a careful physical examination, having in view such a *vidimus* of causes as we have given. Some of the conditions, as, for example, the more pronounced malformations, or imperfect development, make us regard her as hopelessly sterile; others, such as uterine flexions and stenosis, some vaginal occlusions, and injuries and tenderness, we may undertake to treat with good hope of fruitful result.

Treatment.—In commencing the treatment of any case, we must bear in mind that morbid conditions may be present in more than one of the planes of the sexual system, and that we must begin with the removal of the obstacle that lies nearest the surface. Urethral caruncles and other sensitive structures in the vulva must be cut off or cauterised. Contractions of the vaginal orifice or canal must be stretched; and where there is complete atresia an aperture must be formed and kept patulous. Stenosis of the uterine orifices may be overcome by temporary dilatation with a tupelo-tent, which the writer has more than once seen followed by impregnation. Where such dilatation fails, the os may be dilated more permanently, by tearing it with an instrument like a pair of long dressing-forceps, the blades of which are forced apart after it has been passed into the cervix; or by dividing the cervix at both sides, or in one or other lip, with a hysterotome; or the orifice and canal may be dilated by means of graduated bougies. The deviations of the uterus must be rectified: versions, after replacement, being usually retained by some modification of Hodge's pessary, flexions demanding in addition the use of an intra-uterine stem. The stem-pessary of zinc and copper, introduced into the interior, is the best means of stimulating to its full function the imperfectly developed uterus, and the uterus which has withered from super-involution. Morbid conditions in the interior of the uterus require direct applications to its cavity. And as in a large proportion of the cases some inflammatory mischief complicates the other morbid condition, it is often helpful to the cure to make the patient use hot douches and baths, and the internal remedies which tend to remove the effects of inflammatory action. It is to the beneficial influence which the waters of Ems, Aix, Kissingen, and other spas exert on chronic metritis that their reputation for curing sterility is mainly due. In cases where the natural method of getting spermatozoa brought into relation with the ova has failed, success is said to have followed the introduction of seminal fluid by means of a fine syringe and tube into the cavity of the uterus—a line of treatment legitimate, it may be, but only to be adopted in quite exceptional circumstances.

Alexander Russell Simpson.

STERILITY IN THE MALE.—

Synon.: Fr. *Stérilité chez l'homme*; Ger. *Unfruchtbarkeit des Mannes.*—Sterility in the male has been confounded with impotence, no distinction having been drawn between inability to procreate and incapacity for sexual intercourse. A man may, however, be subject to *sterility*, independently of *impotence*. *See* Impotence.

Description.—Sterility may arise from the following causes: (1) Malposition of the testicles; (2) Obstruction in the excretory ducts of the testicle; (3) Impediments to the ejaculation of the seminal fluid; (4) Aspermatism or non-ejaculation; or (5) Azoöspermatism, or absence of spermatozoa from the seminal fluid.

1. *Malposition of the testicles.*—A testicle which does not pass into the scrotum is nearly always small in size, and often undeveloped, not having undergone the enlargement and change in structure which takes place at puberty. A testicle thus detained fails in some animals, as well as in man, to secrete a fertilising fluid; and a male with this defect on both sides, though often potent and efficient for sexual intercourse, is incapable of impregnating the female. Many striking cases illustrating this point have come under the notice of the writer, cases of persons with retained testes, who have married without their wives becoming pregnant, and in whom the fluid emitted in coition has been destitute of spermatozoa—*azoöspermatism*.[1] The facts which have been adduced as opposed to the conclusion that cryptorchics are sterile, are chiefly instances in which they are reputed to have procreated children; but it is remarkable that as yet no case has been found in which a retained testicle has been fully proved to be capable of secreting a fertilising fluid. Spermatozoa have been found absent in almost every case of retained testicle in which search has been made for them.

2. *Obstruction.*—The lymph exuded in the cavity and walls of the excretory duct of the testicle in epididymitis is liable to produce obstruction of the canal. This may be only temporary, the lymph becoming absorbed under treatment. Where the obstruction is complete and permanent, an induration is left in the tail of the epididymis; and when this exists on both sides, sterility is the result. Many curious cases of sterility from this cause have fallen under the writer's observation.[2] They show the great importance of steadily prolonging the treatment of epididymitis, until the enlargement and induration of the part have disappeared. The excretory duct of the testicle is liable also to be interrupted by tubercular deposits in the epididymis. Sterility from this cause in persons with double tubercular disease of the epididymis is not uncommon.

3. *Urethral impediments.*—A close stricture in the urethra so completely interrupts the passage of the seminal fluid, that in

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[1] For detailed [illegible] *Treatise on Diseases of the* [illegible] writer.

[2] Vide *lib. cit.*

ejaculation it regurgitates into the bladder, where it mixes with the urine. This is a condition which is remediable by the cure of the stricture.

4. *Aspermatism.* — Sterility sometimes arises from a cause which has been expressed by the term *aspermatism.* Thus, it is essential to the complete performance of the sexual act, that the local excitement should culminate in the reflex action of expelling the collected semen. Unless this takes place coition is unsatisfactory and fruitless. There are cases of men who never experience ejaculation, even after prolonged coitus, though they are subject to nocturnal emissions. This appears to arise in some instances from defective sensibility in the glans penis, which the writer has endeavoured to correct by the application of the acetum cantharidis to the glans, and by electro-magnetism. In one case of non-ejaculation, the nerves proceeding to the glans appear to have been destroyed by a syphilitic ulcer on the dorsum penis, or to have been compressed in its cicatrisation.

5. *Azoöspermatism.*—A few cases have been recorded of healthy, well-formed male adults, with ordinary sexual desires and sensations, capable of coition, and with seemingly normal ejaculations, who have proved sterile. Repeated microscopic examination of the semen has demonstrated the absence of spermatozoa. No explanation of this condition has as yet been discovered.

Conclusion. — The question may arise whether a man who has the inclination and power to copulate, but who is nevertheless sterile, is justified in contracting marriage. That a man who is unable to fulfil the command, 'to be fruitful and multiply,' is right in disappointing the hopes and perilling the happiness of a woman cannot, in the writer's opinion, be maintained; and he has felt it his duty to give advice in accordance with this opinion. T. Curling.

STERNUTATORIES (*sternuo*, I sneeze).

Synon.: Errhines; Fr. *Sternutatoires*; Ger. *Niesmittel.*

Definition. — Remedies which cause sneezing, and produce an increased secretion from the mucous membrane of the nose.

Enumeration. — The principal sternutatories are Tobacco snuff, Veratrum album, Euphorbium, and Ipecacuanha.

Actions and Uses.— The action of these drugs is simply one of stimulation and irritation of the part to which they are applied; and the slight amount of gentle excitement furnished by snuff has ensured a wide popularity, although diminishing, for this preparation of tobacco.

White hellebore causes almost uncontrollable sneezing when incautiously inhaled, and powdered ipecacuanha-root is well known to cause excessive irritation in exceptional cases. No use is now made of these therapeutical actions, and it seems hardly necessary to retain the term 'sternutatories' any longer in our nomenclature. R. Farquharson.

STERTOR (*sterto*, I snore).

Synon.: Fr. *Sterteur*; *Ronflement*; Ger. *Schnarchen*; *Röcheln.*

Definition.—A term commonly applied to sounds in the throat resembling snoring, which occur in the apoplectic and like conditions. In this article the writer would extend the name to other sounds formed in any part of the respiratory passages or mouth by the movements of the air, under such circumstances.

Varieties.—Several varieties of stertor may be recognised, as follows:

1. *Nasal.*—Nasal stertor arises from approximation of the alæ nasi towards the septum by the in-going air, as in the act of sniffing.

2. *Buccal.*—This form of stertor is due to vibrations of the lips, and puffings and flappings of the cheeks, during inspiration or expiration.

3. *Palatine.*—This arises from vibrations of the soft palate, whether the breath passes through the mouth or the nose.

4. *Pharyngeal.* — Pharyngeal stertor is caused by the lolling back of the base of the tongue into near contact with the posterior wall of the pharynx.

5. *Laryngeal.*—This variety is referable to vibrations of the chordæ vocales.

6. *Mucous.*—Mucous stertor is a term which may be given to the bubbling of air through mucus in the trachea or larger air-tubes.

Ætiology.—One or more of the varieties of stertor, in varying degrees of intensity, may occur in any of the following morbid conditions, namely: Suffocation; epilepsy; convulsions in children; the death-agony; fractures of the skull, and concussion of the brain; bronchitis—particularly in old subjects, sudden œdema of the lungs, and large hæmorrhages into the lungs; great exhaustion; chloroform-poisoning, drunkenness, and opium-poisoning; drowning, and all conditions in which mucus or other fluid is present in the lungs; and all forms of sopor, whether natural or the result of accident or disease.

Description.—The general phenomena of stertor are those of suffocation.

A patient may be found lying in a state of complete unconsciousness, with a congested, turgid, and expressionless face; usually dilated and fixed pupils; insensitive conjunctivæ; a hot and perspiring skin; throbbing arteries; a full and bounding pulse; and, lastly, noisy breathing, the direct result of mechanical interference with the passage of air into or out of the lungs, whether arising from contractions of the orifices, and vibrations of the soft parts of the nose, lips, cheeks, palate, pharynx, or larynx, or from mucus in the trachea and bronchial tubes. When the obstruction to the breathing is only slight, but long-continued, the face may be of a dusky pallor, and there is an entire absence of turgidity and congestion.

Pathology.—All the varieties of stertor, whether manifested singly or in combination, have been usually regarded, especially in the case of apoplexy, as symptoms essentially and mysteriously connected with the primary disease. This is not the true account of their pathology. Whatever may be the original cause, these symptoms only indicate a varying amount of obstruction to respiration, sometimes so great as to be fatal in itself, but only as a secondary and, so to speak, accidental consequence of the primary disorder. Stertor is, in fact, 'suffocation.' In its effects it may be compared with croup; and being equally dangerous, it may equally require relief. But even buccal stertor, which many authors have looked upon as of so grave importance, may not infrequently be observed in ordinary sleep; and the writer has seen recoveries from apoplexy, in which at different times all the forms of stertor have been present. Stertor in apoplexy being, then, apoplexy *plus* suffocation, the whole subject, as regards diagnosis, prognosis, and morbid anatomy, must be approached from a new point of view. The congested and turgid face, the noisy breathing, the *râles* in the chest, the throbbing arteries, and the full and bounding pulse, which are the generally received symptoms of sthenic apoplexy, and which have been regarded as indicating the adoption of venesection and active remedies, are neither more nor less than signs of suffocation. Immediately upon the removal of obstructions to the breathing, all these symptoms disappear, and with them the necessity for active treatment. Long ago Heberden and Fothergill questioned the propriety of bleeding in such cases, and the latter thought that these violent symptoms arose from an exertion of the *vires vitæ* to restore health; whereas they really indicate a struggle to overcome impediments to respiration and circulation. Directly these impediments are removed, all is quiet in apoplexy, and the practitioner is enabled to judge of the real state of the case—which side is paralysed, whether the nerves are losing or recovering their power, and what evidences exist as to greater or less interference with the functions of organic life.

Treatment.—In stertor, as in strangulation, we must proceed at once to remove the impediment to free respiration.

Nasal stertor.—This may be relieved by pressing upwards the tip of the nose, or by keeping the nares open by the handle of a common salt-spoon.

Laryngeal stertor.—In apoplexy this never appears dangerous enough to warrant tracheotomy, which alone would remove it.

Buccal, pharyngeal, palatine, and mucous stertor.—These varieties of stertor are readily treated by placing the patient comfortably on one side, and affording support by well-arranged pillows. In this position the buccal and palatine stertor, if any remain, will be too feeble an impediment to require further attention. The tongue drops to the side of the pharynx, and leaves plenty of room for the in-going air. The mucus or fluid, too, whether resulting from these or other forms of stertor, drains away into the lowermost lung, thus preventing the formation of large foam-vesicles in the trachea (the 'death rattles'), which are always dangerous respiratory impediments. Care should be taken to keep the neck rather straight, as, if the chin be brought too near the sternum, the thyroid cartilage presses upwards and backwards, and pushes the base of the tongue towards the back of the pharynx. In the management of mucous stertor it must be observed that, after a time, varying from one day to three or four, the lower lung becomes filled with mucus, though the patient is still breathing quite placidly. If at this stage the patient be turned over on the other side, the mucus begins travelling across the trachea into the opposite lung; is caught on its passage by the in-going air; and is whipped into foam, which at once blocks up the larger air-tubes of the only lung that can work, and so instant distress and danger result. If the life of the patient be not at once destroyed, still the additional shock reduces very much the chances of ultimate recovery. Under these circumstances change of position should always be tentative, and time for some return of nerve-vigour should be allowed before it is attempted. This warning applies with equal force to all cases where mucus or fluid obstructs the air-passages, as in drowning and bronchitis. In drowning, it may be remarked that the water, on entering the lungs, becomes quickly inspissated with mucus, forming a milky foam, which can only be slowly evacuated by the application of Dr. Marshall Hall's or other process of artificial respiration. *See* Artificial Respiration; and Resuscitation.

Robert L. Bowles.

STETHOGRAPH

(στῆθος, the chest; and γράφω, I write).

Definition.—An instrument for recording the movements of the chest.

The indices in stethometers are adapted to record maximum expansion at any one point. Dr. Sanderson's 'recording stethometer,' described and figured in the *Handbook to the Physiological Laboratory*, [illegible] ally of a tympanum, on one side of which a knob is fixed, for application to the chest-surface. This tympanum is in communication with a second tympanum by means of an air-tube, and the fluctuations of the second tympanum are recorded by a writer upon a revolving surface of paper. By means of this instrument, properly adjusted, the respiratory movements of the chest at any point can be recorded, as regards both depth and rhythm.

R. Douglas Powell.

STETHOMETER (*στῆθος*, the chest; and *μέτρον*, a measure).—Synon.: Fr. *Stéthomètre*; Ger. *Stethometer.*

Definition.—An instrument for measuring the mobility of the chest, and of its several parts, during respiration.

Description.—Various forms of stethometer have been designed. Dr. Sibson's 'chest-measurer' consisted of a simple arrangement by which a rod, attached by a movable rack to an index, might be applied vertically in succession to different parts of the chest (see *Sibson's Collected Works*, vol. ii.). Sir Richard Quain's stethometer consists of a cord attached to an index working on a graduated dial (*Lond. Journ. of Med.*, Oct. 1850). Expansion on the two sides may be measured and compared by means of the double tapes, or the soft metal cyrtometers, held so that the ends overlap in the median line. A more elaborate instrument is that of Dr. Ransome, who has with it made valuable observations on the respiratory movements (*Med.-Chir. Trans.*, vol. lxiv., p. 185).

R. Douglas Powell.

STETHOSCOPE (*στῆθος*, the chest; and *σκοπέω*, I examine).—Synon.: Fr. *Stéthoscope*; Ger. *Stethoscop.*

Definition.—An instrument employed as a medium for the conduction of sound, between the ear and the chest or other parts, in auscultation.

Description.—Stethoscopes are of various patterns. They are commonly made of a thin, cylindrical piece of wood, perforated through its length, which is of about 6 inches to 8 inches; expanded at one end to a somewhat trumpet-like extremity, for convenient application to the chest; and at the other end provided with a nearly flat, broad surface, to which the ear can be comfortably applied. Some practitioners prefer a solid stethoscope—that is, one in which there is no central canal. Such was Laennec's original instrument. Others prefer the stethoscope to be made of metal; others, again, of vulcanite. An instrument made of cedar-wood, with a perforation of about $\frac{2}{10}$ inch in diameter, a chest-piece about $1\frac{2}{10}$ inch in diameter, and a slightly concave ear-piece $2\frac{1}{2}$ inches to $2\frac{3}{4}$ inches in diameter, is perhaps the best adapted for auscultation.

Many auscultators at the present day use the *binaural stethoscope*, which consists of a short hollow chest-piece, of an elongated conical shape, from which two flexible tubes extend, terminating in metal tubes tipped with ivory, to fill the meatus of the ear on each side. This instrument has some advantages. It can be more readily applied to different parts of the chest without the observer being obliged to adopt constrained postures; and by occupying both ears whilst the chest-piece is applied, it excludes extraneous sounds, and considerably intensifies the chest-sounds. One disadvantage is, that sounds produced in the mouth and throat of the patient, which would be recognised by the disengaged ear of an observer using the ordinary stethoscope, are apt to be mistaken for modified pulmonary sounds. Again, with the aid of the rigid stethoscope impulses of various kinds, cardiac or aneurysmal, not recognisable on ordinary palpation, are very appreciable by the ear, which might escape attention with the binaural instrument. Intensification of auscultatory signs, also, whilst perhaps an advantage in the common run of practice, is not so to persons learning auscultation, and whose hearing is not defective.

The *differential* stethoscope, which is a binaural stethoscope having the tube connected with each ear attached to a separate chest-piece, is useful in some cases of heart-disease, and for simultaneously comparing the two sides of the chest—provided the two ears of the observer are of equal auscultatory power. Finally, some practitioners prefer a single flexible tube, with an ear-piece fitting into the meatus, and a chest-piece. It has been attempted to apply the telephone, and even the microphone, to stethoscopy, but as yet without success.

R. Douglas Powell.

STHENIC (*σθένος*, strength). — This term is applied, first, to individuals when they are vigorous and strong, and, secondly, to inflammatory diseases, when they assume an active character, such as *sthenic pneumonia*, as distinguished from *asthenic*. *See* Disease, Classification of.

STIFF-NECK.—A popular name for muscular torticollis. *See* Rheumatism, Muscular.

STILLICIDIUM (*stilla*, a drop; and *cado*, I fall).—The falling of a fluid drop by drop. The term is used to express the flowing of the tears over the lower eyelid in obstructions of the lacrymal passages; also the dropping of the urine in strangury (*see* Eye, and its Appendages, Diseases of; and Strangury). As a therapeutic method of application, stillicidium signifies the dropping of a fluid upon a part. *See* Cold, Therapeutics of.

STIMULANTS (*stimulo*, I stir up).—Definition.—A stimulant is anything which increases the natural function of a part, or which causes a slight degree of superficial irritation.

Enumeration.—Stimulants may be divided into *general*, *cardiac*, *vascular*, and *cerebral*, as Alcohol, Ether, Opium, and Ammonia; *spinal*, including Nux vomica, Strychnine, Phosphorus, Morphine, Ergot, and Belladonna; and *stomachic*, as Aromatic oils, Ginger, Capsicum, Mustard, and other so-called carminative substances.

Actions.—Taking the term 'stimulant' in its widest sense, we are bound to admit that it has very close ties of relationship with almost every other therapeutical group. Thus a drastic purgative is a stimulant to the intestinal mucous membrane; and cholagogues promote the secretion of the liver. So we have stimulating diuretics, diaphoretics, and emetics, and drugs which directly stimulate certain organs or glands, as when ergot evacuates the contents of the womb, or jaborandi causes a copious salivary flow. It is quite sufficient for our present purpose, however, merely to direct attention to these bearings of the subject, which receive fuller notice in other articles, and the enumeration already given shows within what limits we must proceed.

General Stimulants.—The agents which are sometimes called 'general stimulants' act, in the first instance, on the nervous structures of the heart, improving the tone and vigour of the circulation; and, as a result of the increased quantity of blood sent to the brain, the intellectual functions seem to be temporarily augmented. Alcohol in small quantity undoubtedly makes the pulse larger and firmer; gives rise to a pleasant glow and sensation of general warmth; and appears to lend rapidity and freedom to the cerebral operations. Opium, in small doses, has much the same effect. But pushed beyond this point, or given in larger quantity, both these drugs enter upon their sedative and narcotic phase: dulness succeeds the briskness of excited function; and a semi-paralysed condition of nervous energy ensues, ending in sleep. Diffusible stimulants, as they are called, such as ether and ammonia, stimulate perhaps less actively in the first instance; but their effects pass more speedily away, and are not succeeded by any prolonged or well-marked period of subsequent depression.

Vascular Stimulants.—Cardiac and cerebral stimulants are included in what has just been said, but a special division of vascular stimulants is supplied by those drugs which seem to brace up and give tone to weakened vessels. It is thus, no doubt, that we may explain the influence of opium in lending a healthier action to indolent or spreading ulcerations; or to the faculty which quinine seems to possess in high degree of arresting localised suppuration.

Spinal Stimulants.—The best type of spinal stimulant is strychnine, which powerfully excites the reflex functions of the cord, and whose tetanising action is somewhat imitated, in the lower animals at least, by morphine and thebaine. Under this heading we may also include belladonna and carbonate of ammonium, which have a well-marked stimulating influence over the respiratory centre, situated in the medulla oblongata.

Stomachic Stimulants.—Stomachic stimulants run closely on a parallel with tonics, and probably act by gently irritating the mucous membrane, and supplying a sensation strongly resembling the natural physiological craving or desire for food, which constitutes hunger.

Uses.—Whatever views we may hold regarding the propriety of recommending stimulants to persons in full health, the urgent necessity for their administration in certain diseased conditions is one of the fundamental principles of medicine. True although it be that we may often treat acute illness very successfully without alcohol, it is no less an acknowledged fact that, under well-recognised conditions, we are bound to give it to our patients with no sparing hand. When the tongue is becoming dry and brown; when the pulse is weak, soft, rapid, and irregular; when the first sound of the heart is low and muffled; and when muttering delirium is setting in—then we know that the time for wine or spirit has arrived, and that under its judicious use the tongue will moisten, the pulse become slower and firmer, and the sufferer may sink into a refreshing sleep. Good whisky or brandy, or the effervescing wines, are best suited for these emergencies, and must be given at regular intervals and in carefully measured doses, according as the progress of the disease and the condition of the patient seem to render their administration necessary. In convalescence also a little stimulant will promote the appetite and increase the general tone; and good port, Burgundy, or Madeira, or some of the lighter beers, will act well, in virtue of their tonic properties.

Although it seems to be now generally acknowledged that stimulants are not required by the strong and robust, many dwellers in large towns, frequently pursuing unhealthy occupations, subject to much mental strain and worry, and suffering perhaps from depression and want of appetite, derive great benefit from a little sound wine or beer. Under the influence of the stimulant, the secretion of gastric juice is augmented, and more food can be taken and digested; the only caution being that the dose shall be strictly moderate in quantity, and invariably taken with the meals. *See* Alcohol.

The diffusible stimulants also have their place in the treatment of disease when we wish to produce a slighter and more transient effect; and carbonate of ammonium is of especial service in the advanced stages of bronchitis, from its stimulating influence on the respiratory centre.

Nux vomica and strychnine are occasionally used with benefit in spinal disorders when the more acute symptoms have passed away, and when loss of function from sheer debility seems to be the principal obstacle to the recovery of the patient.

The stomachic stimulants find their application in cases when the appetite flags, and when the desire for food requires to be promoted by artificial means. Dwellers in tropical climates make greater use than ourselves of cayenne and other fiery additions to the dietary; and it seems probable that by thus attracting an increased flow of blood to the stomach, more gastric juice may be secreted, and the individual be justified in consuming the greater quantity of food which the increased development of appetite seems to render necessary.

R. Farquharson.

STING: STINGING PLANTS AND ANIMALS.

—Synon.: Fr. *Aiguillon*; Ger. *Stachel.*

Definition.—A sting is an abnormal sensation, partly painful, and partly itching in character, usually caused by the introduction beneath the skin of some poison of animal or vegetable origin. Either increment of the sensation may predominate: the stung surface may be simply painful and tender, or the itching may be intense, and lead to considerable scratching for its relief.

In the widest acceptation of the word, the effect produced by the application to the skin of such substances as mustard, cantharides, strong carbolic acid, and the like, may be denominated as stinging; but here it is proposed to consider only the wounds inflicted by stinging plants and animals. The subject of venomous animals is separately discussed. *See* Venom, Effects of; and Venomous Animals.

Ætiology.—The severity of the sensation and of the local constitutional effects of stinging depends, not only on the quality and quantity of the irritant, but also on individual susceptibility; in some persons the effect may be extremely mild and transient, in others severe symptoms may ensue. In respect to the peculiar susceptibility of the person attacked, the greatest difference is observable amongst individuals, and even in the same person at different times. In many of the recorded fatal cases, the victim had been previously stung and had suffered severely. There seems, however, reason to believe that the system becomes more resistant to the effects after repeated stingings, as is seen to be the case among bee-keepers, and those continually exposed to mosquitoes. Some variations in the virulence of the poison, whether of animal or plant, occurs with the season of the year.

Stinging Plants.—These are almost entirely limited to the order *Urticaceæ*, of which the following species are the most important: *U. urens*, *U. dioica* (British), *U. crenulata*, *U. stimulans* (Indian), *U. ferox* (New Zealand), *U. gigas* (New South Wales), which forms lofty trees, and *U. urentissima* (Java). A few species of the order Malpighiaciæ also possess stinging properties.

In the nettles the urticating organs consist of unicellular hairs tapering towards the free end, each of which terminates in a bent knob, and, swelling out at the attached extremity, is received into a cup-shaped depression of a cellular pedicel. The acrid fluid, the nature of which has not been determined, but is supposed to be an acid similar to malic or acetic acid, is regarded as being secreted by the pedicel and stored in the stinging hair, from which it escapes into the integument when the brittle knobbed tip is broken off by contact. The hairs in the Malpighiads are peltate and not tapering.

Stinging Animals.—Urticating organs, known as *trichocysts*, *cnidæ*, or *thread-cells*, similar in function only to the stinging cells of nettles, are found in many animals, such as the Infusoria, some Annelida, and several Nudibranchiate mollusca. They are, however, best developed and most characteristic in the Cœlenterata, of which the jelly-fishes or sea-nettles are the best known. These organs consist of cells, containing an acrid fluid, and prolonged into a long filament which presents numerous modifications of barbs and serrations. The filament is usually spirally coiled within the cell, from which it is everted on contact, conveying the fluid into the surface that it penetrates. Great variety exists in the form, size, and disposition of these organs; in many of the Actinozoa or sea-anemones they are arranged in rope-like clusters, enclosed in fine tubes, within the body-cavity.

The power of stinging is possessed very generally by members of the articulate subkingdom, such as spiders and scorpions among the Arachnida; bees, wasps, mosquitoes, gnats, and ants among the Insecta. The bite of the flea or bug produces itching rather than a sting. In all cases of true stinging an irritant fluid, thought to be of the nature of formic acid, is introduced beneath the skin by some penetrating organ, which may be connected with the mouth or with the terminal segment of the abdomen, and which is in some animals—as bees, but less frequently wasps—torn out and left in the wound when the sting is inflicted.

Effects.—The introduction of the poison of a stinging vegetable or animal is followed, either immediately or within a very short time, by erythema of the affected part, the surface being red, swollen, and exhibiting all degrees of pain and tenderness. If a mucous membrane, as of the mouth, be the seat of the wound, the swelling is intense, the tongue cannot be protruded, and swallowing becomes difficult or even impossible. Nor are the results limited to the locality of the sting, the erythema often spreading to a considerable extent, from the hands or face, which are obviously the most frequent starting-point, to the arms, neck, and trunk, sometimes presenting the appearance of a scarlatiniform or urticarial eruption. Associated with the local manifestations, general symptoms, often of a most severe and even fatal character, have been known to occur. Well-authenticated cases of death from the stings of bees, wasps, scorpions, and even some species of tropical nettles, have been placed on record. In the majority of such cases the poison has brought on a state of syncope; severe prostration, pallor, and pulselessness being the most general symptoms; and death has been known to occur within a quarter of an hour, or from that to a few hours. Other cases, especially of scorpion stings, are characterised by excitement and some delirium; and tetanic spasms even sufficient to cause death have been not infrequently known to follow the stings of bees, wasps, and spiders (*see* Tarantism). When the case does not prove fatal, recovery is generally rapid and the patient is quite well in a day or two; but this is not always so, and the effects of some nettles, for example, *Urtica urentissima*, the Devil's leaf of Java, are said to last for years.

Treatment.—(*a*) *Local.*—Innumerable applications have been suggested as specifics in cases of stinging. Their efficiency, without doubt, depends mainly upon their being applied to the seat of the sting quickly after infliction. The *modus operandi* of many is quite empirical, but others would seem to decompose the irritating material, and so prevent or arrest its effects. Among those most generally resorted to are alkalis, such as liquor ammoniæ or strong solutions of bicarbonate of sodium or potassium; and it is probable that many popular remedies, such as soap, the 'blue-bag,' &c., depend for their effect upon the alkali they contain. Concentrated solutions or even the pure crystals of alum, and tartaric or other vegetable acids, often afford distinct relief if rubbed in at the site of the sting. The bruised leaves of plants such as the dock, or the juice of a raw onion, applied similarly, will act in the same way. For the more serious stings of tropical plants and animals, more potent remedies are necessary, such as the application of lint soaked in chloroform and laid over the wound; poultices of ipecacuanha, or preferably an extract of the same drug made by mixing equal parts of powdered ipecacuanha, rectified spirit, and ether; or rubbing the part with hydrate of chloral—pure, or liquefied by mixture with camphor, in the proportion of three parts of the former to one of the latter. Menthol camphor will also relieve the pain and irritation; carbolised oil (1 in 20), or even subcutaneous injections of carbolic acid, have been used. The aromatic oils of pennyroyal, lavender, cloves, or cinnamon smeared over the hands and face, are most effective in preventing the attack of mosquitoes, gnats, &c., and often give relief when applied to the stung part.

In the case of bee-stings it is important to search for and remove any parts of the penetrating organ which may have been left in the wound.

(*b*) *General.*—When symptoms of prostration or collapse are produced, stimulation with brandy, ammonia, or ether is an absolute necessity, and one or other of these should be administered without stint, as recovery undoubtedly depends on counteracting the cardiac depression.

W. H. Allchin.

STITCH.—A sharp catching pain in the side, generally associated with pleurisy, pleurodynia, or intercostal neuralgia. *See* Pleura, Diseases of.

STOMACH, Diseases of.—Synon.: Fr. *Maladies de l'Estomac*; Ger. *Krankheiten des Magens*.

The diseases to which the stomach is liable will be considered in the following alphabetical order: (1) and (1*a*) Abscess; (2) Atony; (3) Atrophy; (4) Cancer; (5) Concretions; (6) Contractions; (7) Dilatation; (8) Fibroid Thickening; (9) Gangrene; (10) Hernia; (11) Hyperæmia; (12) Hypertrophy; (13) Inflammation; (14) Lardaceous Disease; (15) Malposition; (16) Morbid Growths; (17) Neuroses; (18) Perforation; (19) Softening; (20) Syphilis; (21) Tubercular Disease; (22) Ulcer; and (23) Vessels, Diseases of.

Several subjects, intimately associated with disorder or disease of the stomach, are discussed separately under special headings. *See* Digestion, Disorders of; Digestive Organs, Diseases of; Eructation; Flatulence; Hæmatemesis; Pylorus, Diseases of; Pyrosis; and Vomiting.

1. Stomach, Abscess in the Walls of.—This is a rare disease, and occurs in two distinct forms. In some cases a *diffused* suppuration is found in the submucous tissue of the stomach, usually in connexion with pyæmia. Acute inflammation of the mucous surface, accompanied by numerous ulcers, is occasionally observed in various infective disorders, and in all probability the form of suppuration just mentioned is the result of the general condition of the system. Under such circumstances symptoms pointing to the implication of the stomach are obscured by those of the general disease.

Abscess of the stômach also occurs as a *circumscribed* collection of pus situated beneath the mucous membrane, often bursting into the cavity of the organ through small openings. It is said by Leube that when such abscesses open into the stomach cicatrisation may take place, with consequent contraction of the lumen of the organ. Most cases have occurred in males. The causes to which the disease has been attributed seem to be too slight to produce such a serious malady. Thus, it has been ascribed to the abuse of spirituous liquors, to over-feeding, to errors in diet, and in a few cases to injuries. The late Dr. Brinton describes the symptoms of this form of gastritis as 'violent pain, and tenderness in the region of the stomach, attended by severe and frequent vomiting, and by high febrile reaction. The pain and vomiting increase in severity, and the tenderness becomes so excessive as to suggest peritonitis; the more so that it is often accompanied by some tympanites, which, however, like itself, sometimes differs from that of general peritonitis in being limited to the epigastrium. By-and-by jaundice may come on. In any case the febrile excitement rapidly merges into prostration, which is associated with delirium, and ends in death in from forty-eight hours to a few days from the commencement of the attack.'

Leube mentions 'that in two cases a tumour, which in one case was as large as the fist, and not particularly painful upon pressure, could be felt in the epigastrium.' It is somewhat surprising that in many of the cases recorded it is stated there was no tenderness on pressure, a circumstance that must be very apt to mislead the practitioner as to the true nature of the malady. In some instances general peritonitis has accompanied the disorder, rendering the diagnosis still more difficult.

Treatment.—When the suppuration in the walls of the stomach is secondary to an acute infectious disorder, the treatment of the local complication is of course secondary to that from which it has arisen. As regards circumscribed abscess, from the rarity of the disease, and the frequent absence of all symptoms pointing to an affection of the stomach, few cases have been diagnosed during life, and consequently the treatment has been directed solely to the relief of such effects as vomiting and peritonitis. In case a tumour should be discovered in the epigastrium in a patient suffering from high fever, the propriety of making an exploratory opening must be considered, inasmuch as if the abscess should prove to be external to, and not in the walls of the stomach, a free opening would be the only means likely to be followed by a good result.

1*a*. Stomach, Abscess around the.—Synon.: Perigastric Abscess.—An abscess occasionally presents itself in the neighbourhood of the stomach, and, on account of the difficulty of the diagnosis, often escapes recognition during the life of the patient.

Ætiology and Symptoms. — Perigastric abscess is usually a complication of gastric ulcer. Only two of the patients whose histories have been reported are said to have enjoyed good health before their final illness. The others had suffered from pain in the epigastrium or abdomen, but in only two is there any mention of hæmatemesis. The great length of time during which the symptoms of gastric ulcer had been experienced is very striking. It is therefore evident that it is only in the very chronic cases of this disease that we can expect the occurrence of perigastric abscess. The final illness of which the patients died was usually ushered in by severe symptoms, and was of short duration. In seven out of twenty-three cases in which details are afforded, sudden collapse occurred, accompanied or followed by pain in the abdomen, tenderness on pressure, distension, and other symptoms of peritonitis. In eleven there was no collapse, but the pain in the epigastrium, from which the patient had previously suffered, suddenly became very severe. The absence of rigors is worthy of remark, as we might naturally have expected they would have accompanied the formation of pus. Details are given in nine cases where collapse was not present, and in all of them severe and continuous pain in the epigastrium or abdomen persisted until death, but there is no record, as might have been expected, of constant vomiting.

Fever is mentioned as a prominent symptom in all. Four of the cases died within two weeks, and two lived more than one month after the commencement of the final illness. Occasionally, temporary recovery ensued; and instances are recorded where the patient was able to return to his employment, and was afterwards attacked with general peritonitis produced by the rupture of the abscess.

Physical Signs.—In a small number of cases no evidence of communication between the stomach and the abscess could be discovered. The physical signs in these cases are, of course, somewhat different from those where such a communication exists, as the contents of the abscess consist in the former of fluid only, whilst in the latter gas and liquid are intermixed. A tumour capable of being distinguished externally is mentioned in only six of the cases of simple ulcer of the stomach, but it was always present when the disease was associated with cancer. The rarity of an external tumour is explained when we remember that in most instances the pus lies very deeply, and is in relation with the diaphragm. In most cases the percussion-note was at first dull, but afterwards it became tympanitic. In one the sound was at first dull, afterwards tympanitic; the tumour then decreased in bulk, after an attack of diarrhœa, and finally disappeared, the contents of the abscess having been discharged through the diaphragm. In another, the line of dulness varied according to the position of the patient, showing that the cavity was of considerable size, and that it contained both air and liquid. The affected side was often considerably enlarged, even when there was no tumour to be felt; and in some cases, where the pus was situated below the diaphragm, the liver or spleen was found to be depressed. In all cases, unless the abscess was of very small size, the diaphragm was thrust upwards and the lower lobes of the lungs were compressed, a condition accompanied by dulness on percussion and increased tactile fremitus, and usually by fine crepitation. If the abscess burst into the pleura, the ordinary evidences of pneumothorax presented themselves. Left pleuritic effusion is occasionally established before, or independently of, actual perforation.

Diagnosis.—When a patient who has long suffered from the symptoms of gastric ulcer is suddenly seized with very severe pain of the epigastrium, which does not spread over the whole abdomen, but is attended by collapse, and when, on recovery from the collapse, the pain persists, with tenderness on pressure and considerable fever, the practitioner may suspect the formation of perigastric abscess. His suspicions will be strengthened if a tumour can be discovered which is tender on pressure, or if a well-marked area of dulness is shown by percussion, which is afterwards replaced by a tympanitic note; or if the left hypochondrium becomes enlarged, or the base of the left lung becomes dull on percussion, accompanied by crepitation and by an increase, not a diminution, of the tactile fremitus. Where perforation of the diaphragm has taken place, the signs of pneumothorax present themselves; but a subphrenic perigastric abscess containing air and pus may give rise to very similar indications. In pneumothorax there is usually a history of cough, dyspnœa, hæmoptysis, or other signs of pulmonary disease; whilst in perigastric abscess the patient has previously complained of pain after food, dyspepsia, or other symptoms pointing to disorder of the digestion. In the former, the whole of the affected side is enlarged, the intercostal spaces are flattened, and the movements of the chest are everywhere absent; whilst, in the latter, the lower part of the chest only is distended, and the upper portion of the affected side still moves on respiration. In pneumothorax there is an absence of the respiratory murmur and of the tactile fremitus all over the affected side; whilst in perigastric abscess the respiratory murmur can be heard for some distance down the side, and is audible at a lower point in forced inspiration than in ordinary breathing. In addition to this, the amphoric sounds are often audible over the whole abdomen, and even to the bottom of the spine, in perigastric abscess, instead of being confined to the immediate neighbourhood of the thorax; the heart is generally pushed to the opposite side in pneumothorax, but is only tilted upwards in the case of perigastric abscess.

Treatment.—In the early stages the practitioner must insist on perfect rest, the least movement of the body being strictly prohibited. Opium should be administered, in order to relieve pain, diminish shock, and prevent vomiting. All food should be withdrawn, and the patient supported on nutrient enemata alone. When clear evidence of the formation of an abscess is obtained, an opening should be made into it, a drainage-tube inserted, and the case treated on surgical principles.

2. **Stomach, Atony of.**—There are numerous cases of indigestion in which the most careful inquiry fails to ascertain any structural change in the stomach. These are usually classed under the head of 'atonic dyspepsia'; and the symptoms seem to arise either from an imperfect secretion of gastric juice, or from the muscular movements of the organ being so enfeebled that the food is allowed to remain an undue length of time in the first part of the digestive canal, or from both of these conditions conjoined.

Ætiology.—A feeble state of the digestion may occur at all ages, but more especially in the decline of life. The stomach, like all other glands, loses its power of secretion as age advances, and consequently we find dyspepsia a common complaint amongst the old. Fibroid changes present themselves in the pyloric end of the stomach in most persons who have passed middle age, the secreting tubes undergoing more or less atrophy, and the adenoid tissue increasing in amount. Females are more liable to atony of the stomach than males, who are more apt to suffer from inflammatory changes in the gastric mucous membrane. It cannot be too much impressed upon the mind of the practitioner that an enfeebled condition of the stomach is a constant result of gastritis, and also that a diminution in the power of the digestion predisposes to attacks of inflammation. Atonic dyspepsia may be an hereditary disease; and when this is the case the symptoms usually manifest themselves at an early period of life. So long as the growth of the body continues, little trouble is experienced in such cases; but from twenty to thirty, when the necessity for great activity of the nutritive power ceases, the patient feels himself incapable of digesting his food as easily as before. It is not, however, necessary that the child should experience the same form of gastric disorder as his parent, for the one may suffer from mere feebleness of digestion, whilst the other may have been liable to the inflammatory form of dyspepsia. It is, perhaps, scarcely necessary to observe that there is no complaint so liable to be excited by errors in diet. A stomach which, although it performs its functions feebly, may be able to digest as much food as is requisite for the maintenance of health, is often incapable of disposing of enough to satisfy the desires of a person who seeks his pleasure in the gratification of his palate. Consequently, one of the most common causes of atonic dyspepsia, more especially amongst the richer classes of society, is to be found in the undue frequency of meals. Every practitioner is consulted by persons complaining of dyspepsia, resulting from food being taken every two or three hours, under the supposition that they are suffering from debility. In reality, the feeling of exhaustion from which they suffer arises from the stomach never being allowed a sufficient period of repose. It is called into renewed activity by the introduction of fresh food before the last meal has passed into the duodenum. Imperfect digestion is the necessary consequence, and only a small portion of what is eaten is assimilated and reaches the blood. On the other hand, atonic dyspepsia constantly arises amongst the poor from an imperfect supply of food, or from the food not being of a sufficiently nutritious nature, or from the long and irregular intervals between meals. An immoderate use of alcoholic liquors seems chiefly to favour the production of gastritis; but the writers have seen those who had habituated themselves to much indulgence become the victims of feeble digestion as soon as they have abandoned the use of stimulants. Persons who live chiefly on liquids, such as tea and soup, are more liable than others to feeble digestion. In all probability the mucous membrane becomes relaxed, and the gastric juice is too much diluted to dissolve the food with the requisite rapidity. Insufficient exercise is another very common cause of the complaint, and those who lead indolent and luxurious lives pay the penalty in the shape of dyspepsia. In a state of health the activity of one portion of the digestive tube seems to be regulated by that of other parts of the canal, so that an imperfect contraction of the large intestine induces a corresponding inertia in the muscular coat of the stomach. In consequence of this, constipation is found to be one of the most common causes of this form of indigestion, and it is partly by producing this symptom that sedentary occupations exercise such a prejudicial influence. As the gastric fluid is secreted from the blood, it is evident that a normal amount and quality of the latter must be necessary for the perfect performance of the digestive process. Consequently, we find that the digestion becomes feeble in all cases of anæmia, however this condition may have been produced, as by long-standing leucorrhœa or other discharges. The nervous system controls not only the secretion of the gastric fluid, but also the muscular action of the organ. Any deviation, therefore, from its normal state is apt to be attended with an alteration in the secretion and movements of the stomach.

Symptoms.—The invasion of atonic dyspepsia is gradual, and in a large proportion of the cases the symptoms replace those of acute or chronic gastritis. In ordinary cases there is not any severe pain, but the patient often complains of a feeling of fulness and distension after meals, which begins shortly after eating, and lasts for an hour or two. In other instances there is a sensation of constriction, produced by flatulence, which affects the lower part of the chest, and is relieved by eructation. Occasionally the pain radiates to the shoulders, or passes down the left arm and hand so severely as to simulate angina pectoris (*see* Angina Pectoris). It is distinguished from that complaint by coming on shortly after food, and not after exertion. When, however, the nervous system is much enfeebled, fermentation may be set up by an imperfect secretion of gastric juice, and the pain may then be very severe, and come on immediately after food has been taken. Under such circumstances, the case may so closely simulate gastric ulcer, that it may be at first impossible to distinguish it from that affection. In other instances the constriction is accompanied by dyspnœa, arising, no doubt, from the movements of the diaphragm being impeded through its being pushed upwards by the distended stomach. In men of advanced age who are inclined to obesity, there may be considerable embarrassment of the pulmonary and cardiac functions from this cause, especially where any unusual exertion is undertaken after a meal. It is, perhaps, unnecessary to say that in hysterical persons, and in those whose nervous systems have been unduly excited by alcohol, there is often a shrinking from the slightest touch upon the skin. In these conditions the tenderness is diffused over a considerable surface, not limited to one spot, as in gastric ulcer. It is not increased by deep pressure, and is often most loudly complained of when the hand is applied to a part distant from the stomach. Vomiting rarely presents itself, excepting as the result of some temporary error in diet, or as an accompaniment of hysteria or phthisis. Eructations are generally troublesome; but, instead of the acidity that accompanies catarrhal inflammation of the stomach, only gas or small portions of undigested food are returned. The appetite is deficient; in some cases there is a craving for various indigestible substances, but this is not so common as in the inflammatory affections of the stomach. Sometimes there is an aversion from all food. The tongue is usually broad, flabby, and indented by the teeth. Thirst as a rule is absent. The large intestine corresponds in the feebleness of its functional power. The bowels are consequently constipated, the stools disordered, and, in many cases, they contain a large amount of undigested food. The most common appearance is of pieces of fibre-like tissue that have escaped the action of the stomach, and which are often mistaken by patients for worms. The urine is usually pale and of low specific gravity. If it deposits lithates, the sediment is pale in colour; more generally oxalates or phosphates make their appearance. A long continuance of imperfect digestion produces loss of flesh and strength, but never to the extent that occurs in the organic affections of the stomach. The pulse is slow and feeble. The heart is especially apt to be affected by functional disturbance. Often the patient complains of a sudden tumbling sensation, as though the heart had turned over; at other times the palpitation comes on after exertion, and relief is obtained by stooping, or some other change of posture. Some are chiefly tormented at nights. They are awakened at two or three o'clock in the morning with violent and irregular palpitation. Such cases occur most frequently in the old, and often indicate a fatty condition of the heart. The skin is cold and clammy; and irregularities in the circulation, producing coldness of the hands or feet, are constant sources of complaint.

The nervous symptoms constitute the most distressing manifestations of the disease, more especially when the affection itself arises from an exhausted condition of the nervous system. The patient awakes at two or three in the morning, and is unable to sleep for many hours, when perhaps he falls into a troubled and unrefreshing slumber. There is often great irritability of temper, gloom obscures the mind, or the patient is incapable of concentrating his mental powers, or he becomes feeble and irresolute in character. Attacks of vertigo are not infrequent in nervous persons, and are often more dreaded than any other symptom. They occur chiefly after food, but may take place during the night.

Physical Signs.—The chief physical sign in atonic dyspepsia is that presented by the dilatation of the stomach that so often accompanies it. Percussion in such cases shows the organ reaching below the umbilicus, and the distension may remain for some hours after even a moderate meal. The splashing of the contents of the stomach by every sudden movement of the body is often a source of great anxiety to the nervous patients suffering from this disorder.

Various attempts have been made of late years to estimate with some degree of exactness the activity of the gastric secretion, and of the contraction of the muscular coat of the stomach, in atonic dyspepsia. Capsules containing iodide of potassium have been fastened down with threads of fibrin, and the patient has been directed to swallow one of these. Ordinarily iodide of potassium when taken into the stomach is excreted by the salivary glands in a period varying from six and a half to eleven minutes; so that the time that elapses, in addition to this, before the salt appears in the saliva is assumed to represent the number of minutes required for the solution of the threads of fibrin by the gastric juice.

The activity of the motor power of the stomach has been attempted to be estimated by the administration of salol, a substance that is not decomposed into salicylic acid until it has reached the intestines. The salicylic acid can be recognised in the urine by the violet colour produced by the addition of perchloride of iron, so that the period which elapses between the administration of the salol and the appearance of the reaction in the urine is supposed to represent its sojourn in the stomach.

Although these and other tests of a similar character have been frequently used by the writers, they are of opinion that the indications presented by them are of but little practical value. The difficulty in atonic dyspepsia is not to prove that the digestion is proceeding more slowly than in the normal state, but to ascertain the cause that has given rise to the enfeeblement of the digestive process.

DIAGNOSIS.—In ordinary cases we have to distinguish atonic dyspepsia from inflammatory affections of the stomach, and this is often very difficult, inasmuch as an enfeebled state of the stomach often results from gastric catarrh, whilst, on the other hand, the long retention of the food in the stomach often sets up inflammation of the mucous membrane. The chief differences are as follows: In atonic dyspepsia there is no epigastric tenderness, which is usually present in gastritis. There is no pain excepting what may easily be referred to flatulent distension; and acidity and heartburn are much more rare than in the latter. Vomiting, again, is unusual in atonic dyspepsia; common in gastritis. The tongue is broad, flabby, and tolerably clean, and forms a striking contrast to its injected tip and edges, and thick coating in the latter affection. The urine is pale, depositing oxalates or phosphates, in a feeble state of the stomach; high-coloured, and loaded with lithates, when the organ is inflamed. The symptoms of atonic dyspepsia occasionally usher in the early stages of malignant disease of the stomach, and if a tumour cannot be discovered, a mistake may be easily made. The chief points to be remembered are, that emaciation and anæmia are much more rapid in cancer, pain is rarely absent, and the vomited materials may present, even in an early stage, indications of blood. The more common difficulty, however, is to distinguish atonic dyspepsia in persons of a nervous temperament—when it is often associated with severe pain, from chronic ulcer of the stomach. In some instances a correct conclusion can only be arrived at after the case has been watched for some time, and it is wise, therefore, to assume that the patient is the subject of ulcer, and to direct the treatment accordingly. In this form of atonic dyspepsia, however, the pain comes on more immediately after a meal than in ulcer, it is less dependent on the nature of the food, it varies in intensity from day to day, the tenderness is less localised, the amount of flatulence is much greater, eructation affords more relief, vomiting is more rare, there is an absence of hæmatemesis, and the patient complains of various other symptoms referable to an exhausted state of the nervous system.

Treatment.—Before commencing the treatment of atonic dyspepsia by means of tonics, the practitioner should ascertain if the symptoms from which the patient is suffering are the result of the fermentation of the contents of the stomach. This is more especially necessary in those cases of nervous dyspepsia to which reference has been already made, as presenting symptoms simulating those of gastric ulcer. In such it will be found useful to restrict the patient for a week or ten days to milk if it agree, beef-tea, chicken-broth, or peptonised foods, given frequently and in small quantities, whilst the fermentation of the contents of the stomach is arrested by means of carbolic acid or creasote. The bowels must be at the same time carefully regulated by some mild aperient or by the use of enemata.

In ordinary cases the first and most important point is to remove, as far as possible, all the causes of the disease. Again, the food should be of such a nature as will require the least possible exertion on the part of the stomach. Thus, lightly cooked mutton, white fish, chicken, or game are more easily digested than beef, pork, or veal. Roast meat is more digestible than boiled. Soups and broths should be avoided, as well as any large quantity of hot tea or coffee. In bad cases vegetables had better be omitted from the dietary for a time; but as soon as the patient improves they may be again employed. Great mischief is often done by forbidding for a length of time all vegetable food; for, although the flatulence and other symptoms may be thereby relieved, the general health soon suffers. In many cases it will be found useful, where we are forced to forbid vegetables, to order one or two tablespoonfuls of lemon juice daily. This may be either taken diluted with water, or squeezed from the lemon over the meat. When there is much tendency to acidity, light puddings and farinaceous food must be sparingly used, but otherwise they generally agree well. Pastry, cheese, pickles, and newly baked bread should be avoided in all cases.

When a person of middle age and inclined to obesity is troubled with feeble digestion it is better that he should avoid potatoes, spirituous liquors, sweets, and fatty substances; and that he should use dry toast instead of bread, and a simple but varied diet. A dinner-pill of rhubarb, ipecacuanha, and ginger may be given to aid digestion, accompanied by a nervine tonic, such as strychnine or tincture of nux vomica, combined with diluted nitro-hydrochloric acid.

Innumerable remedies are recommended for this form of indigestion, but in order that they should be usefully employed it is necessary to ascertain the cause from which the imperfect secretion of gastric juice has arisen. In a large proportion of the cases the feeble condition of the mucous membrane has resulted from previous inflammation. There is a second class where, although the gland-structure is normal, the blood is deficient in quantity, or is abnormal in quality. In a third the defect originates with an exhausted condition of the nervous centres. Each of these states requires a separate medicinal treatment, and, although one often merges into, or is associated with, another condition, yet the features of one or other appear more prominently in each case that comes under our notice.

Where the feeble digestion has arisen from a relaxed state of the mucous membrane produced by previous inflammation, the tonic should be of an astringent character. It is in such cases that the nitric, nitro-hydrochloric, or phosphoric acid, either alone or in combination with bitter infusion, is required. Acids are best given when the stomach is empty, so that they may directly affect the vascular system of the organ. If metallic preparations are preferred, the perchloride of iron may be used. Notwithstanding the adverse opinions of many authors, the writers have often found pepsin very valuable in these cases. The pepsina porci is the best preparation, and it may be given along with capsicum or ipecacuanha before, not after, meals. One reason why pepsin so often proves inefficacious is that it is not administered in sufficient doses. In cases of feeble digestion in young children or aged persons, much benefit will sometimes result from the addition of pepsin, in larger quantities than usually prescribed, to milk, warmed, and left to stand a short time before being taken; or peptonised food may be ordered in some cases. *See* Peptonised Food.

Where the dyspepsia arises from anæmia, recourse must be had to iron. If it is connected with excessive menstrual discharge or leucorrhœa, the writers have often found the phosphate of iron and manganese a useful preparation. In other cases it may be combined with quinine. The saccharated carbonate and the ammonio-citrate of iron are very valuable and unirritating salts. It is a good plan in these cases to alternate the iron with other tonics, and as liberal a diet should be given as can be easily digested.

Where the nervous system is chiefly in fault, preparations of nux vomica and phosphorus, or those of zinc and arsenic, are chiefly of use. Zinc may be given as the valerianate along with quinine, or as the superphosphate in combination with iron. It is in this class of cases that the nitrate and oxide of silver are chiefly valuable.

The colon is usually as atonic as the stomach, and therefore the bowels require attention in almost every case that occurs. All severe purgatives should be avoided; for nothing so increases the feebleness of the digestion as the indiscriminate employment of this class of drugs. Salines, such as the sulphate of magnesium, and the various mineral waters, must be especially prohibited. The most useful aperients are rhubarb pill, combined with nux vomica or belladonna. When there is no affection of the rectum, the extract of aloes answers well; or if this part is irritable, some mild aperient, such as senna electuary, may be employed. Where a slight amount of acidity is present, the compound rhubarb powder, or an occasional dose of soda and rhubarb, is most suitable.

3. **Stomach, Atrophy of.**—Atrophy of portions of the gland-structure of the stomach is exceedingly common, although sufficient usually remains intact to enable the organ to perform its functions. According to the experience of the writers, a certain amount of anatomical change occurs in every person after he has reached the middle period of life, when the necessity for a superabundant supply of nutriment has ceased. It takes place first in the pyloric region, and tends gradually to extend as age advances. Caution is required in the investigation of such changes in the case of the stomach, lest the effects of *post-mortem* digestion should be mistaken for those of disease.

Anatomical Characters.—In atrophy of the stomach the mucous membrane usually escapes *post-mortem* digestion; it is thin, smooth, and firmly adherent to the subjacent coats. Microscopically, in the earlier stage of the disease the solitary glands are enlarged, and filled with cells and nuclei. The gastric tubes, and sometimes the subjacent muscular fibres, are displaced by these bodies, which are scattered everywhere through the membrane. The tubes adhere firmly to each other, but they still contain normal cells. Later in the disease the solitary glands appear empty in their centres, but are surrounded by thick layers of nuclei; the tubes can no longer be traced throughout their whole extent, and are only recognised as bulbs filled with fatty cells, or as lines of cells, whilst the whole tissue is obscured by fatty and granular matters. In the last stage the solitary glands have disappeared, and the tubes are replaced by fibrous tissue. In some cases observed by the writers, although the mucous membrane was very thin, it was so fatty that 33 per cent. was removed when digested in ether. These anatomical changes seem to produce a concomitant decrease in functional power, as proved experimentally by the writers.

Symptoms and Causes.—Atrophy of the stomach presents itself clinically in three different forms:—

(1) We find it combined with inflammation of some of the other coats of the organ, and proving fatal by the exhaustion of the patient. In one case which came under the writers' notice, the patient gradually succumbed to excessive pain and vomiting, which for twelve months had attended the ingestion of food. Complete atrophy of the gastric mucous membrane was the only morbid condition found at the necropsy.

(2) The second class includes a large number of the cases known as 'idiopathic anæmia;' and, in all probability, the morbid alterations result not from inflammation, but from degeneration. It is evident from these cases that some patients suffering from idiopathic anæmia are really the subjects of atrophy of the stomach. There is not much emaciation, for the pancreas, liver, and absorbing apparatus of the intestines are capable of digesting and taking up the fat. But the heart, like the other tissues, becomes loaded with fatty matter; and it has therefore often happened that the general feebleness and evident want of blood have been attributed to this state of the centre of the circulation, and the patient has been said to have died of 'fatty heart.'

(3) There is a third class of cases in which atrophy of the stomach occurs, without any very definite symptoms during life pointing to the organ thus seriously diseased. The writers carefully examined the gastric mucous membrane in fifty-seven persons who had died of cancer affecting various organs of the body. Fifteen of these were females, who suffered from cancer of the breast, and of these 75 per cent. presented well-marked atrophy of the glandular structure of the stomach. In twenty-four there was disease of the uterus, and gastric atrophy was present only in three of these; whilst no case occurred

amongst persons affected with malignant disease of the glands, bones, or skin. It is evident, therefore, that the atrophy of the stomach only accompanies certain forms of cancer. In those cases of cancer of the breast where the microscope disclosed atrophy, the mucous membrane was much attenuated and its weight diminished; in one case it only weighed 360 grains, the average weight in females dying from other diseases being 720 grains. The amount of pepsin contained in the gland-structure was, in every case in which it was tested, remarkably deficient. The diminution in the weight of the mucous membrane in these cases was not the result of a general wasting of the body, for in cancer of the uterus the average weight was 660 grains. The co-existence of this serious disease of the stomach with cancer of the breast supplies us with an explanation of the fact that many cases die some time after an operation has been performed, in whom there has been but a trifling reappearance of the malignant growth, and no great amount of discharge or of bleeding, to account for the gradual loss of flesh and strength. The writers have seen different cases of this kind, and have remarked that the cancerous tumour is usually slow in its growth and liable to contract, and that eventually nodules form in different parts of the skin. The dyspeptic symptoms are limited to failure in appetite, often a disgust for animal food, and flatulence, accompanied by a gradual loss of flesh, strength, and colour.

Diagnosis.—Atrophy of the stomach can only be diagnosed by the exclusion of all other diseases that tend to produce anæmia. When we meet with a case of progressive anæmia in a person of middle life, we should also examine the blood in order to exclude leukæmia. In this disease, as is well known, the white blood-cells are greatly increased in number, whilst the writers have found in atrophy of the stomach a diminution in both kinds of cells. Where we find this and other diseases absent, no discoloration of the skin, and no signs of malignant disease, we may fairly suspect the presence of gastric atrophy. This suspicion will be strengthened if there can be proved to be an absence of free hydrochloric acid in the contents of the stomach during digestion, and if the patient is affected with cancer of the breast, or a hard malignant tumour of any other organ.

Treatment.—The most important point in treatment is the regulation of the diet. As there is usually a great distaste for animal food, the ingenuity of the practitioner is often severely taxed to discover some form of food likely to furnish albumen to the system, which the patient can be prevailed upon to take. The articles of diet that usually agree best are mutton, chicken, game, soles, whiting, flounder, turbot, haddock, and oysters. It is often necessary to order that the meat should be used as a panada, or minced, so that it may be swallowed quickly. Milk and eggs, where they agree, are invaluable, and in the later stages soups and animal broths may be substituted for solid food. The writers have often recommended various kinds of peptonised food with advantage. In some cases gluten bread and gluten chocolate answer well. Other articles of diet, composed of starch and sugar, are usually more readily taken, and more easily digested.

As regards medicines, iron in all forms is beneficial. It may be combined with strychnine, quinine, or other bitters, according to the circumstances of the case. Arsenic may be used with advantage, but it will be found a good plan to alternate it with other tonics. Pepsin is often prescribed, but it does not produce much benefit. Acids are frequently valuable, the most useful being the hydrochloric and phosphoric. They are best given shortly after a meal.

Change of air, travelling, and freedom from the cares of business, are generally of more use in retarding the progress of the disease than any drugs we can prescribe.

4. **Stomach, Cancer of.** — Malignant disease of this organ is much less common than simple ulceration, but nevertheless the stomach is more frequently the seat of cancer than any other organ in the body, with the exception of the uterus. It is almost always primary, unless it arise from an extension of disease from some of the neighbouring organs. Secondary malignant affections of the stomach are exceedingly rare.

Ætiology.—Males are generally said to be more liable to gastric cancer than the opposite sex, but this has been called in question. Dr. Welch states that of 2,214 cases he had collected from hospital statistics, 1,233 were males and 981 females, being a ratio of about 5 males to 4 females. Of 115 cases taken by the writers from the *post-mortem* records of the London Hospital, 80 were males and only 35 females. Age seems to have an important influence in predisposing to the malady; thus Dr. Brinton collected 600 cases, and found the average age at death to be 50; the greatest liability being between 60 and 70. Dr. Welch analysed 2,038 cases obtained from various sources, and found that three-fourths of all gastric cancers occur between 40 and 70 years of age. The earliest age that has come under the notice of the writers was 25.

Cases have been recorded in which an old ulcer of the stomach or a cicatrix has been attacked by cancer, and two instances of this have come under the notice of the writers. Cancer of the stomach has been stated by some to have resulted from an injury; and in the hospital records one case is mentioned as having closely followed a severe blow on the abdomen.

It is somewhat strange that other visceral diseases are uncommon in the subjects of cancer of the stomach. From this fact it appears that gastric cancer is especially apt to present itself, not in those who have been the subjects of chronic disease, but in such as up to middle life have been in the enjoyment of good health. In a large number of cases there is a history of hereditary transmission; and so completely is this established, that the mere fact of more than one member of a family having suffered from cancer would lead us to diagnose its presence in a doubtful case. Neither anxiety, poverty, nor intemperance seems to influence the development of the disease.

Anatomical Characters.—All the varieties of cancer are met with in the stomach, but scirrhus is by far the most common. According to the researches of Dr. Brinton, it constitutes 72 per cent. of all the cases. Next in order of frequency he places the medullary form, which amounts to 18 per cent. Colloid cancer is much more infrequent, excepting when in combination with scirrhus. These different forms are, however, very often combined with each other. Microscopically the new-growths present the ordinary appearances characteristic of the forms of the disease to which they severally belong. Cancer seems generally to begin in the submucous tissue, and spreads from thence to the other coats. The muscular structures vary in appearance in different cases. In some the normal tissue has been completely destroyed, and what appears to the naked eye as muscle proves to be, under the microscope, a mass of cancer-cells and fibrous stroma. In other cases we find, even at some distance from the disease, the muscular bundles much increased in thickness, and the contractile fibre-cells greatly enlarged, with very prominent nuclei. Again, the pressure of the new-growth puts a stop to nutrition, so that the muscular bundles seem to be reduced to a mere mass of fibrous threads. Of equal interest are the changes produced in the mucous membrane. Over the tumour the glandular tissue is generally destroyed, and nothing but cells and connective tissue represent the original texture. But in every case examined by the writers, extensive disorganisation of the glandular structures has been found at a distance from the original disease. This is most marked in scirrhus, where we meet with well-marked signs of interstitial inflammation, the tubes being atrophied, and often reduced to mere bulbs filled with fatty cells. Where the softer varieties of cancer form the main portion of the disease, the tubes are everywhere apparent, but are unusually loaded with cells, whilst between and below them nucleated cells are everywhere profusely scattered. This destruction of the glandular structures in cancer of the stomach is in marked contrast to what we find in cases of simple ulcer, for in this the normal condition of the tubes can be generally seen at a very short distance from the edge of the sore.

Cancer in the majority of cases attacks one of the orifices of the stomach, according to Dr. Brinton the pylorus being the seat of the disease in 60 per cent., the cardiac orifice being implicated in only 13 per cent. Dr. Welch states that out of 1,300 compiled cases the pyloric region was affected in 60 per cent., the cardiac in 8 per cent., the lesser curvature in 11 per cent., and the whole or greater part of the organ in about 5 per cent. The records of the London Hospital afford a somewhat different estimate; the pyloric region being the chief seat of the growth in 56 per cent., the cardiac in 8 per cent., the smaller curvature in 16 per cent., whilst the body of the organ was more or less generally affected in 20 per cent. It is evident, therefore, that the part chiefly affected is the pylorus, and that most of the tumours of the stomach that present themselves during life must be situated in that region.

The effect of cancer of the stomach in producing alterations in the shape of the organ, and in its relations to the neighbouring parts, is very important as regards the diagnosis of the disease; and it will be necessary again to recur to the records of the London Hospital. It is stated to have been much contracted in 8 cases, and much dilated in 23. Its normal situation was altered in a considerable number of cases by adhesions to the neighbouring parts. In one instance it occupied a vertical position, from having become attached to a huge cancerous mass that involved the upper portion of the uterus and the ovaries. It is of great importance, in respect to the removal of the pylorus in case of cancer, to ascertain the frequency with which the disease tends to affect the neighbouring structures. When the pylorus was chiefly or alone the seat of the mischief, the peritoneum presented secondary growths in 8 cases, the liver in 26, the pancreas in 16, the neighbouring glands in 23, the lungs in 4, and the pleura in 2. From the rapidity with which the disease spreads, and from its tendency to implicate all the neighbouring structures, it is evident that any operation, to prove successful, must be undertaken at a very early period of the malady. In addition to infection of other organs, perforation may occur into the colon and the peritoneum; and in some cases a communication may be effected between the organ and the parietes of the abdomen. Death is sometimes due to hæmorrhage, but this accident is more rare than in simple gastric ulcer.

Symptoms.—The symptoms of gastric cancer usually show themselves very insidiously. The patient complains of slight disturbance of digestion, acidity, flatulence, or want of appetite. It has been stated that in the majority of cases there has been no previous liability to dyspepsia. No certain rule can be laid down respecting this point. In some the fatal illness has been ushered in by hæmatemesis; but this is uncommon. Pain is one of the most prominent symptoms. At first it is only slight, and is often described as a dull, gnawing sensation, but, as the complaint progresses, it assumes a more neuralgic character. Generally, it is referred to the epigastrium; in other instances to the back, or to the hypochondrium. It is ordinarily increased during digestion, but, unlike the pain of ulcer, is often equally severe when the stomach is free from food. The pain of cancer has been said by some authors to be occasionally of a colicky character. This, probably, arises from a co-existing atony of the colon, for in many cases this kind of pain is quite relieved when proper attention is directed to the large intestine. There is generally tenderness on pressure over the seat of cancer, but it is neither so localised, nor so severe, as in simple ulcer. Unless the pylorus is obstructed, there is rarely much complaint of acidity or flatulence. This arises from the fact that the absence of appetite prevents the patient from indulging in any large amount of food. When the growth affects the pylorus, the same symptoms are produced as in obstruction of this opening from any other cause (*see* Pylorus, Diseases of). Vomiting is a very general symptom. It varies greatly, according to the part of the organ affected. In disease of the cardiac orifice it is almost always present, and arises partly from the co-existing affection of the œsophagus. It may thus form the prominent symptom of the disease, occurring directly after food, and proving very rebellious to treatment. When the body of the organ is alone implicated, it may be entirely absent, but in pyloric contraction it usually takes place at a lengthened interval after food. Loss of appetite is almost always present, and it shows itself not only in the later stages, but at a comparatively early period in the disease. The loss of appetite is most marked in scirrhus, and it often forms a useful diagnostic sign, for in simple ulcer the appetite is generally unaffected. The tongue is usually dry, but thirst is seldom much complained of. The bowels are often confined in the earlier stages, from the imperfect muscular action of the upper part of the canal; but as the disease progresses, diarrhœa frequently occurs, and tends to enfeeble the patient. The most striking feature of the disease is the steady and often rapid loss of flesh and strength that accompanies it. We meet in the *post-mortem* room with no other examples of such extreme emaciation as are encountered in bodies after death from this disease. No case ever runs its whole course without this symptom manifesting itself. The lips become pale, and the skin often of a greenish or slightly jaundiced hue. The chief cause of the loss of appetite, the failure in strength, and the change in colour, in gastric cancer is the atrophy of the glandular structure of the stomach. The pulse is ordinarily soft and feeble, for in this, as in other forms of cancer, an enfeebled condition of the heart, arising from a softened, fatty state of its muscular tissue, is commonly present. The temperature is usually below the normal point, and if fever is excited by the occurrence of any local inflammation, the rise of temperature is only temporary. As the disease progresses, other symptoms are generally observed. In some cases ascites occurs; in others œdema of the legs; in others jaundice is produced by the pressure of enlarged glands on the gall-ducts, or by the implication of the liver itself.

Although these are usually the symptoms of gastric cancer, the practitioner must not expect them to be always present. He may be called to a middle-aged or elderly man, in whom rapid loss of flesh, strength, colour, and appetite is the only indication of the fatal disease under which he labours. The patient may assert that he has neither pain, nausea, flatulence, nor, in fact, any symptom pointing to a derangement of his gastric functions. The mere loss of appetite and strength in an elderly person should be sufficient to awaken suspicion, and demand a most careful exploration of all the abdominal organs. There is a form of the disease in which anæmia constitutes the most prominent symptom. In such a condition there may be an absence of pain, and vomiting may be only occasional, but the skin and mucous membranes become gradually paler as the disease advances, and the patient complains of feebleness, loss of flesh, palpitation, and dyspnœa on the slightest exertion. If there is no tumour to be felt, it may be impossible to distinguish such a case from one of pernicious anæmia. The stools should, however, be examined frequently, for a slight and continuous hæmorrhage into the intestinal canal from a cancerous ulcer of the stomach or duodenum may be the cause of the bloodlessness. Severe hæmorrhage is more rare than in simple ulcer, but there is a greater tendency to a constant oozing of blood from the ulcerated surface. The blood, thus slowly effused, is acted upon by the gastric juice, and when vomiting occurs it has the appearance of 'coffee grounds.' This colour of the vomited matter used to be considered as pathognomonic of cancer, but it is now known that it only arises from the blood being slowly effused, and may therefore present itself in other kinds of gastric disease. Peritoneal perforation is more rare than in simple ulcer; but we more frequently meet with communication between the stomach and other organs, such as the colon. Marked relief of the symptoms of cancer may be temporarily afforded by such a perforation, although this is not common. In still more rare cases adhesions occur between the stomach and the parietes of the abdomen, and an external opening is produced.

Course and Duration.—Cancer of the stomach destroys life more rapidly than a similar affection of almost any other organ in the body; and it has been calculated that the average duration of the disease is about one year, the maximum being thirty-six months; whilst the shortest period in which life is destroyed from the first symptoms being noticed is only one month. The encephaloid form is most rapid in its course, because its growth is quicker, and the neighbouring organs, such as the liver and lymphatic glands, are more quickly implicated. Colloid cancer is the slowest in producing death, and most of the more chronic cases have consisted of this form of malignant disease.

Physical Signs.—The chief and most important physical sign presented by gastric cancer is the presence of a tumour. It is usually well-defined, hard, and nodular; and not infrequently isolated nodules can be felt in its neighbourhood. The sound on percussion is generally more or less tympanitic. The tumour is usually found in the epigastrium or right hypochondrium, more rarely near the umbilicus. As a rule it is fixed, and does not move downwards with respiration; but in some instances, where adhesions have not formed, it has been dragged downwards by the weight of the stomach, and has presented itself as low as the hypogastrium. It is most readily discovered when the pylorus, or the smaller curvature, is the part affected. Where the cardiac orifice is the seat of the mischief, the growth may be so deeply situated that, unless it be of large size, it may elude discovery. There are certain chances of error as regards a tumour caused by gastric cancer, against which we should be on our guard. Thus the swelling may arise from a fæculent collection in, or from disease of, the colon. Fæculent tumours are, however, most commonly met with at the sides of the abdomen; they usually permit of being indented by the finger forcibly pressed against them; they are apt to alter their position, and may be partly or completely removed by purgatives. Again, cases are mentioned where the stomach was found filled with string, hair, or cocoa-nut shavings, and in each case a tumour existed during life. The rectus muscle, when in a state of tension, may give rise to the sensation of a tumour, and it is only by altering the position of the patient that the mistake can be obviated. The muscle is seldom tensely contracted so as to produce the appearance of a tumour, unless the parts beneath it are unduly sensitive; and when such a condition is persistent and gives rise to doubt, it can be removed by the administration of an anæsthetic.

The writers have known a [illegible] of the [illegible] simulate gastric cancer; but there was an absence of pain and of loss of flesh and strength, although severe vomiting frequently occurred. Syphilitic tumours of the liver may closely simulate those of gastric cancer; but in such cases the pain is less severe, the tenderness is less marked, vomiting is less frequent, and the temperature usually rises towards evening. Such tumours often rapidly disappear under appropriate treatment.

Occasionally the thickening around a chronic simple ulcer gives rise to an undefined sensation of tumour; but the long duration of the symptoms, severe hæmatemesis, the continuance of the appetite, and the smaller amount of wasting, are usually sufficient to distinguish such a case from gastric cancer. It must not, however, be forgotten that cancer sometimes attacks the cicatrix or edge of an old simple ulcer. Cancer of the pancreas may form a tumour in the epigastrium closely simulating a gastric cancer. In doubtful cases the distinction between a tumour of the stomach and one of the colon may be sometimes assisted by the plan adopted in the following case. A patient was admitted into the London Hospital with a hard tumour below the left hypochondrium. As his symptoms did not definitively point to gastric cancer, there was much difference of opinion as to the nature of the disease. The lowest edge of the tumour was first marked out on the skin, when a considerable quantity of soap and water, well frothed, was injected by the rectum. The edge of the tumour was raised two or three inches, but its note on percussion was not clearer than before. As soon as the bowels had acted freely, the patient was requested to drink a pint of effervescing liquid, and now the edge of the tumour descended considerably, and the note on percussion became more tympanitic. From the injection into the colon raising the tumour, it was plainly not connected with the intestine, whilst from the percussion note becoming clearer after the drinking of the soda-water, it was evident that it overlay, or was in some way connected with, the stomach.

The size of the stomach in gastric cancer varies according to the orifice affected, and in this way may prove a useful aid in diagnosis. When the pylorus is obstructed, the organ is usually enlarged; when the cardiac orifice is narrowed, it becomes diminished in size. We derive less assistance from the examination of the vomited matters than might be expected. In dilated stomach they are in a state of fermentation, and contain sarcinæ and torulæ. Occasionally there are portions of cancerous masses, but, as a general rule, these are too much decomposed to afford satisfactory evidence. In some instances of doubtful cancer, the fluids vomited become quite solid when boiled with liquor potassæ, and this may prove a useful indication in certain cases. The recognition of the amount of free hydrochloric acid in the products of gastric digestion has assumed so much importance of late years, both in the diagnosis and treatment of disorders of the stomach, that it seems desirable here to draw the reader's attention to this subject.

In order to obtain an accurate knowledge of the digestive processes, it is necessary to extract the contents of the stomach at a time when digestion is at the height of its activity; and it is therefore the custom to administer a meal, the quantity and quality of which is known, and to withdraw the products of digestion after the lapse of a definite interval of time by means of the stomach tube. With respect to the composition of this 'trial meal' a great deal of discussion has taken place. One school of Continental physicians (Ewald) prefer to give a light breakfast consisting of a dry roll and three-quarters of a pint of warm milk or weak tea, the products being withdrawn from the stomach one hour afterwards. Leube, Riegel, and their followers, however, recommend a meal to be given at midday, which from its greater abundance may put the secretory powers of the stomach to a severer test. Accordingly they administer a 'trial dinner' consisting of 400 grammes of soup, 60 grammes of meat, and 50 grammes of white bread, the organ being emptied three or four hours afterwards. The semi-digested food is immediately filtered, and the filtrate, which is usually of a clear yellow colour, submitted to a chemical examination. In this undertaking it is advisable to follow a regular and fixed order of procedure, the first point being to ascertain the *reaction* of the fluid; the second to demonstrate the presence of *free hydrochloric acid*; and the third to estimate the *quantity* of it in a percentage form.

(1) To ascertain the *reaction* of the filtrate, a piece of blue litmus-paper is generally employed, the change to a red colour indicating the presence of an acid. But since this acidity may be due either to hydrochloric acid, to acid salts, or to the presence of some acid which has been formed by a process of fermentation (lactic, butyric, acetic), it is necessary to use other reagents in order to demonstrate the existence of each one separately.

(2) Many tests are employed for the recognition of *free hydrochloric acid.* The aniline dyes possess the property of changing colour when brought into contact with a mineral acid, and this fact is made use of chiefly in the case of methyl violet. If an aqueous solution of this substance is prepared, the violet colour instantly becomes sky-blue on the addition of hydrochloric acid, even when it exists in the small proportion of 0·024 per cent. In like manner, a solution of fuchsin becomes yellow, and congo-red a bright blue. A saturated solution of tropäolin 00 is a very convenient test, as the orange colour changes to rose-pink on the addition of a minute quantity of the acid. It must, however, always be borne in mind that certain substances have the power of forming a loose combination with the acid, and completely obscuring the reactions above described. Among such may be mentioned peptones, albumoses, syntonin, leucin, mucus, and chloride of sodium. The most delicate test for free hydrochloric acid consists of phloroglucine, 2 parts; vanillin, 1 part; absolute alcohol, 30 parts. A splinter of wood soaked in this solution, and heated, will change to a red colour in the presence of only 0·005 per cent. of free hydrochloric acid (Günzburg).

Lactic acid is detected with the greatest certainty by means of a reaction recommended by Ueffelmann. To a dilute solution of perchloride of iron a few drops of weak carbolic acid are added, until the mixture becomes of an amethyst-blue colour. The addition of lactic acid will cause a canary-yellow precipitate, even when the acid only exists in the proportion of 0·005 per cent. Care must be taken, however, to eliminate any phosphates or sugar which may be present, a task most easily performed by extracting the lactic acid with ether, and evaporating the ethereal solution. Butyric and acetic acids are detected by their odour, and by the fact that the former exhibits the characteristic oil drops on evaporation, while the latter strikes a blood-red colour with perchloride of iron.

(3) In order to estimate the *quantity of free hydrochloric acid* in the gastric juice, a definite quantity of the filtrate must be triturated with normal caustic soda till neutralisation is accomplished. A graduated burette is filled with a decinormal (1 in 10 normal) solution of soda, and 10 c.c. of the filtrate placed in a porcelain dish with a piece of red litmus-paper. The soda solution is then cautiously allowed to fall drop by drop into the porcelain dish, the contents of which are constantly stirred with a glass rod, until the litmus-paper becomes of a violet tint. The tap of the burette is then turned, and the number of cubic centimetres of the soda solution required to neutralise the mixture read off. The acidity of the gastric juice is stated in percentages of the soda solution; thus 50 per cent. acidity indicates that 50 c.c. of the soda solution has been required to neutralise 100 c.c. of the filtrate. But if we know beforehand that the acidity of the gastric contents was solely due to hydrochloric acid, acid salts being absent, and any

lactic acid having been removed by ether, then the amount of free hydrochloric acid may be calculated in the form of chlorides. It is known that 1 c.c. of the decinormal solution of soda is equivalent to 0·003646 chlorides, so that it is only necessary to multiply the number of cubic centimetres of soda solution used during the experiment by 0·3646 to obtain the percentage of free acid in the solution.

By means of a method introduced by Sjoquist and Salkowski, the exact quantity of combined as well as free acid can be estimated. To a definite quantity of the filtered gastric contents, carbonate of barium is added, in order to convert all the hydrochloric acid into chloride of barium. The chloride is separated from the excess of carbonate by means of hot water, and then converted into the insoluble barium carbonate by means of carbonate of sodium. The precipitate is collected, washed and dried, and reconverted into barium chloride by hydrochloric acid. The excess of acid is now got rid of by evaporation to dryness, and the residue is dissolved in water and triturated with a solution of bichromate of potassium and nitrate of silver, the strength of the latter being such that 1 c.c. = 0·001 NaCl. The quantity of hydrochloric acid is then calculated by the formula $x : y$ (quantity of silver chloride) :: 36·5 : 58·5.

Diagnosis.—In the earlier stages, and before the existence of ulceration, gastric cancer may be readily overlooked. We are apt to consider a person who complains of pain at the epigastrium, flatulence, and other symptoms of indigestion, as merely suffering from dyspepsia. The loss of appetite is, however, generally a more prominent symptom in the early stages of cancer than in dyspepsia, and if the patient be a person of middle age, and is rapidly losing flesh, the progress of the case should be most narrowly watched, and the abdomen frequently explored for any appearance of tumour. The chief difficulty in diagnosis is to distinguish cancer from simple ulcer; and it is often requisite to watch the case for some time before a decided opinion can be formed. As a general rule, the pain is more severe, more increased by food, and more relieved by vomiting in cases of ulcer than of cancer. On the other hand, it is less fixed to one spot, and is more neuralgic in cancer. The vomiting is more immediately after food when the cardiac orifice, and is longer delayed when the pylorus, is affected by cancer than in cases of simple ulcer. The fluids rejected in chronic ulcer contain no fragments of mucous membrane, although these may be present in acute cases, and the rejected matters do not solidify when boiled with liquor potassæ, as they sometimes do in cancer. Severe hæmatemesis should lead us to suspect ulcer, frequent 'coffee-ground' vomit should lead us to the diagnosis of cancer. Loss of flesh and strength, although present in both cases, is much more rapid and decided in cases of cancer; and, in like manner, when we can find no evidence of hæmorrhage from any organ, great pallor of the lips and throat should lead us to suspect it. Again, as cancer seldom appears in those under thirty-five years of age, and quickly destroys life, we should decide in favour of simple ulcer if the symptoms occurred in a young person, and had lasted for many years. The presence of a tumour, in [illegible] on this point will settle the question in favour of cancer. The duration of the disease is an important consideration in the diagnosis, as a simple ulcer may be present for many years, with occasional partial or complete cessation of its symptoms, whereas cancer usually runs its course rapidly, without any amelioration being effected by treatment. When hard nodules on the skin of the abdomen, or enlarged glands of the navel, neck, or axilla, can be discovered, the probability is strongly in favour of cancer; and the same may be said if jaundice, ascites, or tumours of the peritoneum present themselves.

Although the late Dr. Golding Bird had previously made known the fact that free hydrochloric acid was sometimes absent from the gastric secretion in cases of carcinoma of the stomach, the subject attracted no attention until the publication of some researches by van der Velden. According to this observer, cancer of the stomach is always associated with an absence of free hydrochloric acid; and the statement was at once accepted as a valuable help in the diagnosis of the disease in question. But further and more exact investigations soon brought to light two important facts: firstly, that free hydrochloric acid *was* present in some cases of carcinoma of the stomach; and, secondly, that the tests which were relied upon for detection of the acid often proved fallacious, inasmuch as many of the albuminous products of digestion (albumoses, peptones, &c.) are very prone to form a loose combination with free hydrochloric acid, and completely obscure its ordinary colour-reactions. Also, it is now an acknowledged fact that catarrh of the mucous membrane is often associated with a diminution in the acid secretion. There are therefore two obvious causes for the apparent absence of free hydrochloric acid in cases of carcinoma of the stomach. If catarrh is present, the secretion is diminished in amount; and if the [illegible] diminished from other causes, the accumulated products of digestion [illegible] obscure the ordinary reactions of the acid. The whole subject may therefore be summed up as follows: the mere failure to detect free hydrochloric acid does not prove the presence of cancer; but if free acid can be easily demonstrated in a suspected case, the disease is probably not of a cancerous nature.

PROGNOSIS.—The prognosis of any case of gastric cancer is always unfavourable. It is bad in proportion to the rapidity of the progress of the case; the early occurrence of vomiting; the frequency of hæmorrhage; and the evidence that other organs, such as the liver, are also implicated.

TREATMENT.—There is not much to be expected from the treatment of this disease. Inasmuch as we are unable to check the progress of the malady, all our efforts must be directed to the relief of symptoms, and to support, as well as we can, the strength of the patient. In some instances, especially where the body of the organ is affected, and where there is no ulceration of the mucous membrane, the administration of small doses of iron is beneficial. Good and well-selected food, rest, and a fair supply of stimulants, often, for a time, appear to afford new strength to those overpowered by the disease. If the body of the stomach be the part affected, the indications for treatment are the same as in simple ulcer. When the pylorus is narrowed, the same plan must be pursued as when dilatation of the stomach has occurred from any other cause. Obstruction at the cardiac orifice often brings with it the greatest misery to the patient. He is tormented with hunger which he is unable to appease, and death gradually approaches by starvation. So long as nutritive enemata can be borne they should be given; and if diarrhœa be produced by them they may be combined with small doses of laudanum. In a case of this kind great relief may be temporarily afforded by passing a narrow gum-elastic tube into the stomach, and pouring through it liquid food.

The uniformly fatal termination of gastric cancer has led to the trial of various surgical measures. When the disease is limited to the immediate neighbourhood of the pylorus, and in an early stage, complete excision of the growth (pylorectomy) has been effected. Few cases, however, can be considered suitable for this operation, which from its tedious nature has proved very fatal (about 62 per cent.). In more advanced cases, where it is found impossible to remove the seat of disease, considerable relief may often be afforded by establishing an adventitious communication between the stomach and the small intestine (gastro-enterostomy). In this manner life has in some instances been considerably prolonged, about 68 per cent. having recovered from the effects of the operation.

5. **Stomach, Concretions in.**—Concretions in the stomach are composed of various indigestible substances that have been swallowed, such as hair, paper, cotton, cocoa-nut fibre, &c. They chiefly occur in idiots and lunatics. In some of the cases recorded a tumour has been observed during the life of the patient, which in one case was mistaken for a floating kidney. Concretions of this kind may give rise to perforation, but more generally they set up inflammation of the mucous membrane, followed by peritonitis.

6. **Stomach, Contraction of.**—Contraction of the stomach occasionally takes place, and the diminution in its size may be either local or general. Numerous cases are mentioned in the *post-mortem* records of the London Hospital in which the organ was puckered up by fibrous bands radiating from the cicatrix of an old ulcer; and the writers have seen considerable distortion from this cause, the coats not being much thickened. Three instances are noted in which the stomach was divided into two pouches by thickening connected with ulceration.

General contraction of the stomach arises from various conditions. When the œsophagus at its lower end or the cardiac orifice is much contracted, constant rejection of food is apt to occur, and the stomach contracts to a small size, on account of its never being distended with food. Most of such cases are due to cancerous growths, but this condition may result from a simple ulcer of the cardiac end.

An ulceration affecting the smaller curvature near its centre may draw together the orifices of the stomach, and thus produce great diminution in its capacity. This generally occurs from cancerous ulceration, but occasionally it is the result of a non-malignant ulcer.

The capacity of the stomach may be reduced by thickening of its walls. The writers have seen simple fibroid change produce in this way a great diminution in the calibre of the stomach; but usually it is the result of a malignant growth infiltrating the coats of the organ.

Contraction of the stomach may also arise from the extension of malignant disease from some of the neighbouring structures. In other cases the coats become greatly thickened, and its capacity diminished, from the effect of chronic peritonitis, either tubercular or malignant. Under such circumstances the stomach is bound down, and it is constricted by the surrounding adhesions, so that its capacity is greatly reduced.

7. **Stomach, Dilatation of.**—This may occur either in an acute or in a chronic form.

(1) **Acute dilatation.**—This form is exceedingly rare, and has attracted but little attention until of late years. The earliest case on record is that of a lady mentioned in the fourth volume of the *Transactions of the Pathological Society of London*, by Drs. Miller and Humby. She had been under treatment for piles shortly before her illness, and the abdomen had been observed to have increased in size. She was attacked

with vomiting of immense quantities of fluid. The vomiting ceased four days afterwards, and the abdomen was found to be greatly enlarged. After death the cause of the abdominal distension proved to be the stomach, which was so much dilated that it was capable of holding ten pints of liquid. The late Dr. Hughes Bennett of Edinburgh relates a similar case, and attributes the dilatation to a large quantity of effervescing liquid the patient had swallowed to allay his thirst. The late Dr. Hilton Fagge, in the *Guy's Hospital Reports* (vol. xviii. Third Series), describes two cases that had fallen under his notice, and also mentions that two similar cases had been observed at Guy's Hospital during fourteen years. Other cases have since been published by various observers confirming these accounts, so that there is no doubt that the stomach may dilate much more rapidly than was formerly supposed.

Diagnosis.—The signs of acute dilatation of the stomach, according to Dr. Fagge, are: '(1) A rapidly increasing distension of the abdomen, which is unsymmetrical, the left hypochondrium being full while the right hypochondrium is comparatively flattened. (2) The existence of a surface-marking descending obliquely towards the umbilicus from the left hypochondrium, and corresponding with the dragged-down lesser curvature of the stomach, this line appearing to descend with each inspiration. (3) The presence of fluctuation in the lower part of the abdomen. (4) The occurrence of splashing when the distended part of the abdomen is manipulated. (5) The presence of a uniformly tympanitic note over a large part of the distended region, when the patient lies flat on his back. Above the pubes, on the other hand, there may be dulness on percussion, simulating that of a distended bladder.

Treatment.—There is no doubt that the treatment recommended by Dr. Fagge is the proper one, namely, to empty the distended stomach as quickly as possible with the stomach-pump; and to maintain life by nutrient and stimulating enemata.

(2) **Chronic dilatation.**—Ætiology.—Any condition that causes the food to remain in the stomach for an undue length of time tends to produce dilatation; and thus it may be either the result of enfeebled muscular power of the organ, or of an obstruction to the passage of its contents through the pylorus. A moderate amount of dilatation is a common accompaniment of chronic gastritis and of atonic dyspepsia, as in both of these conditions there is often a diminution in the contractile power of the muscular coat. The cases in which there is extreme dilatation are generally the result of an obstruction at the pyloric orifice, retarding the passage of the digested food into the duodenum; and this may arise from various [illegible]. 1. Malignant disease is the most common. It must not, however, be supposed that the extent of the dilatation is always in proportion to the narrowness of the stricture, for it seems in no small degree to depend on the amount of the penetration of the muscular coat by the new growth. 2. Dilatation may be the result of ulceration in the pyloric region, and it is often said that it arises from the narrowing of the orifice by the cicatrisation of an ulcer. According to the writers' experience, the most complete strictures of the pyloric orifice are found as the result of the healing of ulcers produced by the swallowing of corrosive liquids, but in two such cases that have come under their observation there was no dilatation, but rather a contraction of the stomach, arising probably from the incessant vomiting that was present in the later stages of the illness. 3. Three cases are mentioned in the hospital *post-mortem* records, and the writers have seen others, in which there was only fibroid thickening at the pylorus, without ulceration. Under such circumstances the exit of the food is probably delayed, partly by the narrowing of the opening, and partly by the changes in the muscular coat that generally attend fibroid degeneration. 4. The stomach may be displaced by adhesions, or the pylorus be so dragged downwards that dilatation results. 5. The [illegible] paralysis of its muscular coat, produced, as in a case given by Dr. Wilks, by injury to the splanchnic nerves. 6. The pressure of tumours upon the pylorus or duodenum externally may prevent the due evacuation of the contents of the stomach. The tumours are usually of a malignant nature, but, more rarely, the same effect may arise from enlarged glands.

Anatomical Characters and Pathology.—When the abdomen is laid open, the stomach is found to be greatly increased in size, often so much so that it appears to fill the whole cavity. The greater curvature lies below the umbilicus, in extreme cases even as low as the pubes. The position of the pylorus varies according to the nature of the coexisting disease. Sometimes it is tied down by adhesions to its original site; at other times it has been dragged downwards by the weight of the enlarged organ, and is situated at a much lower level. When the stomach is laid open, it is found partially or wholly filled with a dark-coloured frothy fluid, the amount of its contents being often enormous. The rugæ are effaced by the constant stretching, and the mucous membrane presents a level surface, which is generally more or less softened by the action of the acid contents upon it after death. Microscopically, the glandular [illegible] found to be [illegible] from the long-continued stretching. In some cases the tubes are visible, widely separated

In one case the destruction had proceeded still further; a large proportion of the tubes had been destroyed, and were replaced by fibrous tissue, the muscular tissue being also thin and fibrous. In other instances the muscular structure proves to be in a state of hypertrophy, this condition being usually most distinct in the pyloric region.

SYMPTOMS.—As, with the rare exceptions before noticed, where the dilatation occurs suddenly, the stomach only slowly enlarges, the symptoms manifest themselves very gradually. They are preceded by those of the malady which gave rise to the dilatation. Thus, the patient may for many years have suffered from the severe pain after food and vomiting indicative of ulceration; or frequent attacks of waterbrash, or flatulence and acidity, may have led to the suspicion of fibroid degeneration of the pylorus. Unless cancer should co-exist, there is seldom much complaint of pain, but a sensation of weight and fulness is usually experienced. More generally, attacks of heartburn present themselves, and a scalded feeling of the stomach and œsophagus annoys the patient. In some, there is a constant sense of craving referred to the epigastrium. Vomiting is almost always present, although it may be absent for considerable intervals. It does not occur, as in gastric ulcer, shortly after food, nor is there usually any complaint of nausea. The patient feels full and uncomfortable, and often has a sensation as if fermentation were going on in the abdomen for two or three days, until he gets relief by the evacuation from the stomach of an enormous quantity of liquid. In other cases, the vomiting occurs more frequently, generally at night, or towards the morning. He experiences great relief for a few hours or days, as the case may be, until the fluid again collects in sufficient quantity to produce discomfort. There is no great amount of straining during the attacks of vomiting, and if the abdomen be examined as soon as the act is terminated, the stomach is still found to contain fluid. It seems, indeed, as if the contents were only partially pumped off by the action of the diaphragm and the abdominal muscles, the stomach itself being quite passive. In some cases hæmatemesis occurs, but this is rare, unless cancer be also present. The characters of the vomited matters are peculiar; usually they are of a more or less dark brown colour, very sour, edging the teeth and scalding the throat of the patient. When the liquid is allowed to stand, it soon becomes covered with a thick scum, and deposits a thick brown sediment. Chemically, it is found to contain various acids produced by the decomposition of the food. Microscopically, we meet with sarcinæ and torulæ in great abundance, intermixed with particles of partially digested food, and with mucus. In a few cases bile is evacuated, but this is an uncommon circumstance, especially where there is a narrow stricture at the pylorus. Acid eructations are very common, and often more distressing to the patient than any other symptom. Thirst is usually complained of, and an excessive secretion of saliva is frequently remarked. The tongue presents nothing characteristic. The appetite is bad where cancer co-exists, but in other cases it is good, often voracious. The bowels are almost always constipated, and the stools hard and knotty. The urine is usually acid, and often deposits an abundant sediment of lithates. The nutrition of the patient soon suffers, and loss of flesh and strength always accompanies the disease. In some rare instances severe attacks of tetanic spasms of the extremities occur, attended with great faintness and exhaustion. Death not infrequently results, but in one case the writers have known the spasms gradually subside and the patient recover. Some pathologists have supposed these attacks to arise from the dryness of the tissues resulting from the imperfect absorption of water, whilst others have attributed them to the absorption from the stomach of some of the products of the decomposition of the substances contained in it. In dilatation of the stomach death usually takes place from exhaustion, and is not infrequently preceded by œdema of the feet and legs.

Physical Signs.—The abdomen is perhaps distended, and covered with enlarged and tortuous veins. The shape is characteristic, the upper curvature of the stomach being visible as it stretches across between the false ribs, the epigastrium being hollow instead of prominent, and the abdomen much fuller on the left than on the right side. When the muscular coat is in a state of hypertrophy, the vermicular movements may be seen through the stretched and attenuated integuments. The movements are slow and gradual, proceeding usually towards the right side of the body. They are almost constant, but can be quickened by the application of cold or by galvanism. Too great stress must not be laid upon this symptom. Whenever any portion of the gastro-intestinal tube is contracted, vermicular movements are visible in the parts above the stricture. The sounds on percussion vary as the dilated stomach is full of air or of fluid. The tympanitic sound is best heard when it is only partially full. By changing the position of the patient, we are enabled to show that the fluid gravitates in the enormously dilated organ. By lowering the head and raising the hips and legs, we may generally define the lower boundary of the stomach, by the clear sound which is thus exchanged for a dull one on percussion. Bamberger asserts that, by placing the stethoscope over the stomach whilst the patient is drinking, we can hear the fluid fall into the distended cavity. This, in the writers' opinion, is of little value, for they have distinctly heard the passage of food through a stricture of the cardiac opening where the stomach was smaller than normal.

Where there is a difficulty in determining dilatation of the stomach, the patient should take a slight meal in the evening, and on the following morning, while he is fasting, a stomach-tube should be introduced, and any material that may have remained in the organ should be removed and examined with the microscope. If a considerable quantity of food remains after twelve hours' fasting, there can be no doubt as to the dilatation.

Certain methods have been lately proposed to test more accurately the motor powers of the stomach. Klemperer introduces a given quantity (100 grammes) of olive-oil into the empty organ by means of a tube, and, after allowing it to remain a certain length of time, withdraws it again and measures the residue. He finds that, in healthy persons, after the lapse of two hours, 70 or 80 per cent. of the oil has usually been expelled into the duodenum, and only about 20 per cent. therefore can be recovered. But where the muscular wall is atonic and the organ dilated, only 25-50 per cent is got rid of in the same time. This method is uncertain in its results, and exceedingly distasteful to the patient.

Ewald has proposed a method which depends on the fact that salol is not absorbed or altered by its residence in the stomach, but that on reaching the duodenum it is immediately converted into salicylic acid, and is excreted by the kidney. He accordingly administers this salt by the mouth, and tests the urine at intervals with perchloride of iron; and finds that, under normal conditions, the characteristic purple reaction takes place in thirty to sixty minutes, but in cases of gastric enfeeblement the period which elapses is very much longer. Huber has modified the method, and made it of more practical value. He finds that, after giving one gramme of salol to a normal individual, the kidney has excreted all the salicylic acid within twenty-four hours; but, if the stomach fails to pass on the salol with the normal rapidity, excretion will commence later and last longer, and hence the urine will still contain salicylic acid at the end of thirty hours. This extended time of reaction indicates gastric enfeeblement and dilatation.

Diagnosis.—With ordinary care, a dilated stomach is not likely to be confounded with any other abdominal disease. The chief points to bear in mind are—the large extent over which there is a tympanitic sound; the irregular distension of the abdomen; the hollowness of the epigastric region; the fulness of the left side of the abdomen; the vermicular motion apparent over the dilated organ; the peculiarity of the vomiting; and the large amount of fluid thus evacuated of an acid character, prostration, [illegible] [illegible] [illegible], and death.

Wherever there is any difficulty, the stomach-tube should be introduced after the patient has abstained from food for twelve hours, and any materials that remain should be removed and examined with the microscope. The practitioner should bear in mind that dilated stomach is not unfrequently met with along with cancer of the pyloric region. The diagnosis of the cause of the dilatation must be determined by the history of the case.

Treatment.—The first and most important indications are to remove from the stomach the mass of decomposing material contained in it, and to cleanse the mucous membrane from the mucus and other substances tending to set up fermentation in any food that may be taken. This is most readily effected by the introduction of a tube, through which the contents of the organ may be evacuated, and water or solutions of antiseptic substances may be introduced. Formerly a stiff stomach-tube was invariably used, and the contents of the organ removed by the action of a pump; but of late years a much easier and less dangerous procedure has been employed. *See* Lavage.

By means of this rational method of treatment the greatest success has been attained during late years in cases of gastric dilatation; and even when the pylorus is rendered impassable by cancerous disease, it is wonderful what a beneficial effect the periodical emptying and cleansing of the dilated organ can exert upon the general welfare of the patient. In many cases which have come under the writers' notice, the patients began to improve immediately the stomach-tube was brought into use, and not only gained flesh and strength, but lived for many months after the cancerous disease had appeared to have reached a fatal stage. But unfortunately there is always a tendency to overrate the value of any therapeutic measure, and consequently to lose sight of the indications for its employment in an ill-advised attempt to extend its sphere of usefulness. Consequently it has happened that many practitioners have tried to introduce lavage into the treatment of every disease where the stomach has appeared at all at fault; and have proclaimed the method as the true panacea for all gastric ills. Atonic dyspepsia, anæmia, the crises of ataxia, and even acute catarrh of the stomach, have all been subjected to the gastric douche, while the products of digestion have been withdrawn and examined in nearly every disease where it has been possible to pass a tube. But, apart from the fact that such indiscriminate application has proved of no practical value, either in diagnosis or treatment, it must always be remembered that the passage of the stomach-tube is not always [illegible] danger. While it may be said that lavage is an invaluable remedy in cases of dilatation of the stomach and chronic catarrh, its indiscriminate employment in every case of disordered digestion will prove an injury rather than a benefit, and will eventually throw discredit upon the whole method of treatment.

Some writers recommend the administration of small doses of diluted hydrochloric acid after each meal to assist digestion, but the writers have seldom seen it of much use. Where cancer is absent moderate doses of cod-liver oil appear of service, but in other cases the drug is apt to produce nausea and loss of appetite. The muscular action of the stomach must be as much as possible assisted; and a well-fitting bandage, or an abdominal belt, is often of value. Electricity has been strongly recommended by some, but in the experience of the writers it is rarely productive of benefit. What, however, is always more or less beneficial is to keep up a free action on the large intestine by mild aperients or enemata. Injections of gruel and barley-water, mixed with castor-oil and turpentine, answer the purpose best.

Symptoms must be relieved as they arise. Subcutaneous injections of morphine are invaluable for the relief of pain. In some cases chloral hydrate answers better, but, on the whole, it is inferior to preparations of opium. One of the most distressing symptoms is acidity. This is best relieved by a combination of bismuth with magnesia or soda, or by lime-water given frequently. Sir William Jenner recommended the hyposulphite of sodium to relieve the acidity. Others have prescribed carbolic acid and creasote.

As regards the diet of the patient, such articles of food should be chosen as are least liable to ferment, and consequently starch and saccharine substances should be as far as possible excluded. Where there is much pain after food, or other symptoms of ulceration, it will be found best to restrict the patient to liquid food, taken frequently and in small quantities, such as milk, meat-juice, chicken-broth, and beef-tea. But where there is not much pain, frequent small meals of solids may be allowed, consisting of soft-boiled eggs, fish, fowls, tripe, sweetbread, &c. When the vomiting persists in spite of the use of the stomach-tube, nutrient enemata should be used. Alcohol seldom agrees; but, if it seems to be necessary, small quantities of brandy or whisky will be found to answer better than wine.

The operative treatment for cicatricial contraction of the pyloric orifice was first advocated by Loreta. The organ is opened in the neighbourhood of the lesion, and the pylorus forcibly stretched, either by the finger of the operator or by means of a mechanical dilator. Among twenty-seven recorded cases collected by the writers, ten died soon after the operation, while the remaining seventeen recovered, and several remained free from their previous symptoms for some months afterwards. In one instance the operation was performed twice. In one unpublished case which has come under the writers' notice, the forcible stretching of the pylorus caused rupture of the orifice, and also of the first inch of the duodenum, the patient dying of acute peritonitis. The writers would therefore advise that in every case a careful trial of medicinal and dietetic treatment be made before surgical interference is undertaken.

8. **Stomach, Fibroid Thickening of.** This condition has received various names, such as 'cirrhosis of the stomach,' 'sclerosis,' 'plastic linitis,' &c. Allusion has been made in another article to thickening of the coats of the stomach of a similar nature to that affecting the pylorus, and usually producing hypertrophy of the muscular layer, narrowing of the opening into the duodenum, and eventually dilatation of the organ (*see* PYLORUS, Diseases of). Such cases, although not common, are every now and then met with, and in many instances the thickening of the submucous tissue extends for some distance from the pylorus, producing a tough, leathery condition of the coats. More rarely the thickening occurs in other parts than at the pyloric end. But, apart from these local thickenings, we occasionally meet with a form of the disease in which the coats of the whole organ are immensely hypertrophied.

ÆTIOLOGY.—Males seem to be more liable to this complaint than females, and it occurs at an earlier period of life than cancer. Dr. Brinton states that, whilst the average age of cancer is fifty, that of fibroid thickening is only thirty-four. Mechanical injury seems in some instances to have produced this disease.

ANATOMICAL CHARACTERS.—On opening the abdomen, there are almost always found signs of general peritonitis, either acute or chronic. In some cases a thick layer of lymph overlies and unites the various organs; in other cases only fluid, mixed with flakes of lymph, is discovered. The stomach is round or oval in shape, smooth on the surface, firm to the touch, often forming a tumour in the epigastric or hypochondriac region. When cut into, its walls do not collapse; and its cavity is often so much reduced in size as to be capable of containing only a few ounces of fluid. The thickness of the walls varies greatly, but in some instances it has been described as upwards of an inch. As a general rule, the walls are thicker at the pylorus than elsewhere, but the opening into the duodenum is not necessarily constricted, although such is not infrequently the case. The coats are of a dirty-grey colour, but the distinction between them can be readily made out. The chief seat of the thickening seems to be in the submucous tissue; but the muscular layers as well as the connective tissue between the muscular bundles, and the subserous structure, are all much increased in thickness and density. The mucous membrane is thrown into folds or elevations, or studded over by small projections, most of these appearances being probably the result of the diminished capacity of the organ; it may also be ulcerated. Microscopically, the mucous membrane is usually found to be healthy.

SYMPTOMS.—In a case observed by the writers the symptoms followed immediately after the receipt of an injury to the epigastrium; but usually they have come on insidiously. There is generally pain in the epigastrium, increased by food, in some instances shooting into the back and shoulders. The tumour formed by the thickened stomach is almost always tender on pressure, but not remarkably so, unless peritonitis is present. Vomiting is a general symptom; in some instances it occurs directly after food, in others the fluid rejected is thin, like saliva. Towards the close of the disease vomiting of blood is not infrequent; but, unless ulceration occur, there is an absence of the coffee-ground fluid so constantly marked in cancer. The appetite is always bad, and decreases as the disease advances; the bowels are usually confined. There is loss of flesh and strength. The pulse is feeble towards the end of the case. Dropsy, both of the peritoneum and lower extremities, generally shows itself; and the patient dies from exhaustion, or is cut off by the occurrence of peritonitis. The duration of the malady varies greatly. In some cases it has been known to last for many years, whilst in others the patient has died in a few months.

Physical Signs.—In almost every instance a tumour has been observed during life. It is generally situated in the epigastrium, but may present itself in either hypochondrium. In one patient it was supposed, from its situation, to be a cancer of the spleen. It is smooth upon the surface, more or less tender to the touch, and usually movable from side to side. On percussion, the sound is not perfectly dull, as in the case of a solid tumour.

DIAGNOSIS.—This complaint may be confounded with cancer, or with foreign bodies in the stomach. It must be most difficult, if not impossible, to diagnose the more acute cases from cancer. The smoother surface of the tumour, and the non-affection of the liver or other organs, are the most likely points on which stress may be laid, to distinguish between the two diseases. In the chronic cases of fibroid thickening, the long duration of the illness, the less constant pain, the vomiting directly after food, the less frequent occurrence of coffee-ground vomiting, and the absence of the history of a family predisposition to cancer, may afford some grounds for a diagnosis. To distinguish these cases from foreign bodies in the stomach, we must remember that the latter are found chiefly in idiots and in the insane or in hysterical females. One of the writers has long been in the habit of distending the stomach in all doubtful cases, by making the patient drink freely of soda water; and in one instance where the coats of the stomach were much thickened, he succeeded by so doing in proving the case to be one of fibroid disease. The note on percussion became more tympanitic, and the lump descended, but in the case of a foreign body in the stomach no change would be effected by such a proceeding.

TREATMENT.—Careful attention to diet is the most essential point in the treatment of this disease. The diminution in the size of the stomach is sufficient to show that only small quantities of food can be retained, and the impaired condition of the motor apparatus indicates the necessity that the nourishment should consist only of liquids. Milk and animal soups seem best fitted for such cases. Opium is almost the only medicine likely to be of value. Occasional leeches, and small blisters, frequently repeated, to the epigastrium, tend to relieve the sufferings of the patient.

9. Stomach, Gangrene of.—It is supposed by many modern authors that ulcerations of the stomach are produced by the solution, by means of the gastric juice, of small patches of the mucous membrane that have been deprived of their vitality, and become gangrenous. Such may no doubt be the case when the morbid condition is confined to merely isolated patches of the stomach; but where general acute gastritis co-exists there is often a complete suspension of the secretion of gastric juice, and in many such cases the edges of the sloughing tissues may be seen still attached to the neighbouring healthy structures. Where there has been great depression of strength, we occasionally meet with sloughing, to a considerable extent, of the mucous membrane of the stomach, both in the inferior animals and in man. Cases of sloughing of the stomach occurring in the human subject have been recorded by various writers. A case is mentioned in the records of the [illegible] Hospital in which sloughing of the cardiac end of the stomach was found in a woman [illegible] years of age, but it was associated with ulceration of the ascending colon, and there was also sloughing of the left lobe of the liver and suppuration of the left kidney. The late Dr. Habershon also mentions one in which, along with diseased kidneys and pneumonia, there were several sloughs at the lesser curvature of the stomach. The most ordinary form of gangrene of the stomach is where it [illegible] cancer of the organ. A large mass of sloughing tissue is found connected with a malignant ulceration, often of large size, and generally situated towards the pyloric end of the organ.

TREATMENT.—Gangrene of the stomach is beyond treatment other than what may be afforded by opium or perhaps some simple antiseptic.

10. **Stomach, Hernia of.** — *See* 15. Malposition.

11. **Stomach, Hyperæmia of.**—The mucous membrane of the stomach is frequently found to be congested after death, where there has been but little evidence of disease during life.

ÆTIOLOGY AND ANATOMICAL CHARACTERS. Gastric hyperæmia may arise from different causes. If an animal be killed when fasting, the lining membrane of the stomach is found to be pale and anæmic; but if death should occur whilst digestion is going on, the vessels are seen to be filled with blood. The same observation is made in the human subject, and serves to explain the frequent occurrence of a congested state of this organ after death. In other instances the increased vascularity is the result of a lavish employment of alcoholic stimulants during the later hours of life. The most extreme degrees of hyperæmia of the stomach are met with in cases of diseased heart, more especially when the mitral valve has been constricted. When we open the stomach we are at once struck with the dark purple condition of its lining membrane, the appearance of congestion being most evident in the pyloric region, and terminating abruptly at the end of the œsophagus. The rugæ seem thick and prominent, and the whole surface is covered with a layer of tenacious mucus. Spots of extravasated blood present themselves, some being softened on their surface, as though they had been acted upon by the gastric juice. There is seldom, however, any of the general softening characteristic of the action of the gastric juice after death, and the surface looks raw and uneven after the removal of the adherent mucus. The whole stomach has a thickened, fleshy feeling, and is, in reality, considerably increased in bulk. Microscopically, sections of the stomach have an opaque appearance, from the quantity of blood and serum they contain, but after being for some time macerated they become more transparent. In some cases the tubes can be readily separated from each other, and are normal; in other cases they are of unusually large size, and distended with cells and granular matter. The blood-vessels are always enlarged, and in long-standing cases the coats of the veins are thickened. The capillaries surrounding the orifices of the tubes are especially dilated and engorged with blood. Long-continued congestion reduces the secretion of the stomach. The secretion of acid is evidently lessened, for in some instances phosphates have been found in the contents of the stomach, and, as a general rule, the mucous membrane does not present the appearance of *post-mortem* solution. The formation of pepsin is also impaired. The question may be asked, why hyperæmia is more intense in the pyloric than in the more actively secreting portions of the organ. In all probability it arises from the fact that the vessels of the stomach perforate the muscular coat obliquely before they pass upwards between the tubes to the surface. The circular fibres must compress these vessels during their contraction; and the veins, from the greater weakness of their coats, and from their being less protected by surrounding fibrous tissue, must feel the effects of the compression more than the arteries. The transverse muscular fibres are comparatively thin and weak in the larger portion of the stomach, and become firmer and stronger as we approach the pylorus. Consequently the veins are more liable to compression during the more energetic motions of this region, and the effects of the congestion are here more appreciable.

12. **Stomach, Hypertrophy of the Walls of.**—*See* 8. Fibroid Thickening.

13. **Stomach, Inflammation of.**—SYNON.: Gastritis; Fr. *Gastrite*; Ger. *Gastritis.*

All the coats of the stomach may be simultaneously inflamed, but this is rarely met with (*see* 8. Fibroid Thickening). Usually the mucous membrane is alone the seat of the disease, and it has of late years been the custom to describe this as 'gastric catarrh.' This term is objectionable, as catarrh is so generally applied to the inflammation of mucous membranes of a much more simple anatomical structure. It should be borne in mind that the mucous membrane of the stomach is in reality an expanded gland, the elements of which have a greater functional activity than those of any other secreting structure in the human body. The injuries inflicted upon it by disease are therefore in no way analogous to those suffered by an ordinary lining membrane, but tend to lessen or altogether destroy the function of an organ of primary importance to the well-being of the individual. In addition to this, the anatomical changes are not always of the same character, but seem to the writers in certain cases quite distinct from those ordinarily produced by catarrh. Inflammation of the mucous membrane of the stomach will therefore be described under two forms, namely, (1) *Catarrhal*; and (2) *Erythematous gastritis.* It will be also necessary to consider the disease according as it occurs in an *acute* or *chronic* form.

(1) **Acute Inflammation—Acute Gastritis.**—ÆTIOLOGY—Acute *catarrhal gastritis* is most common in persons of middle and advanced age, and more frequently affects females than males. Sometimes it occurs in gouty and rheumatic subjects, and

is relieved when the disease appears in the joints. Again, it presents itself in those who suffer from disease of the heart, emphysema of the lungs, cirrhosis of the liver, and other disorders that have a tendency to keep up a congested condition of the digestive tract. Under these circumstances it often proves dangerous, and snaps the feeble thread by which the patient clings to life. The most common exciting causes of acute gastritis are errors in diet; various indigestible substances, such as cheese or shell-fish, being especially liable to produce it. Above all, an immoderate indulgence in spirituous liquors is apt to set up this form of inflammation, not infrequently laying thereby the foundation for other and more serious morbid changes.

Acute *erythematous gastritis* is more generally met with in children and in young persons, and constitutes a considerable number of the so-called 'gastric' and 'remittent' fevers so common at this period of life. It also presents itself in scarlet fever and other eruptive disorders; and although it usually passes off without provoking any local symptoms during the fever, it nevertheless constantly leaves a liability to a frequent recurrence of the disorder. Considering how often the recurrence takes place, it is strange that so little attention has been attached to the circumstance. A similar morbid condition of the stomach often makes its appearance in the last stage of phthisis and other exhausting disorders, and adds greatly to the danger and sufferings of the patient.

ANATOMICAL CHARACTERS.—In *catarrhal gastritis* the stomach is usually contracted and empty. The lining membrane is covered with a tenacious or thready mucus, beneath which it appears irregularly congested. It is softer than usual; and often presents numerous small hæmorrhages. These are most commonly met with in the pyloric region, are round or oval in shape, and frequently superficially ulcerated. Microscopically, the pits on the surface of the membrane are found to be swollen, prominent, and their vessels much congested. On section, the gastric tubes are seen to be greatly distended with large granular cells, which, by their increased size and number, bulge outward the basement-membrane, so as to produce an irregular outline. The solitary glands are generally enlarged.

We meet with the most perfect examples of acute *erythematous gastritis* in scarlatina. In the earlier stages there is no increased secretion of mucus, and often but slight injection of the surface, whilst at a later period the mucous membrane may be even paler than usual. Microscopically, the gastric tubes are much distended by granular and fatty matters, so that the cells are quite obscured, and in many cases these seem to be reduced greatly in number. Casts of the tubes are in some instances met with in the contents of the stomach. It will be observed that the morbid appearances, which are strictly analogous to those of the skin in scarlatina, differ from those produced by catarrh, in the amount of mucus not being increased, and in the tubes being distended by an albuminous fluid, instead of by an increased growth of the cells themselves. It is therefore analogous to an erythematous affection of the skin, with which, indeed, it is associated in scarlatina; whilst the catarrhal form is analogous to the eczematous and other inflammations of the cutis, which are characterised by a more abundant formation of the cellular elements.

SYMPTOMS.—The *catarrhal* form of gastritis is sometimes preceded for a few days or hours by a feeling of general weakness; in other cases the attack comes on without warning. There is seldom any complaint of pain in the region of the stomach, although a sense of fulness and uneasiness is not uncommon. Nausea or vomiting is usually present, and in nervous subjects is often very distressing; it constitutes one of the most characteristic signs of the disease. Tenderness on pressure is rarely absent. At first the remains of the previous meal are rejected, but afterwards a thick, glairy mucus is expelled, attended with violent retching. The tongue is foul, and the breath often offensive, from the co-existence of oral catarrh. There is an absence of appetite, or a positive aversion to all food. The bowels are confined; the urine, which is often pale and copious before the attack, becomes scanty and high-coloured during its continuance. The pulse is rarely quickened, and the temperature of the skin is unaltered. There is almost always headache, the pain chiefly affecting the forehead and eyes, and being accompanied by intolerance of light and sound, whilst sleeplessness forms a prominent symptom in many cases.

In *erythematous* gastritis, on the contrary, pain at the epigastrium is a prominent symptom, excepting when the disease accompanies eruptive fevers. It usually comes on directly after food, sometimes shooting towards the shoulders, or down the left arm. In phthisical cases a feeling of rawness in the œsophagus and stomach is more generally complained of. The pain is associated with tenderness on pressure over the pit of the stomach. In children there is usually an absence of pain, but the tenderness is well-marked. Vomiting is as general as in the catarrhal form, but the matters rejected seldom contain much mucus. Nausea is present where vomiting is absent, and in the slighter cases forms the chief ground of complaint. Thirst is almost always troublesome. The tongue is at first red and injected, but in a day or two it is apt to become dry and glazed. Diarrhœa generally accompanies the disease, the stools being fœtid and unhealthy. The pulse is frequent, often out of all proportion to the severity of the other symptoms. The temperature of the skin is increased, especially in children.

Both these forms of gastritis generally subside, but in other cases the disease shows a tendency to become chronic. In both there is a diminution, or entire cessation, of the secretion of the stomach. This does not arise from any deficiency in the amount of pepsin in the tubes, for the writers have found the mucous membrane after death capable of forming an active artificial gastric juice. In all probability, the secretion of acid is arrested, or its flow into the stomach prevented, by the swelling of the orifices of the tubes or of the pits into which they open. The result, however, is that fermentation occurs in any food taken; the inflammation is thereby kept up; and large quantities of torulæ, mixed with food or mucus, are rejected by vomiting.

Diagnosis.—The vomiting of acute catarrhal gastritis, attended, as it so frequently is, by headache, is apt to be confounded with the gastric irritability of brain-disease. In affections of the brain the vomiting occurs more directly after food, and is often unattended by nausea. The tongue may be clean, whilst the pulse is quick, the skin hot, the bowels obstinately confined, and other symptoms are present pointing to some brain-lesion. In gastritis nausea is more complained of; the tongue is foul; the pulse, in the catarrhal form, but little quickened; the skin comparatively cool; the bowels often relaxed; and there is a history of previous attacks, or of some dietetic error or co-existing visceral disorder. Acute erythematous gastritis may at first closely simulate typhoid fever, especially in children. It is, however, distinguished from it by the gastric symptoms being prominent from the onset; by their sudden occurrence; by the rapid, not gradual, rise of the temperature; by the red, injected tongue; and by the spleen not being enlarged. The fall in the temperature, and the absence of eruption and of diarrhœa, serve to prevent mistakes after the first week of the illness.

Prognosis.—When gastritis is uncomplicated, the prognosis is favourable, but it is otherwise if it take place in the course of some serious chronic disorder.

Treatment.—The general principle to be kept in view is to afford the stomach as perfect physiological rest as possible. In severe cases, therefore, it is best to let the patient abstain entirely from all food for twenty-four or forty-eight hours, allowing him to suck only a little ice, in order to allay thirst. If there be much exhaustion, or if the attack be a protracted one, the strength may be supported by nutrient enemata. Sometimes the subcutaneous injection of morphine assists in giving rest to the inflamed organ. In acute catarrhal gastritis, especially when it is attended with portal congestion, or has arisen from excessive indulgence in spirituous liquors, we can often put a stop to the attack by calomel. From two to five grains may be placed on the tongue, and be followed by a saline aperient, and a second dose may be administered the following day. When there is diarrhœa or much exhaustion, it is a good plan to give a grain every few hours. In the slighter attacks effervescing liquids often give great relief to the patient. In the earlier stage of erythematous gastritis, nitrate of potassium or chloride of ammonium, along with diluted hydrocyanic acid, is generally of benefit; the bowels being at the same time relieved by some mild aperient, or by an enema.

In both forms the practitioner should be on the watch lest the symptoms should be kept up by fermentation. This is readily determined by placing a drop of the vomited matters, mixed with a weak solution of iodine, under the microscope; or by testing for lactic, acetic, and butyric acids. Torulæ, if present, will be detected by their brown colour, round or oval shape, and their tendency to the formation of chains of cells. In case of fermentation, carbolic acid, creasote, or sulphurous acid may be prescribed. The glycerine of carbolic acid, in does of ten or twelve drops, is to be preferred, combined with tincture of belladonna or solution of morphine.

Occasionally the vomiting appears to persist from exhaustion. When this is suspected to be the case, stimulants must be had recourse to; and in many instances champagne will stop sickness at once, when all other remedies have been fruitlessly tried. It is in such circumstances that the hypodermic use of morphine is so valuable; a single dose often giving sleep, and allowing the stomach sufficient repose to recover its normal tone.

When there is much epigastric tenderness, the application of a few leeches is often of great value. This is chiefly the case where the attack has occurred as a complication of some other gastric disorder, such as ulcer. In obstinate cases of catarrhal gastritis, dry-cupping may be used with benefit. In the erythematous form the writers always find warm external applications useful, such as poultices of linseed meal, with or without mustard, hot fomentations, and in some cases stimulant or opiate liniments.

As soon as it is considered advisable to allow food, it should be given in the liquid form; in small quantities at a time; and often repeated. In catarrhal gastritis all saccharine and starchy fluids should be avoided. It is best to restrict the patient to chicken-broth, or mutton or beef tea, or milk mixed with soda, Vichy, or Seltzer water. In the erythematous form, where there is less tendency to fermentation, barley-water, arrowroot, or other farinaceous food mixed with milk may be used. It often happens that condensed or peptonised milk is tolerated where cow's milk is rejected.

(2) **Chronic Inflammation.**—Synon.: Chronic Gastritis.

This is, perhaps, the most common disease met with in practice, and comprises all the forms of chronic gastric derangement usually described under the head of 'inflammatory dyspepsia.' It is almost always of a catarrhal nature; for when signs of erythematous gastritis present themselves, it will generally be found that the latter affection is an acute attack supervening on chronic changes of a catarrhal nature.

Ætiology.—Males are more subject to chronic gastritis than females; and amongst the working classes the writers found it was most frequent in men between forty and fifty, and in women between fifty and sixty. In a large proportion of the cases that occur in early life it is an hereditary disease, and the mother is much more apt to transmit it than the father. It often results from attacks of acute inflammation. Persons of a full habit of body are more especially liable to chronic gastritis, and it is in such that the complaint usually proves especially rebellious to treatment. Of all causes, errors in diet are most apt both to induce it, and to maintain it when once it has been lighted up. Thus, a too free supply of animal food is one of the most potent causes; and equally so is the habit of too frequent repetition of meals, without allowing a sufficient interval between them. This habit of eating too frequently is greatly kept up by the craving which is so common a symptom of the disease. Imperfect mastication is another common cause; but, above all, the immoderate use of alcohol occupies a prominent place. It is strange how frequently we discover signs of chronic gastritis after death, where no particular complaint has been made of any derangement of the digestive organs. This is more especially the case where cirrhosis, chronic congestion of the liver, diseased heart, and other disorders tending to obstruct the portal circulation, are present. In like manner, it is apt to occur whenever any excretory organ is performing its office imperfectly, as in chronic diseases of the kidney, or when constipation or inactivity of the skin exists. It is very common in gouty subjects, and in females who suffer from catamenial derangements; and it is often met with in persons who have died of phthisis and other wasting disorders.

Anatomical Characters.—The mucous membrane of the stomach is covered with a layer of greyish white, tough, transparent mucus, which firmly adheres to the surface. On its removal, an abnormal amount of vascularity becomes apparent, the veins being large and prominent. The surface is often of a grey or slate colour, and not infrequently numerous hæmorrhagic erosions present themselves. This is more especially the case where long-continued congestion has been kept up by cardiac or hepatic disease. In other cases the surface is strikingly uneven, being studded over with numerous little prominences, separated from each other by shallow furrows. This condition is named 'mammillation.' More rarely, small polypoid formations project from the membrane. The whole membrane is firm and tough, and can be stripped away from the subjacent structures in flakes of considerable size. These anatomical changes are more common in the pyloric region than in the more actively secreting portions of the organ.

Microscopically, in the slighter cases the anatomical changes may be limited to enlargement and thickening of the small pits on the surface, together with dilatation and congestion of the blood-vessels. But when the disease has been of long standing, a section shows the glandular structure itself to have participated. The secreting tubes are closely united together, and to the subjacent coats; their basement-membrane is greatly thickened; and they are distended with cells and granular matters, which often project like little lumps from their orifices. At a later stage the tubes become atrophied, and only a few fatty cells remain to point out their former site; or their free ends are obstructed, whilst their lower ends are dilated into a flask-like form. The grey pigment may be deposited either between the tubes or in the cells themselves. The solitary glands are generally enlarged, and tend to atrophy the tubes by their pressure. Patches of thickened layers of epithelium may remain attached to the surface, showing that a condition may exist in the stomach analogous to squamous diseases of the skin.

Symptoms.—There is a great difference amongst authors as to the symptoms produced by chronic catarrhal gastritis. This, no doubt, in part, arises from the fact that simple and uncomplicated cases are so rarely fatal, and that we have, therefore, but few opportunities of verifying the diagnosis by *post-mortem* examination. But it also depends on the symptoms of other co-existing affections being so often described along with those arising from the deranged stomach. There is seldom much complaint of pain, excepting it be a sense of fulness and oppression at the epigastric region after food. When there is acidity, the patient often experiences a severe burning from the stomach to the throat. In such cases temporary relief may be afforded by food or stimulants, on account of the introduction of fresh aliment exciting the stomach to increased action, so that the decomposing remains of the previous meal are either neutralised or hurried through the pylorus. There is generally a certain amount of tenderness at the pit of the stomach, which is most evident in the cases in which congestion of the liver is also present.

The appetite is variable, being usually lessened; but in other cases a craving for food is experienced. Nausea is a common symptom; but vomiting, in the ordinary run of cases, is not so frequent as might be expected. When the affection has been induced by drunkenness, a rejection of mucus in the early morning takes place, and in gouty subjects this forms a most distressing symptom. Acid eructations, and a sour taste in the mouth, are commonly complained of. These probably arise from particles of undigested food remaining entangled in the mucus, setting up acetous or lactic acid fermentation in the saccharine and starchy articles of diet. The writers prevailed upon a number of patients who were suffering from this symptom to excite vomiting in the early morning by drinking warm water. In every case a quantity of thick, ropy mucus was rejected, and intermixed with it were portions of partially digested food. In some the amount of fluid rejected was so large that the conclusion could not be resisted that the muscular coat had been enfeebled by the inflammation, and had been thus unable to completely expel its contents. Thirst is often present, and, as a general rule, is most complained of towards evening. The bowels are usually confined, but where the catarrhal condition has extended to the intestines, frequent attacks of diarrhœa take place. The urine is high-coloured, depositing lithates; but as the inflammatory condition subsides, it may become of low specific gravity, alkaline or slightly acid, and may deposit pale-coloured lithates or phosphates. Where the oral cavity is, as is usually the case, also inflamed, the throat presents a red, congested appearance. The tongue is large, indented with the teeth, and, if the liver is simultaneously congested, is coated with a thickened epithelium of a brown or yellow hue. If the catarrh have extended to the salivary glands, the surface of the tongue becomes dry, or is covered with a white, creamy mucus. If the duodenum be affected, the patient is liable to jaundice from obstruction of the biliary passages. Generally the results of imperfect lacteal absorption are shown in loss of flesh, dryness and harshness of the skin, and imperfect nutrition of the hair and nails. The pulse is ordinarily slow, full, and regular. A short cough is often complained of. The temperature is seldom increased, excepting towards evening, and the patient often complains of coldness in the extremities. The nervous system almost always suffers. There is great wakefulness, or the patient wakes after a few hours of broken and disturbed slumber. Attacks of headache are frequent, the pain affecting chiefly the forehead and eyeballs.

It is necessary to notice two important varieties of the complaint, both on account of their practical importance, and also from the little attention they have received from authors. In one class of cases the prominent symptom consists in the rejection of an enormous quantity of mucus. This may occur almost constantly, vast amounts of glairy or of blood-stained mucus being rejected. In other instances the vomiting occurs only every few days, mostly after breakfast; and, from the quantity expelled, it would almost appear as if a gradual accumulation took place before each attack, until the stomach was excited to get rid of it. There is often no nausea preceding the vomiting, and but few gastric symptoms between the attacks. This form of gastric catarrh is most apt to occur in females, but it may also affect the other sex. The second variety appears to be an eczema of the stomach; at any rate, the catarrh of the mucous membrane replaces a similar catarrhal condition of the skin, and is often relieved as soon as the latter reappears. In many cases the condition may be attributable to a gouty diathesis, of which both the skin-affection and that of the stomach are the expressions. Still, this alternation between the disorder of the skin and stomach is not infrequently witnessed in practice.

Diagnosis.—The only disease likely to lead to mistakes in diagnosis is atonic dyspepsia; but we may meet with very rare cases of chronic catarrhal gastritis that are difficult to distinguish from ulceration and cancer of the stomach. Where, as occasionally happens, a certain amount of hæmatemesis presents itself, the diagnosis between this disease and ulceration requires care. But in catarrh there is usually some co-existing disease of the heart or liver, or some disorder of menstruation; there is an absence of pain, or, if pain be present, it is relieved, not increased, by food, as in the case of ulcer. Again, the vomiting is less excited by food; the epigastric tenderness is slight and diffused, not confined to one particular spot, as in ulcer. Cases are sometimes mistaken for cancer. The pain, however, in gastric catarrh is slighter; the tenderness comparatively trifling; and the hæmatemesis is never excessive or long-continued, as in cancer. On the other hand, in the latter disorder there is a more rapid loss of flesh and strength, and more pallor of the lips and complexion. The discovery of a tumour in the epigastric region, or in some other organ, would remove all doubts as to the real nature of the malady.

Treatment.—The first point as regards treatment is to discover, if possible, the cause of the disease. It is useless to attempt to relieve an inflammation of the stomach, so long as the veins of the organ remain in a state of congestion produced by a disease of the heart or lungs. Cases that had been ineffectually treated for months with purgatives and tonics have yielded at once to rest and digitalis, prescribed on account of the discovery of a dilated heart. In other instances, chronic Bright's disease, by preventing the due elimination of the effete matters, gives rise to the gastritis; and, under such circumstances, treatment directed to the relief of the original affection yields more satisfactory results than that which would be ordinarily prescribed for inflammatory dyspepsia. Constipation will be often found to have preceded the gastric symptoms, which have been produced by the food being too long retained in the stomach, from the diminished muscular activity of the whole canal. Here a regular action of the bowels is the main indication for the relief of the gastric catarrh. There is often, as before mentioned, a craving for food every two or three hours, set up by the presence of mucus in the stomach. Numbers of cases prove rebellious to treatment, because the patient persists in seeking temporary relief by frequently cramming the stomach with food, or because he keeps the mucous membrane in a state of excitement by stimulants, taken under the idea that debility is the cause of his sufferings. In the majority of very obstinate cases, one or other of these habits requires to be overcome, before other treatment can be made available. The mere removal of the cause producing the disease is often sufficient to ensure its cure, but in other instances we are forced to employ other means. The chief indication in the ordinary run of cases is to take off any increased pressure upon the venous circulation. In any glandular structure we can only effect this object by lessening the amount of blood flowing to it, or by increasing the rapidity of the circulation through the organ by stimulating its secretion. The first of these objects in the case of the gastro-intestinal tract is accomplished by purgatives, which drain away a large quantity of the liquid portions of the blood which has to pass through the vena portæ. In young and vigorous subjects, therefore, salines, such as the sulphate of magnesium, tartarated soda, or the mineral waters of Pullna or Friedrichshall, may be employed. These may be assisted by small doses of mercurials, given every second or third night. The salines should not be too long continued alone, as they are apt to enfeeble the muscular powers of the canal. After a short period, it is necessary to combine them with a tonic, such as quinine, gentian, or calumba, or with sulphate or phosphate of iron. In more feeble subjects, or in those who have previously suffered from atonic dyspepsia, it is better to relieve the congestion by stimulating the biliary secretion. For this purpose, taraxacum or chamomile may be employed, assisted by a pill each night, containing podophyllin or blue-pill. In another set of cases, where the patient is not robust, both objects may be attempted at once—by the administration of soda and rhubarb in the day, assisted by an occasional dose of blue-pill at night, or by a course of the Carlsbad water every morning.

It has been before remarked how readily fermentation is set up, whenever the secretion of the gastric juice is lessened or arrested. This circumstance must be borne in mind in the treatment of this as well as of other gastric disorders. As soon as the more urgent symptoms of chronic gastritis are subdued in any case, tonics, such as iron, calumba, or quinine, along with acids, may be used to obviate the enfeebled state of digestion that always results from the long continuance of the inflammation.

The treatment of cases where large quantities of mucus are vomited must be conducted on a different principle. Here the venous system is in a state of passive congestion, and no active inflammation of the mucous membrane is in progress. We must use astringents, the best of which are bismuth, nitrate or oxide of silver, oxalate of cerium, kino, tannin, and opium. Purging makes the patient worse. In order to obviate the ill-effects of the astringents, it is necessary to give each night a pill of podophyllin and creasote, or of nux vomica and aloes, or some other similar preparation. In obstinate cases of chronic gastritis, and especially where there is frequent vomiting of mucus, the stomach should be washed out every two or three days with Vichy water or a weak solution of bicarbonate of sodium (*see* LAVAGE). The patient should be cautioned not to pass the tube too frequently. To avoid the removal of the partly digested food, it is better to have the operation performed in the early morning. Many patients find great comfort from the use of a compress, which may be worn either during the day or, in obstinate cases, both night and day. In all cases where a compress is not employed a warm abdominal bandage should be used.

Eczema of the stomach is most difficult to treat satisfactorily, probably because it depends on the general state of health. It is best relieved by moderate doses of solution of potash, taken a little before the time when the scalding pain is expected, assisted by a pill, every night, of podophyllin and creasote. In other instances, a combination of bismuth, soda, and carbolic acid is successful in removing the pain after food. As soon as the urgent symptoms have been overcome, benefit may be expected either from the official compound iron mixture, or from quinine combined with ammonia. Flannels dipped in a solution of common washing soda, and covered with indiarubber, may be applied over the epigastrium with benefit; or a liniment of croton oil may be employed. The latter must be used with great caution, as, from the unusual irritability of the skin, the eruption is apt to be very severe.

Theoretically, it might be expected that a farinaceous diet would not be suitable in these cases, inasmuch as it is apt to set up fermentation. It is better to confine the patient to sparing meals of mutton, chicken, game, or fish, along with bread. Vegetables and fruit should be at first avoided, but may be freely used as soon as the more urgent symptoms have subsided. The breakfast is the most difficult meal to manage, for tea and coffee are apt to disagree and increase the mischief. Dandelion coffee is often very useful in such cases. It is made by boiling the roasted and dried root of the taraxacum with a quarter of its weight of the best coffee. Where this cannot be readily obtained, the taraxacum juice of the Pharmacopœia may be taken, along with weak coffee. If milk does not disagree, it may be used, mixed either with lime-water, Seltzer, or Vichy water. Alcohol should be avoided; but if from long habit or other circumstances its use is necessary, a small quantity of weak spirit and water may be substituted for wine.

14. **Stomach, Lardaceous Disease of.**—This affection is an exceedingly common accompaniment of lardaceous disease in other organs, especially when the liver and intestinal tract are affected. It may occur as the result of prolonged suppuration from bone-disease, but is most usually met with in cases of chronic pulmonary phthisis (87 per cent. of all cases of chronic phthisis) (Fenwick). As a primary affection it is excessively rare, only four cases being recorded (Marfan). The disease usually commences in the pyloric region, the inner coats of the interglandular capillaries being the first to show signs of degeneration. Next in frequency come the capillaries which ramify on the surface of the mucous membrane, and the longer vessels situated in the neighbourhood of the blind extremities of the gastric tubes and in the submucosa. In an advanced case, almost the whole of the tissue of the wall of the stomach is found affected. Large areas of muscular tissue are completely lardaceous, as well as their nutrient vessels. The connective-tissue elements give a brilliant reaction with the aniline dye, and even the membrana propria and the peptic cells may suffer. The vessels which enter the solitary lymphoid follicles are early affected by the disease, and a marked atrophy of the follicle is usually observed in advanced cases; but the lymphoid elements themselves possess a considerable degree of resistance towards the lardaceous change.

Three results of this degeneration are particularly to be noted. In the first place, as in the case of the kidney, the disease of the vessels tends to deprive the secreting cells of their proper degree of nutrition, and hence we find that lardaceous disease is always accompanied by well-marked signs of tubular gastritis. Secondly, hæmorrhage is apt to occur from rupture of the weakened wall of the affected vessels; and the writers have convinced themselves by repeated observations that the superficial ulcerations so common in the pyloric region of advanced cases of pulmonary phthisis originate in this manner. Thirdly, the lardaceous degeneration of the muscular tissue is a potent factor in the causation of the dilatation of the stomach which is so commonly found in advanced cases of phthisis.

The *symptoms* of lardaceous disease present no striking peculiarity. It must be mentioned, however, that marked anæmia is usually present, and that Edinger has shown that free hydrochloric acid is usually absent from the gastric secretion in these cases.

15. **Stomach, Malposition of.**—The stomach may be displaced congenitally; or as a result of accident or disease.

In congenital displacement the stomach may be situated on the right side of the body, the fundus pointing to the right hypochondrium, the pylorus to the left. But, as in such cases it will be also found that there is a similar malposition of the heart, liver, and spleen, no mistake in diagnosis is likely to occur. As a congenital condition, the stomach may occupy the left pleura, through a partial arrest of development of the diaphragm. It may be also situated in the left pleura, owing to a rupture of the diaphragm. It is said that such a state has given rise to a mistake in diagnosis between it and pneumothorax of the left side. In both there is a clear sound on percussion, and a gurgling produced by motion of the body. Besides this, the pressure of the distended stomach has been seen to displace the heart, and produce dyspnœa. Bamberger has pointed out that in protrusion of the stomach into the left pleura the respiratory sounds can be heard in the upper part of the left lung; the clear note on percussion becomes duller after food; and any metallic sounds that may present themselves are unconnected with the breathing of the patient. The dyspnœa of congenital displacement is only occasional, not persistent, and it will be found to have existed for years, instead of occurring suddenly, as in pneumothorax. When the hernia has resulted from an accident, it is usually accompanied by vomiting of fluid containing sarcinæ, and by other signs indicating that the stomach does not get freely emptied of its contents.

The organ may be displaced downwards by the weight of a tumour situated in its coats. This is more especially the case with the pylorus, which is generally the seat of such a morbid change. Under these circumstances, the pylorus may be so depressed as to occupy the right iliac region, or it may have fallen still lower, and be united by adhesions to some of the pelvic viscera. In some cases the stomach is found in the contents of large umbilical and scrotal herniæ. When a stomach is much dilated, in case no adhesions have been formed between it and some of the neighbouring organs, it is displaced downwards by the weight of its contents.

16. Stomach, Morbid Growths in.—The stomach is liable to all the forms of morbid growth that are met with in the other structures of the body. Excepting the breast and uterus, no part is so frequently the seat of malignant disease. All the varieties of cancer attack this organ, and not infrequently they are combined. Thus we meet with scirrhus and encephaloid, or scirrhus and colloid, in the same tumour.

Scirrhus is by far the most common, constituting, according to the researches of Dr. Brinton, three-fourths of the whole number. Its most usual seat is the pylorus or the lesser curvature, and here it forms a tumour which rarely invades the duodenum, but tends to surround the organ. When a section is made at an early period of the disease, the distinction between the different coats is readily seen. The peritoneum and the tissue directly beneath it are thickened; the muscular structure is of a grey colour, and much increased in bulk, the bundles of fibres being divided from each other by firm septa of connective tissue. The mucous membrane covering the tumour may appear to the naked eye to be healthy. Sooner or later ulceration takes place, and a deep excavation results, with thickened elevated edges, and with a base not infrequently covered with fungoid projections. Microscopically the tumour presents the ordinary appearances of scirrhus. The muscular tissue is usually in a state of degeneration near the cancerous structure, even when it has not been invaded by the disease. The mucous membrane has been more or less diseased in all the cases the writers have examined, even at a distance from the tumour. The tubes were generally united to each other; and were, in many places, in a state of atrophy or of fatty degeneration.

Encephaloid cancer has affected the stomach in about one-tenth of the cases recorded, according to the inquiries of Dr. Brinton. It forms soft, quickly growing nodules, which project beneath the peritoneum, or elevate the mucous membrane. It seems generally to commence, as scirrhus does, in the submucous tissue. When ulceration occurs, numerous fungoid masses, which are often very vascular, project upwards. The muscular coat is more completely destroyed in the neighbourhood of the tumour than in scirrhus, and the mucous membrane is generally diseased in all parts of the organ. The tubes are not, however, so much atrophied as in the harder form of cancer, but are usually distended with cells, and the subtubular and intertubular spaces are occupied by cells of various sizes.

Colloid cancer is generally associated with scirrhus. The structure feels softer than when scirrhus is present alone, and consists in part of a gelatinous material contained in round or oval spaces bounded by connective tissue. Dr. Brinton calculates that only 9 per cent. of all the cases of cancer of the stomach are composed of colloid uncombined with scirrhus.

Epithelioma may occur in two forms. The most frequent variety presents itself as soft white masses in the submucosa, which rapidly destroy the subjacent mucous membrane and tend to ulcerate. Microscopically the growth is found to consist of tubular alveoli which are lined by columnar cells, while the lumen is not infrequently occupied by nests of cells of irregular formation. The stroma is deficient, and often represented by an infiltration of small cells. The true squamous epithelioma is much rarer than the cylindrical type, and is exclusively met with at the cardiac orifice, where it obviously originates in the lower end of the œsophagus. Ulceration is tardy and never very extensive.

Lipoma, *sarcoma*, and *adenoma* are also occasionally met with in the stomach.

Tubercle is very rare, and only found where there has been general tuberculosis.

Five cases of non-malignant tumour of the stomach are noted in the *post-mortem* records of the London Hospital. In one case a tumour—the nature of which is not mentioned—was found growing from the smaller curvature; one consisted in a large cyst attached near the pylorus; in a third there was a fatty tumour in a woman who seems to have died from heart-disease; a boy aged fourteen who had been killed by an accident presented a tumour attached to the peritoneal coat; and another who died from a perforating ulcer had a fibroid tumour situated near the ulcer. In all probability many have been omitted, as cases of adenoma and other forms of growth have fallen under the notice of the writers.

The *symptoms* and other clinical relations of morbid growths in the stomach are described under 4. Cancer.

17. Stomach, Neuroses of.—Under this head are generally included cases in which the symptoms point to a functional disorder of the stomach, unaccompanied by any change in the various structures of which the organ is composed. Looking at the subject from a physiological point of view, it is evident that the sensibility, the special sense, the motility, and the vaso-motor system must all be liable to deviation from their normal state, and should be therefore considered, each of them, separately. But it can scarcely be supposed that, in an organ the functions of which are so important and so complicated, any one alteration from the healthy state will generally present itself alone; and on this account it will be necessary to bear in mind that one functional change may be combined with others. Thus a great diminution of the special sense is commonly associated with an alteration in the ordinary sensation of the stomach, or with a diminution in its power of secretion, whilst an increase of its sensibility and irritability is often accompanied by an augmented activity of the glandular apparatus.

(1) **Neuroses of Ordinary Sensibility.**—*Morbid Sensibility of the Stomach.* Modifications of the sensibility of the digestive canal, unattended by pain, are by no means uncommon, and usually occur in persons suffering from nervous exhaustion. Under the name of 'morbid sensibility,' this disorder at one time attracted considerable attention, and almost every form of dyspepsia was referred to it. In a case of this kind the patient can often trace the passage of the food along the mucous membrane, especially when it has been taken warm or is of a stimulating character. In some there is a sensation as if the digestive tube were in a state of constant motion, and this often gives rise to a suspicion that the patient is suffering from worms. When, as is not infrequently the case, the action of the stomach is so impaired that portions of the food are passed in an undigested state, these insoluble materials are often looked upon as indubitable evidence of the existence of parasites. Others describe a sensation that shows still more the excited condition of the nervous system. It is as if 'a wave' passed over and obscured the mental faculties for a second, this feeling being instantaneously followed by a movement of flatus in the stomach or intestines. The tongue is usually clean; the appetite good, sometimes craving; the urine clear, depositing phosphates or the oxalate of calcium. The bowels are almost always confined; and in females especially, but sometimes also in the other sex, the abdominal aorta may be felt to pulsate with unusual force. These evidences of disorder in the digestive canal are always associated with others, indicating a feeble condition of the nervous system. Attacks of giddiness and mental depression are seldom absent; there is usually loss of strength, sometimes general emaciation; and the severity of these symptoms seems to be increased by any exacerbation of the disorder of the digestive organs.

Cases of this description, attended by great irritability of temper or despondency, not infrequently occur in persons of middle age who are hereditarily predisposed to gout or rheumatism; and the gastric symptoms may be suddenly replaced by muscular rheumatism or by an attack of sciatica.

The most marked examples of this complaint, however, occur in women about the period of the cessation of the menses, and are attended with a sense of fulness or distension after the smallest quantity of food, or these feelings may persist even when all food has been refused. The appetite is bad, or there may be a loathing of food. The bowels are usually constipated, but act readily with aperients. There is often a sensation of heat or scalding in the mouth and tongue, or it is described as if the tongue had been 'peppered.' In some instances the same feeling is complained of as extending down the œsophagus to the stomach; and more rarely there is a loss of sensation in the gullet, so that the food cannot be felt as it passes downwards. In other instances, the patient feels faint after every action of the bowels, and has to lie for hours in the recumbent position after their evacuation. There is almost always rapid loss of flesh and strength; sleeplessness, irritability of temper, or great despondency are usual accompaniments of this condition; and in many cases neuralgia of the head, back, or sciatic nerve adds to the sufferings of the patient.

TREATMENT.—The treatment of such cases is very difficult, as the patient is usually too impatient to follow out any regular course that may be recommended. It is advisable to commence with sedatives, such as the bromide of potassium, and to follow these with tonics. Travelling is almost always beneficial, but all undue exertion should be avoided.

The diet requires careful regulation, and should be varied according to the condition of the digestive organs. Practically, the best information respecting the suitability of the food may be obtained by watching the sensations of the patient. Whatever meal has been followed by an augmented sensibility of the digestive canal, or by an increase in the mental distress, must have been unsuitable either in quantity or quality, and observation will soon show in what way the diet may be best improved.

As a general rule, the food should be sparing in amount, and vegetables, soups, wines, and other articles difficult of digestion or apt to produce acidity, must be avoided. Bread, lean meat, and farinaceous food should form the chief articles of diet; and all stimulants should be prohibited, unless there is some special indication for their employment.

Hyperæsthesia of the Stomach.—The commonest form of this disorder shows itself as the result of ulceration of the stomach occurring in young persons. It is often exceedingly rebellious to treatment, and is probably analogous to the neuralgic affections of the ankle and knee that so frequently follow injuries of these parts in hysterical females.

The usual history of such a case is that a patient has been suffering from the symptoms of gastric ulcer, and has been kept for some time with marked benefit upon a liquid diet, when without apparent reason, although the vomiting may have ceased, the pain returns as severe as before, or even increases in violence. Its character also not infrequently changes. Sometimes it is as severe after liquids as after solids; in other instances it ceases for many days and reappears without any evident cause; or it comes on directly after the food has been taken, but does not last during the whole of the digestive process; or it may attack the patient more severely at night, when the stomach is empty, than during the period of its greatest activity.

The localised tenderness characteristic of gastric ulcer is usually replaced by a general sensitiveness of the epigastric region, or the whole of the abdomen appears unduly sensitive, deep pressure provoking less complaint than a slight touch. The pain is usually less affected by exercise or standing than during the period of ulceration, but it is not infrequently increased at, or just before, the catamenial periods. Under these circumstances it will be often observed that the patient is gaining flesh, that the appetite is good, sometimes craving, and that flatulence is a prominent symptom, even when pain is not present. In some cases there is a well-marked interval between the cessation of the symptoms of ulceration and the appearance of those of the hyperæsthesia. In other patients the pain very gradually alters in its character, and it is impossible to say when the hyperæsthesia has replaced the suffering resulting from the ulceration. In fact, in many cases it is only by watching the effects produced by a tonic treatment that we are able to convince ourselves of the neuralgic nature of the complaint.

Abdominal Neuralgia.—Neuralgia rarely occurs in the gastro-intestinal tract, excepting as the result of some organic change in it or in the neighbouring organs. Since the abdominal nerves are not exposed, as those of the limbs, to sudden changes of temperature, nor are surrounded in their course by unyielding bony structures, as the nerves of the head and face, they are less liable to this affection than other parts of the body. Again, as malaria, syphilis, and gout, which are the chief predisposing causes of neuralgia, ordinarily affect such of the abdominal organs as are but little endowed with sensitive nerves, it is seldom produced by constitutional ailments. We should, therefore, be most cautious in our diagnosis of idiopathic neuralgia as affecting the digestive tract. Everyone must have seen how often the subsequent development of an aneurysm, a deep abscess, or disease of the bones of the spine, has explained the cause of pains of the abdomen, which had been unhesitatingly referred to a mere nervous affection in the early stage of the malady.

The practitioner will, however, encounter cases in which there are severe attacks of pain, evidently of a neuralgic character, occurring in various parts of the abdomen. They may come on at any time of the day, are not increased by food, are usually aggravated by exertion, either bodily or mental, and are relieved by the recumbent position. In some they are accompanied by severe pains of the head or face, both pains coming on and subsiding at the same time. Symptoms of dyspepsia are occasionally present; more frequently they are absent. The best-marked cases occur in those who have been long in the tropics, or who live in malarial districts; but not infrequently they present themselves in persons liable to gout who have been suffering from great mental anxiety or distress. Arsenic and quinine are the most useful remedies, and where there is much nervous exhaustion the valerianate of zinc or phosphorus may be added with benefit.

(2) **Neuroses of the Special Sensibility of the Stomach.**—The appetite, which is the special sense of the stomach, and by which the supply of food required for the system is regulated, is frequently disordered. It may be increased, perverted, or diminished. Usually these changes result from some abnormal condition of the whole body, or of some important organ, but occasionally they arise from a nervous affection of the digestion alone.

A great *increase in the desire for food* not infrequently accompanies chronic gastric catarrh. It occurs two or three hours after a meal; is attended with a sensation of giddiness, faintness, or palpitation; and is relieved for a time by food or stimulants. It is, in all probability, produced by the irritation of partially digested food, a fresh supply of nutriment calling forth a new secretion of the gastric juice, and thus affording temporary relief.

There is another form of increased appetite which does not arise from an inflammatory state of the stomach, but occurs chiefly in young females who are of a nervous or hysterical temperament. The craving takes place usually at night, even after a late dinner, and the distress arising from it is often so severe that large quantities of food are consumed before the appetite can be appeased. In all probability it arises from an excessive irritability of the stomach, which causes the food to be hurried into and along the intestinal canal before digestion and absorption can be completed. In many instances it is associated with diarrhœa, and the stools consist largely of undigested materials.

A complete *failure of appetite* attended with great wasting of the body has been described as 'anorexia nervosa.'

It seems to be confined to young persons; in most instances it first makes its appearance between fifteen and twenty. It occurs chiefly in the female sex, but boys may be also the subjects of it. It is much more common in the wealthier classes of society than amongst those who have to procure their bread by daily labour.

The earliest indication of a failure in health is a distaste for food. At first butchers' meat is alone disliked, and the patient will partake freely of fish, vegetables, or fruit. The latter is more generally chosen, and some will eat oranges or apples when all other kinds of nourishment are refused. There is no vomiting and no complaint of pain, but in many cases a sensation of fulness is experienced. The bowels are almost always constipated, and the evacuations hard, dry, and knotty. The extremities are cold, especially at night, the action of the heart is feeble, and the pulse is small, slow, and regular.

In almost every instance, even at an early period, the temper is irritable, the patient becomes obstinate and self-willed, the sleep is very imperfect, and dreams and nightmare form constant subjects of complaint. In one case the patient was liable to slight hallucinations. Still more remarkable is the restlessness. One of the writers has known a patient in this condition so unable to remain at home that she would undertake railway journeys without any apparent motive, and although she knew they would be followed by attacks of severe exhaustion that would confine her to her bed for many days. Others will take long and purposeless walks, and it is a matter of surprise how persons eating so little can undergo so much fatigue. Emaciation soon shows itself, the patient steadily loses weight, the cheeks become thin, and she presents the appearance of advanced phthisis. The ankles in almost every case begin to swell at an early period, and this is often the first symptom that alarms the friends and convinces them of the serious nature of the malady. In other instances violent attacks of palpitation have occurred, attended with great dyspnœa and fear of instant death. The pulse under these circumstances is often exceedingly rapid (130 or 140 in the minute), and yet in two or three days it may gradually fall, the exhaustion may pass off, and the patient resume her former state. The catamenia are always irregular, often suppressed, and in one case did not return for five years, although the other symptoms had disappeared.

In severe cases, where the complaint is allowed to proceed unchecked by treatment, the situation of the patient becomes most pitiable. The dislike to food increases, until it is necessary to force it upon her; and as there is little or no thirst, even liquids are refused. The restlessness, which is so marked a feature in the earlier stage, now disappears, and the patient becomes less and less capable of exertion, until at last she is entirely confined to the recumbent position. The wasted limbs require to be kept apart, lest ulcerations should be produced by their contact, and the back and nates demand constant attention to prevent the formation of bedsores. The patient often lies in a condition of semi-consciousness, from which she can be roused, but into which she relapses as soon as she is left to herself. The pulse is small and feeble, and often very rapid. The skin is dry and harsh; the bowels are obstinately confined; and the urine scanty, and of low specific gravity.

Even from this condition the patient may be gradually restored to health by proper treatment; but, as may be readily imagined, many are allowed to sink under the idea that they are suffering from tubercular disease of the lungs or brain.

TREATMENT.—As the disease consists only in the loss of appetite, whilst the power of digestion remains intact, it is evident that careful and regular feeding of the patient must be the first principle in the treatment. In the early stage it is advisable to try to overcome by argument her dislike to food, as the physician can rarely at this period rely upon the active co-operation of her friends. So long as she can walk about, she can point out that her activity is increased rather than diminished by abstinence, and the ignorance of relatives generally leads them to blame any determined attempt at forcible feeding. Every means, therefore, should be employed to tempt the appetite, and observation will usually show that certain articles of diet are less distasteful than others. In many cases fowl, game, or even shell fish, will be taken when beef and mutton are obstinately rejected; in other cases vegetables and fruit are selected. Milk in various forms should be tried, either cold or thickened with vermicelli or macaroni; jellies and farinaceous puddings are sometimes acceptable, and, although inferior to other articles of diet for the purpose of nutrition, they supply matter for oxidation, and thus save the rapid waste of the tissues. Not infrequently the patient may be induced to choose her own diet, and it is then better to acquiesce in her choice than incur the risk of increasing her obstinacy by insisting on more wholesome food. In the later stages, when she has become so feeble that she is unable to go about, forcible feeding should be adopted. The patient ought to be treated as a person of unsound mind, and moderate quantities of milk, soup, beef-tea, eggs, or any other kind of nutritious food, must be frequently administered. Friends are never to be relied upon, but the case should be entrusted to a properly trained nurse, who must be held responsible for carrying out the treatment.

Tonics of some kind are always useful, but the patient often cannot be prevailed upon to take them. In the early stage, if anæmia is present, we may use some preparation of iron, such as an effervescing citrate mixture, the phosphate, or the saccharated carbonate, or it may be combined with quinine and strychnine, or with calumba or quassia, according to the circumstances of the case. Where there is no anæmia, or when iron disagrees, zinc may be prescribed, especially the valerianate or the sulphate. In cases in which the feeling of distension is very marked, the writers have seen more benefit from the use of pepsin and hydrochloric acid after meals than from the mineral tonics.

(3) **Neuroses of Motility.**—These are the most common and the best known of the neuroses of the stomach, but they often present considerable difficulties both in their diagnosis and treatment. The most usual deviations from the healthy condition are (*a*) *spasm*, (*b*) *eructation*, and (*c*) *vomiting*.

(*a*) *Spasm of the Stomach.*—Spasm of the stomach is a common accompaniment of all forms of dyspepsia occurring in persons of a nervous temperament. It probably arises from a closure of the cardiac orifice, preventing an escape of gas from the organ when it is distended with the products of fermentation. An attack is usually preceded by a sense of weight upon the chest, or a feeling of constriction, arising from imperfect digestion of the food. It generally comes on a few hours after a meal, especially during the night, when an escape of the gaseous contents of the stomach has been prevented by the recumbent position of the patient. It may be accompanied by ineffectual efforts at eructation or vomiting, but even when an escape of some of the contents of the organ takes place, relief is not necessarily obtained.

The severity of the attack depends much upon its duration. Where it passes away quickly, pain may be the only symptom; but where the spasm is long-continued and severe, other organs of the body are liable to be implicated. Thus, the action of the heart may become feeble and irregular, the pulse weak and fluttering, the face covered with perspiration, the extremities cold, and the respiration laboured and difficult. The patient sits upright, or rolls from side to side, in vain attempts to gain relief from the agonising pain with which he is affected. The epigastrium feels hard and distended, and is very tympanitic on percussion. The writers have seen the suffering so intense, and the collapse so sudden and severe, that they have doubted whether the patient were not suffering from perforation into the peritoneum. In some instances the attack disappears as suddenly as it came on, but more generally it subsides gradually.

Treatment.—The prevention of spasm of the stomach requires the removal of any morbid condition that may be present, and that is capable of giving rise to imperfect digestion of the food. It must be borne in mind that the patient is almost always of a nervous temperament; and that if aperients are requisite, they should be combined with a stimulant or antispasmodic. The diet must be carefully regulated; and effervescing liquids, as well as articles of food that are liable to ferment, such as uncooked fruit and vegetables, wines and malt liquors, must be prohibited.

During an attack, if it be of moderate severity, an alkali, combined with a stimulant and sedative, is usually sufficient to afford relief. For instance, a dose of bicarbonate of sodium or of magnesium, with chloroform or ether and morphine, is generally preferred. In the more severe cases the subcutaneous injection of morphine is requisite; and if the heart is much depressed, ammonia or brandy may be given, either by the mouth or in an enema.

The application of heat and warmth to the epigastrium is always of service, and flannels wrung out of hot water and sprinkled over with laudanum or turpentine, and a hot-water bottle, are favourite remedies. In some cases a mustard plaster, or, where the pain resists other treatment, a hot bath, is efficacious in affording relief.

(*b*) *Eructation.*—Eructation is a common symptom of dyspepsia, and is especially apt to occur to an excessive degree in women about the time of the cessation of menstruation. It is usually associated with flatulence, constipation, and other signs of feeble digestion, and it often proves very rebellious to treatment. But it may also occur in the young, as a purely nervous symptom, and is then apt to be very obstinate. Eructations occasionally result from malaria, and one of the writers has seen them replaced by almost constant hiccough, which was relieved by a course of arsenic.

(*c*) *Nervous Vomiting.*—It is unnecessary to mention that vomiting is one of the most common symptoms of various affections of the brain. It also frequently presents itself in locomotor ataxia, and may be one of the earliest symptoms of that disorder. As a rule, the attacks are accompanied by pains in the epigastrium, chest, or abdomen, and are often extremely severe; but the writers have seen persistent vomiting unattended by pain precede various affections of the spinal cord. In most cases the attacks of pain and vomiting subside after a few days, but recur from time to time. In some instances they seem to occur periodically. The pains are sometimes referred to the abdomen, and the functions of the intestinal canal are mainly affected. The patient may suffer from severe colic, attended with great distension of the abdomen, and constipation. In others diarrhœa is the most prominent symptom, which may not be accompanied by pains; and, unless great care be taken, mistakes in diagnosis are certain to occur. The writers have seen the earliest symptom consist in severe neuralgic pains about the anus, along with the passage of small and frequent stools. This was followed by frequent attacks of uncontrollable vomiting, and after some months the usual symptoms of tabes dorsalis presented themselves.

Vomiting is also a prominent symptom in 'Addison's disease,' probably from the changes that occur in the ganglia and nerves in that disorder; but the diagnosis must be determined by the other symptoms, and by the characteristic appearance of the patient.

A form of nervous vomiting known as *hysterical vomiting* is not infrequent. It occurs shortly after a meal; so quickly, indeed, in many cases, that the patient is forced to leave the table. It is not attended with nausea, and does not take place when the stomach is empty. What is rejected is usually tasteless; but when the vomiting occurs some time after eating it is sour, from the food being more digested. In many cases, although this is by no means necessary, this form of vomiting is accompanied by a sensation of weight or uneasiness after eating, flatulence, and other signs of dyspepsia. The bowels are almost always greatly constipated.

Although vomiting may occur at every meal, only a portion of what has been taken is rejected, for there is no great loss of flesh or strength. Not infrequently the patient looks unusually healthy and robust, very different from the emaciated and cachectic subjects of gastric ulcer. There are usually other manifestations of hysteria, such as the sensation of a ball in the throat, difficulty of swallowing, or palpitation. The catamenia are in most instances disordered, often absent; but at times they are more frequent than usual, and excessive in quantity.

There is another form of nervous vomiting which has but little attracted the notice of practitioners. It occurs in persons who have been long exposed to malaria, and often makes its appearance when no other evidences of malarial poisoning are present. It is probably from this reason that its true nature is so commonly overlooked.

The vomiting is at first only in the early morning or after breakfast, and does not trouble the patient in the subsequent part of the day. By degrees it becomes more constant, occurring directly after every meal, and especially after solid food, and even awaking him during the night; sometimes the food is described as sticking in the lower part of the chest, and the patient is uneasy until it is rejected. The appetite is bad, extreme debility is always present, there is rapid loss of flesh, the skin is sallow, the lips bloodless, the expression anxious; and the appearance of the patient is so cachectic, that the practitioner expects to find a carcinomatous tumour in the epigastrium. The writers have often diagnosed cancer of the stomach in such cases, and have seen a similar mistake made by others; and this is the more excusable, as the vomiting is often most intractable, and the patient seems rapidly to lose ground in spite of all the ordinary treatment adopted to relieve him. When the nature of the malady is clearly appreciated, and quinine or arsenic employed, the vomiting usually subsides, and improvement in the general health is often rapid and striking.

(4) **Neuroses of the Vaso-motor System.**—The secretion of the stomach, which is under the control of the vaso-motor system, is liable to be increased or altered in various neurotic affections; in some of the cases of gastric neuralgia, for example, the pain is accompanied by excessive acidity. Whether the augmented secretion arises from the nervous affection, or whether both are the result of a general cause, such as gout, is a question we are at present incapable of satisfactorily answering. In the neuroses of motility an increase in the quantity of acid secreted is often a prominent symptom. But not only alterations in the secretion, but even catarrhal inflammation of the stomach may arise from a morbid action situated in other and distant organs; thus, we not infrequently see vomiting of enormous quantities of mucus during menstruation, no signs of disturbed digestion being present in the intervals. In some rare cases blood is vomited during menstruation, and the writers have seen enormous quantities of blood-stained mucus evacuated, the digestion being unaffected at other times. In all probability, some of the cases of diarrhœa that occur in hysterical subjects result from vaso-motor disturbance.

18. **Stomach, Perforation of.**—With the exception of a few rare cases where the coats of the stomach have been penetrated by mechanical injuries, or by the extension of disease from some of the neighbouring organs, perforation of this viscus is the result of ulceration. In the majority of the cases of ulceration, the peritoneal covering of the stomach inflames as the disease approaches it, and the organ becomes attached to some of the adjoining parts. In this way a barrier is formed against an opening being made into the peritoneal cavity; and, as the ulceration deepens, its base is formed of the structures to which the coats of the stomach adhere. It has been calculated by Dr. Brinton that 70 per cent. of the simple ulcers situated at the posterior surface are closed in by union with the pancreas or liver. But when this safeguard does not exist, the extension of the ulceration outwards finally reaches the peritoneum, this thin membrane sloughs, and a portion of the contents of the stomach escapes

into the peritoneal cavity. Sudden and violent peritonitis is immediately set up, which is almost always followed by fatal consequences. In some cases the opening into the peritoneum is found to be closed with lymph, so that peritonitis is not set up; and in others, instead of the contents escaping from the stomach, a mere leakage occurs through the peritoneum, which is sufficient to produce inflammation of the serous membrane. Hence it may happen that, instead of general peritonitis, circumscribed inflammation is set up by the perforation, and an abscess follows, bounded by the neighbouring organs, which have become closely united to each other and to the stomach. Some cases are recorded, where an abscess thus formed was evacuated through the lung by perforation of the diaphragm, the pus exciting in its passage gangrenous pneumonia or pneumothorax. In one case at the London Hospital the patient was suffocated by the sudden bursting of a perigastric abscess; in another a communication was established between the stomach and the external surface; in a third, the stomach became adherent to the duodenum; whilst in another the colon was perforated by the extension of a gastric ulcer through its coats.

Ulcerations situated in the anterior surface of the stomach are most apt to perforate the peritoneum, as the greater mobility of this region lessens the chance of adhesions taking place. Simple ulcerations are more apt to penetrate the serous sac than those of a cancerous nature, as adhesions are much more apt to occur in the case of the latter. Perforation again takes place more readily in the young than in those of more mature age, and it is especially liable to affect females. More than half the cases amongst females occur between the ages of fourteen and thirty, but in the other sex the effects of age are not so strongly marked.

Symptoms.—In cases of chronic ulcer, the symptoms produced by the perforation are preceded, for a more or less lengthened period, by pain, vomiting, or hæmatemesis. But in cases of acute ulcer the occurrence of perforation often takes place with startling suddenness, and the pain comes on when the patient believes herself to be in perfect health. In most instances careful inquiry shows that there has been previously slight uneasiness after food, flatulence, or other signs of disordered digestion. It is, however, important to recognise the fact that this terrible accident occasionally occurs where there has been no previous complaint of ill-health, so that any sudden and severe pain in the abdomen in a young person should never be treated lightly. In a large proportion of the cases admitted into a hospital, purgatives or stimulants have been previously given, and it has occasionally happened that castor oil, or some other medicine, has been detected in the peritoneal cavity on examination after death. The first symptom of peritoneal perforation is a sudden and severe pain in the abdomen, and this is not necessarily referred to the region of the stomach. It is quickly followed by retching or vomiting; and when the patient is seen by the practitioner, the symptoms of general peritonitis are present in a marked degree. The patient lies upon his back, with his knees raised, dreading to make the slightest motion, speaking only in a slow and guarded manner, and breathing quickly and carefully, lest the action of the diaphragm and abdominal muscles should increase his suffering. The face is pale, covered with a cold sweat, and expressive of suffering and anxiety; the whole abdomen tense, and so excessively tender that the slightest pressure is dreaded; the pulse is quick, small, and compressible; the extremities are cold; and the bowels obstinately confined. The patient may either sink in the stage of collapse, or the pulse may recover its strength, the extremities regain their warmth, and death may occur from peritonitis some days later. Occasionally peritonitis occurs without collapse. Well-authenticated cases of recovery are excessively rare. When perforation of the colon takes place from the extension of a gastric ulcer, the pain is often very severe, from the co-existence of peritonitis; and the sudden appearance of fæces, or of fœtid gas, in the vomited matters, indicates the presence of an opening into the large intestine. In other cases, the communication between the organs appears to be of a valvular kind, so that severe diarrhœa may occur from the entrance of the gastric contents into the gut, without any appearance of fæculent matters in the fluid rejected from the stomach. Where perforation of the diaphragm has taken place, there has usually been severe febrile action, with great pain in the side or epigastrium, followed, after an interval of some time, by the symptoms and physical signs of pneumothorax or gangrenous pneumonia. As gas usually escapes from the perforation into the peritoneal cavity, there is generally a great and uniform swelling of the whole abdomen; and the normal dulness of the liver is replaced by a tympanitic sound, from the organ having been pushed backwards by the gas. Former adhesions, however, between the liver and the parietes of the abdomen may prevent the appearance of this latter sign; and, on the other hand, coils of distended intestines may overlap the liver, and so present a tympanitic sound on percussion, when perforation has not occurred. In the latter case, the abdominal swelling is not so uniform as in cases of perforation. If the patient should survive thirty-six or forty-eight hours, evidence of the presence of fluid in the peritoneum may be obtained. *See* 1a. Abscess around.

Diagnosis.—Peritoneal perforation is most apt to be confounded with colic, or the passage of a biliary or a renal calculus. In all these cases there is the occurrence of sudden and severe excruciating pain in the abdomen, often attended by vomiting; and all may be accompanied with great depression. In perforation, however, the patient lies in the recumbent position, with the legs drawn up; whilst in the passage of calculi or colic he is restless and tosses about. In the former the pulse is rapid, and there is intense abdominal tenderness; in the latter the patient often seeks, by pressure over the seat of the pain, to relieve his suffering, and the pulse is but little quickened. In perforation, there is often a history of symptoms indicating gastric ulcer; in colic, not infrequently, an account of previous attacks of a similar description.

Treatment.—The main chance the patient has of escape from death is in the most perfect rest, both of the whole body and of the digestive canal. Food and drink of every kind must be forbidden, and even enemata should be avoided. A full dose of opium must be administered—as much as two grains, and a smaller quantity repeated every two or three hours subsequently. Cold applications externally have been recommended, but it will be generally found that warm fomentations give more relief. If improvement take place, it will be better to support the strength of the patient for some time by nutrient enemata, than by food given by the mouth.

Many cases are now on record where surgical treatment has been resorted to when perforation of the organ has been diagnosed. But although the performance of abdominal section is simple, the task of discovering a small perforation in the posterior wall of the stomach and in the midst of the numerous soft adhesions which co-exist, has mostly rendered the operation unsuccessful. Several times, when the perforation occurred in the anterior wall of the organ, it has been found, and the edges of the aperture carefully united by stitches; but in almost every instance the patient eventually succumbed. It may be, however, that when the diagnosis of perforation can be made with greater certainty, and the operation undertaken at an early period, a greater measure of success may attend what is at present merely a forlorn hope.

19. Stomach, Softening of. — There are few stomachs examined after death, more especially during the warmer months of the year, that do not show some signs of softening. When this change is only slight, the surfaces of the rugæ alone seem softened, and have a semi-transparent appearance. When it is more extensive, the whole of the lining membrane covering the fundus has a smooth, thin, translucent appearance, and is either readily detached by the finger, or forms a slimy mucus overlying the subjacent coats. Where the process has proceeded still farther, the muscular and peritoneal layers are soft and pulpy; and occasionally the organ is perforated, and the contents are found in the cavity of the peritoneum. More rarely still, the softening affects the neighbouring organs, the œsophagus or diaphragm being perforated; and the gastric contents may be found in the left pleura. The nature of this process has given rise to no small discussion. John Hunter, who first remarked its occurrence in healthy persons who had been killed by accidents, attributed it to the action of the gastric fluid upon the stomach after death. Some pathologists of eminence, whilst admitting that softening may result from *post-mortem* solution, contend that certain forms of this condition occur during life and differ in their character from cadaveric changes. Rokitansky distinguishes two primary forms of softening: one a disease of infant life, called *gelatinous* softening, in which the whole fundus is converted into a greyish, transparent jelly, and which is usually an accompaniment of cerebral affections; the other, in which the parietes of the stomach are converted into a dark-brown pulp, occurs either in diseases of the brain, or as a sequela of typhus fever, pyæmia, acute tuberculosis, acute cancer, and other diseases. One chief cause of difference in the appearances of these forms is the state of the blood-vessels. In the first the pallor arises from the anæmic condition of the lining membrane; whilst in the latter the dark-brown colour is probably dependent on the action of the acid upon the blood contained in the distended veins and capillaries. Notwithstanding the authority of the distinguished pathologist just named, it is generally believed at the present day that all the various forms of softening are merely the result of *post-mortem* digestion, and that the differences in appearance between them are only the effects of the varying amount of acid that may exist in the stomach at the time of death.

Certain circumstances have been found to favour the occurrence of *post-mortem* softening of the stomach: (1) The condition of the atmosphere at the time of death is one element. It was in summer that the cases occurred that first attracted the attention of Hunter, and it is found that the extent of softening which occurs in cold weather is comparatively trifling to what is observed in the warmer months of the year. This is what might have been anticipated, for we know that heat is requisite in order that artificial digestion should proceed quickly. (2) The amount of the contents of the stomach exercises a considerable influence. When death has occurred whilst the stomach is empty, little or no softening occurs, but if it contain food the mucous membrane is sure to present some indications of change. (3) The nature of the contents of the stomach is still more important in determining the amount of softening. It is well known that the presence of an acid in the gastric juice is requisite for the performance of digestion, and we consequently find that there is the greatest extent of change where there is a large amount of acid in the contents of the stomach at the time of death. This fact has been ingeniously used to explain why the *post-mortem* changes are so extensive, as remarked by Rokitansky, in disease of the brain and in the case of children. It is believed that an unusual amount of acid is secreted in cerebral affections, as we know is the case in certain irritations of the liver and kidney; and as the food of children is mostly composed of milk, it is assumed that the lactic acid resulting from its decomposition, united with the pepsin contained in the stomach, forms a digestive fluid possessing great activity. (4) The condition of the stomach as regards the amount of pepsin stored up in it exercises a considerable influence upon the chance of its softening. It has been elsewhere shown that in typhoid fever, chronic atrophy, and chronic hyperæmia, the amount of pepsin stored up in the gastric mucous membrane is very small, and it is in these disorders that we meet with very little alteration in the organ after death. (5) Another point, which has not attracted sufficient notice, is that the texture of the organ varies in different cases, and that some stomachs more readily yield to the solvent action of the gastric juice than others. To prove this the writers placed in an artificial digestive fluid equal portions of three human stomachs. The first was normal; the second in a state of fatty degeneration; whilst, in the third, the gastric tubes were replaced by fibrous tissue, and the blood-vessels were much congested. After a few hours' digestion the first piece was found reduced to a pulp; the second was gelatinous, and of a yellow colour; the third formed a black, opaque mass, quite unlike the others. Here, it will be observed, the colour and appearance of the different specimens varied; and in many cases, as for example in children, the softness of their healthy mucous membrane greatly determines the rapidity and completeness with which the gastric fluid acts upon it. To ascertain if this were correct, four pieces of stomach were placed in very dilute hydrochloric acid. The first was taken from a healthy dog and was soft; the second from a healthy human subject; the third and fourth from women who had died from cancer of the breast, the mucous membrane of whose stomachs was extensively atrophied. After three hours' digestion at 100° F., the first broke up into fragments; the second was reduced to a pulp; whilst the third and fourth showed only a little softening on their surfaces, but were in other respects unaltered. The completeness with which the first two were dissolved was found, from other experiments, to have partly arisen from the acid being imbibed by the tissue, and coming into contact with the pepsin stored up in the gastric cells, which were absent in the diseased structures of the third and fourth specimens.

Softening of the mucous membrane of the stomach may also occur without *post-mortem* solution. During the continuance of the cattle-plague the animals affected were killed, and in some cases the stomachs were immediately removed and brought to one of the writers. In each case the mucous membrane was very soft, and presented, under the microscope, the usual appearances of acute gastritis. Again, in certain disorders—as, for example, in cancer of the uterus—the gastric mucous membrane is very soft, even when there is no appearance of cadaveric change. This softness probably arises from imperfect nutrition, and is analogous to the fatty heart so commonly met with in such cases. Fatty degenerations of the stomach are by no means uncommon—for instance, the whole membrane has been found in this state in a case of gastric ulcer; and we can scarcely suppose that an organ in such a condition can have the same firmness as when the glandular texture is in a perfectly healthy state.

20. **Stomach, Syphilis of.**—The fact that syphilis ever affects the gastric mucous membrane is denied by many authors, and is very generally overlooked by practitioners; but the subject is so important from a practical point of view, that it seems necessary to devote some attention to its consideration. In the *post-mortem* records of the London Hospital three cases of ulcer of the stomach are mentioned, of which one presented old syphilitic ulcers on the leg; in another there was a syphilitic testis along with fibroid changes in the liver and kidney of a syphilitic nature, and also fibroid disease at the apices of the lungs; whilst in a third there was also a syphilitic affection of the testis. But in a considerable number of cases there were, along with chronic gastric ulcer, fibroid changes in the lungs, liver, or kidneys; and where a number of organs are thus simultaneously affected, the writers have usually been able to obtain a history of syphilis. Chronic gastritis of an obstinate character often shows itself in those who have suffered from syphilis; and in such cases, as well as in chronic ulcer, the most marked relief is frequently afforded by the administration of the iodide of potassium. The fact that chronic ulcer, with hypertrophy of the stomach, is apt to occur in advanced cases of tertiary syphilis had been noticed by Virchow, Leudet, and Lancereaux. Gummata have also been found situated in the submucous tissue in the

neighbourhood of the lesser curvature, and in close proximity to a cicatrix of an old ulcer (Cornil). Engel states that 10 per cent. of all chronic gastric ulcers are preceded by syphilis, whilst Lang asserts that 20 per cent. of all ulcers occur in syphilitic subjects. On the other hand, Chvostek only found one case of syphilis among 143 instances of duodenal ulcer. Although there is thus a considerable difference of opinion respecting the frequency with which gastric disorders follow the infection of syphilis, the practitioner will do well to bear in mind the possibility of its occurrence in any chronic case that has proved rebellious to ordinary treatment.

21. **Stomach, Tubercular Disease of.** The occurrence of ulcer of the stomach in persons who have died of phthisis has been already mentioned; but as the subject is of practical importance, some further observations seem necessary. Ordinarily the ulcerations are not of a tubercular character. Tubercular disease of the stomach is indeed very rare; only two have been found out of two thousand *post-mortem* examinations on cases of pulmonary phthisis (Soltau Fenwick). Amongst the cases on record the greater number have occurred in children. The disease is never primary; but in every case which has been verified by a necropsy the lungs have been the seat of tuberculous mischief. In nearly every instance the intestine has been in an advanced state of disease; in fact, the affection of the stomach might be said to be the result of an intestinal tuberculosis progressing upwards. In two instances on record tuberculous peritonitis co-existed with the gastric lesion. This peculiar exemption of the gastric mucous membrane from tubercular invasion appears to depend upon two causes. In the first place, the acid secretion of the organ is prejudicial to the development of the bacilli (Koch); while, in the second place, the lymphoid tissue, which is always the favourite point of attack, exists only in very small quantities in the stomach, and is situated deeply in the mucous membrane. That children are more liable to the disease than adults may be explained by the fact that they almost always swallow their expectoration, and thus introduce large quantities of the bacilli directly into the stomach.

The disease commences by the growth of miliary tubercle in the submucous tissue of the stomach. The granulations increase in size, undergo central caseous degeneration, and by their coalescence form small areas of necrotic tissue, over which the mucous membrane is rapidly destroyed.

Certain characteristics serve to distinguish the tubercular from the simple forms of ulceration. In position they usually affect the pyloric end of the stomach, in the neighbourhood of the smaller curvature. They are seldom round in shape, being more generally oval or scalloped in outline. The edges are irregular and infiltrated; the base is yellowish in colour and granular in appearance; and they are usually shallow, seldom extending deeper than the muscular layer. Around the ulcer may be observed many solitary tubercles, varying in size and shape. The peritoneal surface of the ulcer is covered with miliary tubercle, which may also be seen arranged in radiating lines along the course of the efferent lymphatics. With the microscope the ordinary tubercular formation can be observed, with plentiful bacilli.

The *symptoms* of tubercular disease of the stomach are very equivocal. Occasionally fatal hæmatemesis has occurred; in other instances perforation has proved fatal. In one case a tubercular ulcer of the transverse colon formed a communication with the stomach—gastro-colic fistula (Oppolzer).

22. **Stomach, Ulcer of the.**—Ulceration of the stomach occurs both (*a*) in an *acute* and (*b*) in a *chronic* form, although the description of the disease, as usually given by authors, is based upon the latter alone.

(*a*) **Acute Ulcer of the Stomach.**—This form occasionally presents itself in infectious disorders, such as pyæmia, erysipelas, and typhoid fever. Out of 100 cases of gastric ulcer recorded in the *post-mortem* registers of the London Hospital, three had occurred after severe injuries to the limbs, and two after erysipelas. The ulcers were small in size, numerous, and scattered over the surface of the mucous membrane. They appeared to have commenced as hæmorrhages in the mucous membrane, the parts affected being afterwards removed, in all probability by the action of the gastric juice. Ulcerations of the duodenum following severe burns of the body were first described by the late Mr. Curling from cases observed in the London Hospital; and in two instances ulceration of the stomach is mentioned in the *post-mortem* records as being found in such cases. In the opinion of the writers, the ulcerations found in persons dying from pyæmia and erysipelas, as well as after burns, are due to the absorption of deleterious substances from the affected parts. Acute ulcers occur also in the later stages of heart-disease, especially where great congestion of the portal system has been produced by disease of the mitral valve. Here also the first step in the production of the ulcers is hæmorrhage into the mucous membrane. From the examination of a case of gastric ulcer occurring in the course of typhoid fever, the writers are disposed to believe that the morbid change commences in the solitary glands of the stomach, and to attribute the small perforating ulcers that occasionally occur in young persons to ulceration of the same structures.

Symptoms.—Although pain is occasionally complained of in cases of acute gastric ulcer, this is by no means common. Even in the perforating ulcer of young females, pain rarely precedes the faintings or hæmatemesis which are ordinarily the first indications of the disorder. In other instances the symptoms of acute peritonitis present themselves suddenly in a person who supposed himself to be in perfect health up to the time of the attack; and on *post-mortem* examination a small ulcer is discovered which has perforated all the coats of the stomach, although the most careful microscopical examination fails to discover any evidence of mischief beyond the edges of the sore. The most common indications of an acute ulcer are persistent vomiting of mucus or mucus mixed with blood, or a severe hæmorrhage taking place suddenly from the stomach. There is often in pyæmia and cardiac cases tenderness on pressure, but this has not been observed by the writers either in typhoid fever or in the acute perforating ulcer.

TREATMENT.—As the ulcerations are the direct consequences of other maladies, treatment can only be directed to relieve any dangerous symptoms to which the ulcers may give rise. Hæmatemesis requires the use of ice and astringents, whilst peritonitis arising from perforation should be treated according to the methods recommended for that disorder.

(*b*) Chronic Ulcer of the Stomach.

ANATOMICAL CHARACTERS AND PATHOLOGY. — Chronic ulcerations of the stomach are of frequent occurrence, being present, according to the researches of Dr. Brinton, in about 5 per cent. of the deaths arising from all causes. The ulcers are usually round or oval, varying in size, as a general rule, from the diameter of a fourpenny-piece to that of a half-crown. They have been found to destroy life when so small that the most careful search was necessary to ascertain their existence, and, on the other hand, they may be met with many inches in diameter. When of recent formation, the edges are sharp, and the sore looks as if a portion of the mucous membrane had been punched out; but when the ulcer has lasted for some time, the edges are hard, callous, and adhere to the subjacent tissue. The diameter of the ulcer usually lessens from above downwards; so that, in case the peritoneum has given way, the perforation may be a mere chink. The base of the ulcer may be formed either of the muscular coat or peritoneum, or of some of the neighbouring organs —such as the pancreas, liver, or spleen— which have become attached to the stomach by adhesions. Microscopically, in recent cases the writers have generally found the tubes around the ulcer healthy, with the exception that a few blood-globules are extravasated amongst them. In older cases, the surrounding tissues are matted together, and the tubes are compressed and atrophied, whilst the newly formed fibrous tissue closely unites the edges of the lesion to the parts below and around them. But the mischief is always confined to the neighbourhood of the ulcer, and we never discover a general atrophy of the secreting structures of the stomach, as in malignant disease. At the most, the mucous membrane presents the signs of fatty degeneration, or the usual appearances of acute or chronic catarrhal gastritis. Where the ulceration is spreading, the tubes immediately around it may be seen to be more or less emptied of their secreting cells, whilst their basement membranes have fallen together. Still farther off may be remarked tubes only partially filled with cells, and the mucous membrane is consequently thin and soft.

Gastric ulcers are most common in the pyloric region, being chiefly situated on the posterior surface, and near the smaller curvature. When two are present, it is not unusual to find them opposed to each other, as though they had been both produced by the same irritation. When an ulcer exists in the duodenum, it is very common to find one also in the stomach. The most common cause of death in gastric ulcer is perforation of all the coats of the stomach. This occurs most frequently into the peritoneal cavity, and consequently produces severe peritonitis. In rarer cases the ulceration spreads to some of the neighbouring organs, such as the pancreas or liver, or opens a communication between the stomach and the colon, pleura, or pericardium, or produces a perigastric abscess, by attacking adhesions already formed between the organ and some of the adjoining structures (*see* 18. Perforation; and 1*a*. Abscess around). In other instances one of the large blood-vessels may be laid open, and severe hæmorrhage result. Although hæmorrhage is more common than perforation, it is not so generally a cause of death. Ulceration more rarely causes death by producing alterations in the size of the stomach. Thus cases are recorded at the London Hospital where great dilatation had resulted from thickening at or near the pylorus, produced by the old ulcer; whilst occasionally the organ was greatly reduced in size by a cicatrix near the cardiac orifice, or in the smaller curvature. In some instances death has resulted from pyæmia, and abscesses have formed in different parts of the body.

ÆTIOLOGY.—The age of the individual is allowed by all observers to be one of the chief predisposing causes of gastric ulcer. Where the functions of the stomach are most actively performed, as in childhood, it is scarcely ever met with, the late Dr. Brinton having been able to find only two cases out of 226 in children below ten years of age. It becomes gradually more frequent as age advances. Females are more liable to the disease than males, in the proportion of three to one. The chief preponderance of liability amongst females occurs at the commencement and the cessation of the catamenia. In both sexes, want of food, mental anxiety, and other depressing conditions, have been referred to as tending to produce the disease in question. Many authors regard intemperance as one of the most potent causes. Although the writers have certainly seen the symptoms of gastric ulcer follow too free a use of alcohol, yet they have been greatly surprised to find how rarely the stomach has presented any signs of disease, beyond those of catarrhal gastritis, in a considerable number of persons who had died of delirium tremens. The action of corrosive liquids, such as the mineral acids, when swallowed, is not infrequently a cause of gastric ulcer; but if the first effects of the caustic are overcome, the ulcers thus produced usually heal rapidly. In other instances an ulceration is the result of a tumour pressing upon an isolated portion of the stomach or duodenum, or of the bursting of an abscess originating in some of the neighbouring structures. Occasionally the symptoms of ulceration follow a severe shock or accident, and there seems no reason to doubt that the mucous membrane may be torn or otherwise injured in this way.

The co-existence of various diseases with chronic gastric ulcer has attracted less attention than it deserves, as the subject is most important both in prognosis and in treatment. In the cases recorded at the London Hospital more than one-half presented some other visceral affection. Thus, in nine there was either cirrhosis of the liver or thickening of its capsule; in eight there was valvular disease of the heart; and in eight others there was cardiac disease, the exact nature not being specified. The spleen was noted as very small in three, and in five others it presented some other morbid change. Granular disease of the kidneys is mentioned in thirteen, and some other form of renal disorder in four others. Many authors have stated that persons suffering from phthisis are especially liable to gastric ulcer, and sixteen cases are noted in the hospital records in which there was tubercular disease of the lungs. In six of these the description points to the case being one of fibroid phthisis; and it is in the very chronic forms of this malady that the writers have generally encountered gastric ulcers. One of the writers of this article has shown that in most of the cases of ulcer in chronic phthisis there is lardaceous disease of the mucous membrane, and that the ulcer appears to arise from localised hæmorrhage into this tissue. In three instances distinct evidences of syphilis are mentioned as co-existing with gastric ulcer; and although doubts have been expressed as to how far ulcer of the stomach is ever the consequence of that disease, the successful treatment of many chronic cases with iodide of potassium seems to the writers conclusive upon the point. *See* 20. Syphilis.

There has been much difference of opinion as to the method by which gastric ulcers are produced. Some authors are fond of pointing out that sores of this character are confined to the stomach and duodenum, where an acid secretion comes in contact with the tissues; whilst in the remaining parts of the small intestine they are rarely discovered. Hence it has been assumed that they are dependent, in some way or another, upon the solvent action of the gastric juice; and the discovery that there is usually an excess of free hydrochloric acid in cases of ulcer of the stomach has been supposed strongly to confirm this view. But although there is no doubt that the gastric secretion is capable of dissolving any portion of the mucous membrane that has lost its vitality, there is no proof that any excess of acid is able to produce an ulcer, so long as the structures are in a normal condition. The various hypotheses that have been invented to account for the production of gastric ulcers cannot here be discussed; but we may fairly allow that, like ulcerations on the exterior of the body, they must originate from very different causes.

An acute ulcer often becomes chronic. It has been proved by experiments on animals that anæmia is sufficient to prevent the healing of a gastric ulcer; and as in cases of acute ulcer hæmorrhage is very apt to take place, we have in this a possible explanation of their tendency to assume a chronic form. As soon as the edges of such a sore become thickened, a still further impediment to cicatrisation is produced.

The death of small portions of the mucous membrane has been attributed to embolism of the arteries of the stomach. Against this, as a common cause, is the fact that the gastric ulcer is generally single, and that we constantly fail to discover ulcerations where numerous emboli can be shown to be present in the vessels of the other principal organs of the body. It is probable, however, that some rare cases are to be attributed to this cause.

Dr. Copland pointed out how often the arteries of the stomach were diseased where an ulcer was present, especially in old people. The truth of this remark the writers can confirm from the microscopic examination of a number of specimens, in which they found the arteries in the neighbourhood of ulcers thickened. It is evident that such a condition must diminish the supply of arterial blood, and therefore lessen the vitality of the part, and so produce a tendency to ulceration. In addition to this, as the cause is a permanent one, it would prevent cicatrisation; or in case healing of the sore should take place, it would confer a liability to a fresh attack of ulceration.

It was before stated that affections of the heart and of the liver are frequently discovered in those who had suffered from gastric ulcer, and it is often found that the veins are thickened and tortuous in the vicinity of chronic gastric ulcers. The retardation of the current produced by an increased pressure upon the portal system, or by a change in the venous circulation of any portion of the mucous membrane, is sufficient to account for the tendency to ulceration under such circumstances, and must also tend to prevent the cicatrisation of a sore when it has taken place.

The causes of gastric ulcers must also be sought for in changes in the mucous membrane itself. In twenty of the cases recorded at the London Hospital there is mention made of thickening at a distance from the ulcer; and, although in some this may have arisen from the irritation set up by the sore, it is not sufficient to explain them all. Thus, in one instance the sore 'seemed to be excavated in a thickened tissue, and had no thickened margin, the middle coat was hypertrophied a quarter of an inch thick, the tissue being hard and glistening.' In another case there were two ulcers, but there was also 'fibroid induration in patches scattered over the mucous membrane of the stomach.' When the frequency with which the microscope detects isolated patches of fibroid, fatty, or lardaceous change in stomachs that to the naked eye seem healthy is considered, there can be no doubt that no small proportion of chronic gastric ulcers originate from such changes in the tissues. It has been mentioned that a number of the cases of ulcer co-existed with contracting kidneys; and as the writers have proved that in this disease there is almost always a similar degeneration of the gastric mucous membrane, it seems probable that this is the reason of its occurrence.

Ulcers are apt also to occur whenever the circulation of the stomach is generally or locally impeded. Thus, in four instances in the records of the London Hospital an ulcer co-existed with dilatation of the stomach arising from stricture of the pylorus; and in one the sore was situated near to a fibrous tumour the size of a walnut.

SYMPTOMS.—Pain is by far the most constant and prominent symptom of ulcer of the stomach. At first it is only a feeling of uneasiness after food, but as time goes on it increases in constancy and severity. It commences shortly after food, and persists during the whole period of digestion, or until the contents of the stomach are rejected by vomiting. In some cases it begins as soon as food has been taken, but more generally after an interval of fifteen or twenty minutes. The pain is usually relieved by the recumbent position, but in some cases the patient finds relief by bending the body over a chair or by lying on one side. In some cases of large ulcers there may be little or no pain, the sore being apparently insensible to irritation, as is sometimes seen to be the case in old ulcers of the legs. The pain is referred to one spot, which is usually situated in the epigastrium, but more rarely it affects the left hypochondrium or the umbilical region. In a considerable number pain is experienced in the back, usually at a place between the last dorsal and the first lumbar vertebræ, or rather a little to the left side of this region. The pain may increase for a few days, and then gradually subside. These exacerbations are chiefly observed in very chronic cases. They probably point to an extension of the ulceration, for they not infrequently precede hæmorrhage and perforation. In almost every case there exists tenderness on pressure over the seat of the sore. This may be so great that the patient is unable to wear his clothes moderately tight; in other patients it requires a careful search to discover the sore spot. The tender part is, as a rule, opposite the place to which the pain is referred, and can often be covered by the finger-end. General tenderness is no test of an ulcer, as it is often present in congested liver, gastric catarrh, and other complaints of the epigastric region. It is necessary to be careful in testing for the existence of a gastric ulcer by the finger, for a very slight pressure often suffices to bring on a paroxysm of pain, even when the stomach is empty of food. The tender spot is generally situated in the epigastrium, but may be in the hypochondrium, or near the umbilicus.

Vomiting, although often present, is a much more variable symptom. It seldom occurs directly after food, as is often the case in cancer, because the cardiac orifice is rarely the seat of simple ulcer. It is preceded by nausea, and not infrequently by a copious flow of saliva; and it relieves the pain by freeing the stomach of its irritating contents. The tongue may be perfectly clean, or may be thickly coated. As the abnormal appearances of the tongue in dyspepsia arise from an extension of gastric catarrh to the mucous membrane of the mouth, a perfectly clean tongue is present if the ulcer is unattended by gastritis. Flatulence is not a common symptom, inasmuch as the amount of food taken is limited, on account of the pain produced by it. Extreme acidity occasionally presents itself, but it is not so common as the statements of some authors would lead us to imagine. The appetite is seldom much affected, especially in the young. Patients often remark that they could and would eat freely, were it not for the dread of the pain. The bowels are generally confined. The stools are knotty, and in many cases contain mucus. There is nothing characteristic about the urine. It is usually clear; and is passed frequently, and in unusually large quantities. Whenever the disease has lasted for some time there is a loss of strength and energy, arising from imperfect nutrition, from the frequent attacks of pain, and from the vomiting.

The duration of gastric ulcer varies greatly. In some cases the sore seems to heal rapidly; whilst in others the symptoms often subside and reappear, so that the patient remains an invalid for years. Chronic cases in old people are often very difficult to cure, and great patience and perseverance are required in order to obtain even an alleviation of the symptoms. The symptoms produced by hæmorrhage and perforation are elsewhere described. *See* HÆMATEMESIS; and 18. Perforation.

Physical Signs.—In a recent case of gastric ulcer we can expect no assistance from physical signs, but where the disease has lasted for some time evidence of adhesions may be detected. Adhesions may be suspected, when it is found, by auscultation and auscultatory percussion, that only a small portion of the stomach is in apposition with the abdominal walls, and more especially if this part is the tender spot, and does not vary its position with different states of distension of the organ. Again, if the stomach is found to be of considerable size when empty, and its extent is not increased by food, we may suspect that its motions are trammelled by adhesions. The microscope affords but little assistance in the detection of gastric ulcer, because the extension of this disease is usually very slow, and we therefore have little chance of discovering portions of the mucous membrane in the vomited matters.

One of the most important points is the absence of tumour on palpation. No doubt in some instances the ulcer is accompanied by a certain amount of thickening, but it is only in rare cases that this can be discovered by the hand. The writers have for years been in the habit, in all doubtful cases, of administering one or two teaspoonfuls of common salt in half a tumblerful of water in the early morning before any food has been taken, on the supposition that where an ulcer is present the irritation of the salt would produce pain. In many instances pain referred to one spot has followed the exhibition of the salt, and when this has not occurred it has generally been subsequently found that the case was one only of dyspepsia. The salt has never produced any bad results, except retching, and in fermentative dyspepsia has usually proved beneficial. Various other fluids, such as dilute hydrochloric acid, have been tried, but have not succeeded so well as the chloride of sodium.

It has been recommended by Leube that a galvanic current (twenty to forty cells) should be passed from the spine to the stomach, in order to distinguish ulcer from neuralgic affections. It is said that pain is produced in the former; in the latter the pain, if present, is soon relieved. The writers have tried this plan, and in some cases of ulcer pain has followed the application; but the trials have not been sufficiently numerous to enable them to determine its value. In some instances tenderness has been discovered in the pneumogastric nerve in the neck, but this is rarely present in recent cases. In chronic ulcer there is almost always an increase in the amount of free hydrochloric acid in the contents of the stomach; but although in the case of a constant excess this may be useful in diagnosing ulcer from cancer, it is in other respects not applicable, inasmuch as vomiting usually comes on shortly after a meal, and the use of a stomach-tube is not advisable in this disease.

DIAGNOSIS.—It is generally said that ulcer of the stomach may be confounded with colic arising from gall-stones. In ordinary cases this mistake is not likely to occur, for the pain in ulcer is referred to the epigastrium; it is absent or moderate when the digestive process is finished, but is increased shortly after solid food; and it is relieved by vomiting. In gall-stones the pain is situated in the right hypochondrium; it is severe during each attack, but disappears afterwards; it is not influenced by the process of digestion; and it is not relieved by vomiting. In addition to this, there is no hæmatemesis in gall-stones; the gall-bladder can often be felt to be enlarged; and jaundice generally succeeds to an attack. It must not be forgotten that irritation of the gall-bladder may set up ulcer of the duodenum. One of the writers has seen a case where uneasy pain was constant, was increased after food, was relieved by vomiting; and on *post-mortem* examination there was no ulcer, but only a vastly dilated gall-bladder, the exit of which was blocked by a calculus.

The diagnosis from cancer, atonic dyspepsia, and neuralgia is considered under these separate headings in the present article.

TREATMENT.—The main indication, where the symptoms of ulcer of the stomach are urgent, is to give to the affected organ as perfect a state of rest as is possible. The patient must be placed in the recumbent position, unless it produce pain, and must retain it strictly. In chronic cases, or when the more severe symptoms have subsided, a limited amount of exercise may be permitted, lest the general health may become deteriorated by confinement. In urgent cases mere position is not enough, and physiological rest must be ensured. It is, therefore, often necessary to interdict the use of all food, and to keep up the nutrition of the body by nutritive enemata. This should, however, never be continued longer than is necessary to subdue the more urgent symptoms, as the strength of the patient soon fails when rectal alimentation forms the only means of support. In less severe cases it is only necessary to confine the patient to liquid food, taken in small quantities and frequently. Milk, if it can be digested, should form the basis of the diet, and it can be either taken alone, or, if there be much acidity, mixed with lime water or with Seltzer or Vichy water. In some cases buttermilk agrees, where sweet milk produces vomiting. In others the concentrated Swiss milk is more readily digested. But sometimes milk in all forms disagrees, unless it be mixed with some farinaceous material, such as arrowroot, sago, tapioca, or cornflour. In many instances peptonised food is of value.

Leube recommends that the diet of the patient should consist, at the start, of one pot of beef solution *per diem*, corresponding to half a pound of beef; and to this he usually adds, for breakfast and dinner, some milk and a few pieces of rusk, which should not be swallowed until they have been thoroughly softened and masticated. The beef solution is taken pure, or it may be stirred into *bouillon* with a little of Liebig's extract of meat, and a little salt added, or not, as desired. As the patient improves, a more nutritious diet may be prescribed, such as beef-tea, mutton-broth, chicken-broth, eggs, macaroni, or light puddings, followed by fish, sweetbread, chicken, and finely scraped beef, lightly cooked; but all irritating food, such as brown bread, oatmeal, green vegetables, and fruit, must be prohibited. Where the patient is young and otherwise healthy, leeches are often of great service. Some practitioners have objected to their use, but the writers have often seen them of signal benefit. It is seldom necessary to apply more than six at a time, and they may be repeated from time to time as the case requires. In other cases dry-cupping answers a good purpose. Where there is reason to object to the effects of the leeches, a bladder filled with ice and applied to the part may afford relief; but, in general, hot poultices and fomentations are more useful. In long-standing cases great benefit is often derived from repeated small blisters, or from the application to the epigastrium of tartar emetic ointment or croton oil. The most valuable remedy in all cases is opium. It relieves pain, controls the action of the muscular coat, and restrains the secretion of the stomach. It is best given in doses of one or two grains, once or twice a day, shortly before food. It is a common practice to administer morphine hypodermically, but this in some cases produces vomiting, and must therefore be used cautiously. Besides this, it must be remembered that the sedative, when taken by the mouth, is more directly applied to the ulcerated and tender surface. The vomiting is a most distressing symptom, and tends to prevent the healing of the sore. The fluids rejected should be often examined by the microscope. If torulæ or sarcinæ are present, recourse must be had to carbolic acid, creasote, or sulphurous acid; at the same time a small blister should be applied to the epigastrium. Bismuth is the remedy usually given whenever gastric ulcer is suspected to be present, but it acts best where a considerable quantity of mucus is discharged by vomiting. In ordinary cases opium is more efficacious, and may be combined with the bismuth and with soda or magnesia. As soon as the more active symptoms subside, iron or some other tonic may be prescribed, but the least irritating preparations of iron should be preferred, such as the saccharated carbonate or the ammonio-citrate. Some practitioners prefer small doses of the tincture of the perchloride well diluted with water.

When the case is still more chronic, preparations of silver, copper, and zinc have been recommended. The nitrate of silver is, in the opinion of most authors, to be preferred, whilst others have looked upon it as inert in the doses usually given. The writers have certainly seen great benefit both from it and from the sulphate of copper; but, on the other hand, serious mischief may result from the administration of these salts at too early a period. As the bowels are almost always confined in gastric ulcer, it is necessary to promote their action by castor oil, small doses of aloes, enemata, or glycerine suppositories. In the more acute stage of the disease all irritating aperients must be, of course, carefully avoided, and the bowels should be relieved only by enemata.

Of late years Carlsbad salt has been strongly recommended as an aperient, under the idea that it will remove any gastric catarrh which may be associated with the ulcer, but the writers' experience of it has not been favourable. Whenever syphilis is suspected, the iodide of potassium may be used. It is best to commence with a small dose, and augment it gradually. Some cases that have resisted all other treatment rapidly improve under the drug, pain and vomiting disappear, and the patient gradually regains flesh and strength.

The stomach tube was used in cases of ulcer shortly after this method of treatment for gastric disorders was introduced, but in the writers' opinion it is unfitted for ordinary cases. Hæmorrhage has followed its employment in some instances, probably not so much from the mere contact of the tube with the sore, as from the severe retching that is often produced by passing it. They have, however, found it of value in some very chronic cases, where dilatation co-existed with the ulcer, the removal of the fermenting contents of the stomach appearing to favour the cicatrisation of the sore.

In case of severe hæmorrhage from a gastric ulcer, it would appear to be easy to perform the operation of laparotomy, and apply a ligature to the vessel at some distance from the point of ulceration. But it is well known that any interference with the vascular supply of the stomach is rapidly followed by softening and perforation of the coats of the organ, from the action of the gastric juice on the devitalised tissue. Consequently any attempt to ligature the bleeding vessel, except at the exact site of ulceration, would probably prove disastrous in its results, while from the fact that, in order to expose the bleeding point, the stomach must be opened, the only feasible operation would be an exceedingly hazardous undertaking. It must be noticed, however, that in one case of severe gastric hæmorrhage, Milkulicz is said to have opened the stomach, exposed the site of ulceration, scraped it, and cured his patient. Such an operation is at present unique.

23. **Stomach, Vessels of, Diseases of.** The blood-vessels of the stomach are frequently diseased, and their morbid conditions no doubt play an important part in the production of anatomical changes in the other structures of the organ. Dr. Copland, many years ago, drew attention to an atheromatous state of the arteries as frequently present along with gastric ulcer, and the same remark has since been made by Virchow. From repeated examinations of cases of chronic gastric ulcer with the microscope, the writers can confirm the truth of these statements. They have constantly found the arteries thickened and enlarged in the neighbourhood of the ulcer. Not infrequently the vessels, as well as the other textures of the organ, are in a state of fatty degeneration, the condition being in some degree analogous to what is observed in fatty degeneration of the heart, in connexion with obstruction of the coronary arteries. Where the arteries are healthy in gastric ulcer, the veins of the mucous membrane are generally thickened and dilated, displaying a state like that so constantly remarked in the veins of the lower extremities where ulcers have been long existing. In cancer of the stomach, the smaller arteries in the neighbourhood of the malignant growth have been often found greatly thickened. This condition no doubt leads to the rapid ulceration and sloughing that are such constant accompaniments of malignant disease in this organ. Still more extensive affection of the blood-vessels of the stomach is met with in lardaceous disease, inducing superficial ulcerations in the pyloric region, and diminution in the secreting powers of the mucous membrane.

Samuel Fenwick.
W. Soltau Fenwick.

STOMACHICS (στόμαχος, the stomach). Synon.: Fr. *Stomachiques*; Ger. *Magenmittel.*

Definition.—Substances which increase the functional activity of the stomach.

Enumeration. — The most important stomachics are Alcohol, Acids, Alkalis, Aromatics, Arsenic, Bitters, Pepsin, and Strychnine or Nux Vomica.

Action.—In the act of digestion the stomach has the threefold function of secretion, movement, and absorption. By an abundant secretion of gastric juice some of the albuminous constituents of the food are quickly digested; and this digestion is aided by the movements of the stomach, which mingle the gastric juice with the food, and aid solution by breaking up the particles. From the stomach, also, absorption of some of the products of digestion goes on. Some stomachics, such as alcohol and dilute alkalis, increase the secretion of gastric juice; possibly also bitters, and small doses of arsenic. Dilute acids, given after meals, and pepsin supply the essentials of gastric juice when secretion is deficient. It is not improbable that the peristaltic movements of the stomach are increased by strychnine and nux vomica. We want experiments on the action of drugs which increase absorption. It is also probable that some of the good results of bitters are due to their preventing abnormal processes of fermentation in the stomach.

T. Lauder Brunton.

STOMATITIS (στόμα, the mouth).—Inflammation of the mouth. *See* Mouth, Diseases of.

STONE.—A popular name for calculus. *See* Calculi.

STOOLS.—Synon.: Fæces; Motions; Fr. *Excréments*; *les Celles*; Ger. *Stuhlgänge*; *Stühle.*

Introduction. — An examination of the fæces frequently affords valuable evidence of the condition of the organs engaged in the process of digestion, and furnishes important data on which to found a diagnosis and suggest a rational treatment. Not only may structural changes in the alimentary tract be discovered, but also the completeness of action of the various digestive juices be recognised. As with the examination of the renal secretion, a previous knowledge of the healthy characters of the fæces is an essential: this being granted, the investigation may be pursued on the same lines in both cases, as regards the general, microscopical, and chemical characters. Since, however, the characters of the fæces are much more directly dependent on the ingesta, their examination cannot be so valuable an index of tissue-change as is that of the urine.

I. **Physical Examination.**—1. Quantity.—This is extremely variable. Taking the normal average for an adult to be about 5 ounces daily, it may vary from 2½ to 10½ ounces. The quantity would seem to bear no relation to the size or weight of the individual, but is rather influenced by the quantity and kind of food taken, and by the activity of the secretions of the alimentary canal. With an average diet, it is estimated the fæces form one-seventh to one-eighth of the weight of the ingesta. As a rule, the amount is increased by a vegetable diet. In children it would seem the total daily amount is relatively slightly greater, whilst in old age there is an absolute diminution. When in disease the quantity is increased, it is chiefly of the fluid portion, whilst a diminution affects both the solid and fluid parts. The writer has noticed a class of cases of intestinal derangement characterised, among other symptoms, by the daily passage—especially in the earlier hours of the day—of several very large pultaceous stools, amounting to a total quantity several times in excess of the normal, and this without a large ingestion of food; the lower part of the ileum, the cæcum, and the ascending colon appear to be in a condition of chronic catarrh in these cases. Tea is said to diminish the quantity of the fæces (Chambers). *See* CONSTIPATION; and DIARRHŒA.

2. CONSISTENCE AND APPEARANCE.—Departures from the normal cylindrical shape are frequent, and depend very much on the existence of constipation or diarrhœa. In infants the evacuations should be unformed and of a pappy consistency. The contents of the bowels pass from a semi-fluid condition in the ileum to the firmer state in the colon, mainly from an absorption of fluid constituents; should there be any delay in the passage the motions are liable to become hard and nodular (scybala), and this may occasionally be extreme, the fæces having all the appearance of sheep's dung, and being passed with considerable pain. Certain drugs, such as vegetable astringents, and many preparations of iron, bismuth, or lead, tend to make the fæces hard and firm. On the other hand, an increased peristalsis is associated with motions of all degrees of fluidity. This is very marked in the various forms of irritation to which the intestinal mucous membrane is liable, from the simple effects of a saline purge to the extreme conditions of ulceration, as in typhoid fever or dysentery. The rate of passage of the intestinal contents, together with the amount of intestinal secretion, are the conditions determining the various degrees of consistency of the stools designated by the terms 'scybalous,' 'formed,' 'semi-formed,' 'pultaceous,' 'loose,' and 'fluid.'

The existence of hæmorrhoids, rectal growths, or an enlarged prostate, may be recognised by groovings and marks on the excrement. It is very common in cases of stricture of the colon to find the motions flattened and ribbon-like, or as cylinders much contracted in diameter. Such appearances, however, are by no means constant, for it has been clearly shown that a considerable stricture, even as low down as the junction of the sigmoid flexure and rectum, may co-exist with motions of normal appearance, the fæcal matter becoming remoulded below the seat of constriction. But the invariable occurrence of such contracted motions is strongly in favour of stricture. Occasionally, as in psilosis intestini, the motions are passed in a fermenting condition, presenting a frothy brown or yeast-like appearance, and containing sarcinæ, similar to certain vomits.

3. COLOUR.—This is dependent on stercobilin ($C_{32}H_{40}N_4O_7$), which is regarded as identical with hydrobilirubin (urobilin), a derivative of bilirubin ($C_{32}H_{36}N_4O_6$), the chief bile-pigment, and is subject to considerable variation even within the limits of health. The usual brown colour becomes much darker if the fæces be long retained, or with an exclusively meat diet; pale yellow with milk food, as seen in infants; while it tends towards a greenish tint when vegetables form the bulk of the food.

Unaltered bile-pigment is never found in healthy stools. The conversion of bilirubin into stercobilin, regarded by Dr. MacMunn as a process of intermediate oxidation, normally commences in the first part of the colon; but if from any cause—such as the use of aperients, or ulceration or other affection of the bowels—the intestinal contents be hurried along and a diarrhœa established, then bile-pigments, as such, may be found in the motions, causing the bright yellow colour of the well-known 'bilious stool,' and often leading to much smarting of the anus when voided. In dysentery, the presence of bile in the motions is frequent, especially staining the mucus which is so abundant in the motions of that disease; globules of mucus from the small intestine, similarly coloured, may be seen in the stools of typhoid fever. Other constituents of the fæces, such as the shed intestinal epithelium, may also be stained with unaltered bile under the same circumstances.

It is noteworthy that the meconium contains a considerable amount of the normal bile-pigments, bilirubin and biliverdin, but no stercobilin.

The principal alterations in the colour of the stools are—

(*a*) *Pale and colourless stools.*—All degrees of deficiency of colour may be met with, producing the so-called 'clayey' or 'putty-like' stools. This condition is seen in its most marked degree when the bile is absolutely excluded from the intestine, as from impacted gall-stone; the motions being unformed, lumpy, 'porridge-like,' or scybalous, and almost or quite colourless, frequently, however, accompanied by a small quantity of distinctly bile-coloured fluid, which is secreted by the mucous membrane of the bowel from the bile-laden blood. The causes of pale stools when there is no such obstruction to the bile-flow are varied and not always apparent. In children the explanation is sometimes to be found in the presence in the motions of a large proportion of undigested fat (derived from the milk food); in various anæmic states the fundamental deficiency of blood-pigment appears to be the cause, and this may account for the frequent occurrence of this condition in rickets. But there remain many cases in which such explanations do not apply, and for which the cause can only be definitely ascertained when we know more certainly than we do at present what becomes of the bile as regards its reabsorption and decomposition in the intestine. The occurrence of colourless or clay-coloured stools in cases where there is no perversion of the biliary secretion or of its discharge into the duodenum, but where disease of the pancreas has been proved to exist, has suggested 'that the formation of the colouring-matter of the fæces depends on the mutual reaction of the bile and pancreatic fluid, under the influences met with in the intestinal tract;' though what the nature of this interaction is remains unexplained (*see* Pancreas, Diseases of). A remarkable case which was under the writer's care would tend to show that the production of clay-coloured stools, in cases where the bile reaches the intestine and there is no jaundice, is due to some interference with those changes in the bile which normally take place in the first part of the colon. The patient died from the remote effects of an accident in which he had been severely squeezed between the buffers of a train; for several months previous to death he suffered from constant diarrhœa, the motions being invariably copious and quite colourless. *Post mortem*, the cæcum was found to be represented by a quantity of inflammatory fibrous tissue involving the adjacent parietes, excavated in which were a series of irregular spaces and channels, by which continuity was maintained between the ileum and ascending colon, and outside the peritoneal cavity; down to the end of the uninjured ileum the bowel contents were of normal condition and colour (the patient taking almost an ordinary diet) and contained bile, but in the colon they were colourless, as voided, whilst in the segment of mesentery corresponding to the cæcum and commencement of the colon, the lymphatic vessels were outlined by black pigment, presumably due to absorption of the biliary colouring-matter from the damaged portion of the intestinal canal. Further support for this view is to be found in the character of the motions met with in psilosis of the intestine, they being large, formed, white, and acid in reaction. Since no disease of the liver or pancreas exists in this malady, it has been argued by Dr. Thin 'that the abnormal reactions of the intestine must produce abnormalities in the development of the bacteria normally present in the bowel; ' and it is suggested 'that the normal colouring-matter of the stools, under the influence of abnormal bacterial products, either is not formed or is destroyed.' *See* Psilosis.

(β) *Black stools.*—This condition is well marked when blood has escaped into the stomach and passes through the bowels. The hæmoglobin is decomposed by the gastric juice, and its constituent iron is converted into the black sulphide by the sulphuretted hydrogen present in the intestines. Such stools may look like tar; or if they have been long retained they become hard and almost coke-like in appearance (*see* Melæna). Iron, bismuth, or charcoal taken internally will similarly colour the fæces; but if taken in only small quantities the motions are slaty rather than black.

(γ) *Green stools.*—These are of frequent occurrence in children, and their cause appears to be due to very different conditions. Sometimes the coloration is certainly due to the presence of biliverdin ($C_{32}H_{36}N_4O_8$), an oxidation product of the biliary colouring-matter bilirubin, and it not infrequently results from a dose of calomel. Such stools are likely to be excessively acid in reaction. The green motions of severe infantile diarrhœa, which are neutral or only slightly acid, and sometimes, though not always, very ill-smelling, are said to owe their colour, even if the disease itself be not due, to a green-pigment-producing bacillus, there being a deficiency or even absence of bile. Bright-green stools have been occasionally noticed in typhoid fever, especially it would seem when the first part of the colon is involved in the ulceration. Here, again, the coloration appears to be closely associated with an altered state of the cæcum and ascending colon, whereby the fæces are subjected to abnormal conditions—among other things, to an increased acidity. Recent observations of Pfeiffer, however, throw some doubt upon this point, and seem to show that in cases of infantile diarrhœa the normal acidity of the intestinal contents is replaced by an alkaline condition, to which the green coloration is really due, though the fæces as voided may be acid from secretions of the colon. It is certainly the case that green stools in such cases are often rendered normal in colour by the administration of mineral acids.

(δ) Certain articles of diet and drugs are liable to colour the fæces more or less distinctly. Thus spinach, coffee, claret, and logwood impart to the excrement their characteristic tints; rhubarb, senna, and santonin cause a bright-yellow colour; and much cocoa may make the stools grey.

4. Odour.—The characteristic odour of the fæces is chiefly due to certain substances, especially skatol, and to a less degree indol,

developed during the pancreatic digestion of proteids, and partly to special secretions from the glands of the colon. Impaired intestinal digestion, particularly, it would appear, if there be any abnormal bacillary action, is apt to cause fœtid stools, but this is very variable. Absence of bile from the alimentary canal, by interfering with the pancreatic digestion, and also by the want of its own special antiputrescent power, is often, but not always, accompanied with very ill-smelling motions. In certain diseases of the colon, as dysentery, the evacuations are of a most foul and acrid character, owing to putrid changes in the sloughs thrown off from the ulcerated bowel. In children, the alvine discharges are frequently offensive from errors in diet, and emit a peculiar sour odour.

5. Reaction.—The reaction of the fæces in health may be slightly acid, or slightly alkaline. This variability is due to the nature of the food, and still more to the extent and character of the changes in the colon. The stools in some diseases, as typhoid fever, are distinctly alkaline, and in others, as infantile diarrhœa, markedly acid; the colourless stools in obstruction of the bile-duct are also very acid from a large excess of free fatty acids.

6. Foreign Bodies.—By inspection of the evacuations we may discover—

(*a*) Substances *accidentally* swallowed, such as coins, pins, &c.

(*b*) *Indigestible food residua*, such as fish-bones, the stones, skins, and peel of fruits, fig seeds, the ligneous grit in pears, &c. Small seeds and particles of vegetable tissue, if long retained in the canal, may become encrusted with lime-salts, and, if abundant, form what has been called intestinal sand (*sable intestinal*).

(*c*) *Undigested food*, that is, portions of food that have escaped digestion. In certain severe disturbances of the digestive functions some of the food may be passed scarcely, if at all, altered, and may be easily recognised. This condition, known as 'lientery,' is especially prone to occur in the intestinal catarrh of young children during dentition. Curdy lumps derived from milk, and consisting of undigested masses of coagulated casein entangling fat, are often met with in infantile diarrhœa. 'On a moderate diet unaltered proteid is never found' (Halliburton).

(*d*) *Fat.*—This special element of the food may occur in the motions in such quantity and in such forms as to require separate mention. Anything more than a trace in the fæces is to be regarded as abnormal, and as the expression of a failure in its digestion or absorption. This may be due to an excessive ingestion, as may occur in a milk diet, or where undue quantities of olive or cod-liver oil are given for medicinal purposes; or to a deficiency of the digestive fluids, especially the pancreatic juice. The presence of fat in the stools has long been known as a diagnostic sign of pancreatic disease (*see* Pancreas, Diseases of), and of not infrequent occurrence in diabetes. In those morbid states characterised by extensive destruction of the epithelium of the small intestine, fat may appear in the motions from not being absorbed, although the quantity taken may be but moderate, and the conditions for its digestion unimpaired.

The form in which fatty matter appears in the stools is very variable, and much depends upon the kind of fat taken. Masses of almost pure fat may be found; or lumps of greasy-looking substances, consisting mainly of crystals of the fatty acids, or compounds of these with earthy bases, forming soaps, may be met with. Occasionally these substances may be voided in cylindrical form, which has been compared to macaroni.

(*e*) *Mucus.*—The amount of this substance in normal fæces is quite inappreciable, but in catarrhal and other inflammatory states of the lower end of the ileum and colon it is formed in considerable quantity. Its disposition in respect to the fæcal matter is, to a great extent, diagnostic of its site of production. Thus in catarrh of the ileum, with the very bulky stools above-mentioned, it is intimately diffused through the fæces in microscopic particles; in the motions of typhoid fever, bile-stained globules of mucus may be seen with the naked eye. It may be taken as a general rule that the more distinctly separate the mucus is from the excrement, the lower down in the bowel does it come from. When it occurs in masses adherent to or apart from the fæcal matter, it comes from the sigmoid flexure or rectum; whilst from the upper part of the colon the mucus appears as fair-sized globules mixed with the stool. In dysenteric inflammation and ulceration of the colon the mucus frequently forms discrete particles, which have been compared to grains of boiled sago or to frog-spawn, and may be mixed with pus and blood.

(*f*) *Blood.*—Blood voided *per anum* presents very different appearances according to its source. When coming from the stomach or upper part of the intestine it is much altered, being black and tarry (*see* Melæna). Even when recognisable as blood, there is a considerable range of variety in colour, as well as degree of admixture with the fæcal matter. On the one hand, it may be passed in a perfectly pure state, quite free from foreign matter, as would be the case when the bleeding took place from an eroded artery low down in the bowel, or even as high up as the ileum, provided the quantity were considerable, and it were discharged immediately after its escape. Practically, the purer and brighter the blood, the lower down is its source. Or it may occur as a brownish-red material thoroughly mixed with the fæces, and then comes from the commencement of the colon or small intestine; or streaks or smears of blood scarcely altered in appearance, with or without mucus, and attached to the surface of the motion, suggest a lesion in the lower part of the colon and rectum. The blood, from internal piles or extreme congestion of the venules of the rectum, has a characteristic purplish tint, and is frequently passed quite free from fæculent matter. *See* Intestines, Diseases of: 10. Intestines, Hæmorrhage from.

(*g*) *Pus.*—This is not a very frequent constituent of the stools, the amount in ordinary catarrhal states of the bowel being too small, as a rule, to be recognised without the microscope. In dysentery, however, the quantity is greater, and pus then becomes a prominent feature in the motions. When large quantities are passed, the source is usually an abscess which has burst into the canal.

(*h*) *Entozoa*, such as segments of tænia, the various round-worms, or the contents of hydatid cysts that may have burst into the canal, may be present in the fæces.

(*i*) *Miscellaneous.*—Under this head may be included *gall-stones, intestinal concretions, mucous or membranous casts of the intestines* (*see* Casts: I. Of the Alimentary Canal; and Intestines, Diseases of: 13. Intestines, Inflammation of; Chronic Enteritis), *portions of bowel sloughed off from intussusception, or of new-growths, &c.*

II. **Microscopical examination.**—*See* Microscope in Medicine: B. Fæces.

Concerning the micro-organisms of the fæces, it may be observed that they exist in vast numbers, and of many kinds, both in health and disease, but except the specific forms associated with cholera, typhoid fever, and tuberculosis, little clinical importance can at present be attached to them. Whilst cocci are more numerous in the solid evacuations, bacilli predominate in the fluid discharges. Among the latter the most abundant and most constant are Bacillus subtilis, Bacterium termo, Bacillus coli commune, and Clostridium butyricum.

III. **Chemical examination.**—The imperfect knowledge we possess of the actual chemistry of the tissues and secretions, with the exceeding variety in the composition of the ingesta, prevents our obtaining, from any analysis of the fæces, much information of a practical character. It is seldom if ever that such examination furnishes evidence of primary importance, as does analysis of the urine; it is only occasionally that the results correspond to what other signs and symptoms indicate to be the existing condition.

On an average the fæces contain about 23 per cent. of solid matter to 77 per cent. of water, but this proportion is liable to the widest variations both in health and disease, although the amount of water is little if at all affected by the quantity ingested. Thus in cholera-stools the solid residue may be but a few grains per pint. In many diarrhœal states the fluid portion of the stools is something more than a simple exudation, being partly of the nature of a true secretion.

The food is of course the main source of the constituents of the fæces, a few only of these constituents being derived from the bile.

For the chemical processes—often elaborate—required for their detection, reference must be made to standard works on physiological and pathological chemistry.

1. *Phenol* (C_6H_5OH), *indol* (C_8H_7N), and *skatol* (C_9H_9N) are normally formed in the intestines during the pancreatic digestion of proteids. A considerable proportion of these substances is absorbed, and, undergoing various chemical changes, is eliminated in the urine, but a sufficient amount of each leaves the body in the fæces, where they may be separated and detected by appropriate reagents. To skatol the odour of the fæces is mainly due, and it is said by Brieger to be absent from the evacuations of typhoid fever.

Leucin and *tyrosin*, which are also derived from the proteid elements of food by tryptic digestion, are not found in the fæces in health, though of frequent occurrence in the stools of various conditions of diarrhœa, especially cholera. *See* Leucin; and Tyrosin.

2. Two bodies—*excretin* and *stercorin*—have been described as characteristic of the fæces, but their existence is doubtful. They are non-nitrogenous, crystallisable, non-saponifiable bodies, differing in their crystalline form, and their solubility in alcohol and ether. They appear to be closely related to cholesterin, with which in many points they agree. It is said that when the bile which normally contains cholesterin is prevented reaching the intestines, neither of these bodies occurs in the fæces; and that they are also absent, being replaced by cholesterin, in the meconium, and in starving and hybernating animals, when there is no obstruction to the bile-flow. Flint considers about ten grains *per diem* to be the average amount of stercorin, and the excretin of Marcet to be about a fifth of that. *Cholesterin* itself, except in very small quantities, cannot be regarded as a normal constituent of the fæces; but the precise significance of its occurrence is uncertain. Its chief source is the bile, and only a small quantity comes from the food.

3. Fatty Acids, Fats, and Soaps.—Various members of the fatty-acid series, such as acetic, butyric, caproic, valerianic, and the higher terms, oleic, palmitic, and stearic, only occur free in minute proportions, in ordinary circumstances, but the latter are readily increased to considerable amounts when the alkaline secretions of the liver and the pancreas are prevented entering the intestines. The presence of neutral fats in the excrement may be taken to indicate that

there has been excessive ingestion or a diminished digestion, since under ordinary circumstances they would be absorbed. When occurring in considerable amount in the stools they produce the so-called 'fat-diarrhœa,' described in various dyspeptic states. The soluble sodium and potassium soaps ordinarily formed by the ingested fats with the bile and pancreatic juices should be in great part taken up by the lacteals; but fats, meeting with any calcium or magnesium salts that may be present in the alimentary canal, form with them insoluble hard soaps, which are passed in the fæces.

4. Salts.—These are but in small amount, and are chiefly the earthy and triple phosphates, with small quantities of iron and silica; there is in health a marked absence of chlorides. When the stools are very alkaline the triple phosphates may be very abundant, as in typhoid fever; and in cholera-discharges the whole amount of salts is largely increased, there being nearly an ounce in every hundred fluid ounces of evacuation, a large proportion of which consists of chlorides. A similar excess of these salts occurs in the stools of other diarrhœal states, with a corresponding decrease in the urine.

5. Pigment.—The characters of the fæcal pigments have been already referred to.

6. Mucin, Albumen, &c.—A very appreciable amount of *mucin* may be extracted from the fæces by well mixing with lime-water, and adding acetic acid to the filtrate.

Albumen, as such, can scarcely be looked upon as a normal ingredient of the evacuations; but the fluid part of cholera-stools, which resembles dilute blood-serum in composition, contains a very appreciable quantity. In typhoid and other diarrhœal stools albumen can be detected.

Peptones are not found in healthy fæces, but occur in considerable quantities in various diseases, of which the most frequent are typhoid fever, dysentery, tubercular ulceration of the intestines, and cirrhosis and carcinoma of the liver.

Ferments similar in action to ptyalin and pepsin are described as existing in the fæces, but how they may be modified in disease is quite unknown.

Certain of the groups of putrefactive bodies termed *ptomaïnes*, such as cadaverin and putrescin, have been recognised in the fæces.

In uræmia and also in intestinal catarrh *urea* has been detected in the stools.

In certain diseases, especially cholera, dysentery, typhoid fever, intestinal catarrh, both acute and chronic, and to a less degree hepatic and pancreatic affections, the stools are more or less characteristic, though the diagnosis rarely depends on their appearances alone. They are fully described, beyond the references to them in the present article, under their respective headings.

W. H. Allchin.

STRABISMUS.—Synon.: Squint; Fr. *Strabisme*; Ger. *Strabismus*; *Schielen*.

Definition.—A condition in which the two eyes are not directed to the same point in space.

Description.—Squint is commonly either (1) *convergent*, or (2) *divergent*; but (3) it may be complex, where there is a deviation either *upwards* or *downwards*. When one eye appears to be normally directed, and the other to deviate, it is convenient to distinguish the former as the *working*, and the latter as the *squinting* eye.

The extent or degree of strabismus, or, as it is more usually called, the *magnitude* of a squint, is expressed in terms of millimètres. In convergent or divergent squint it is customary to measure the distance between an imaginary vertical line bisecting the palpebral fissure, and another imaginary vertical line bisecting the pupil of the deviating eye. In an upward or downward squint, the distance between the horizontal diameter of the pupil, and an imaginary horizontal line bisecting the palpebral fissure, would give the measurement required.

1. **Convergent Squint.**—This is seen under two principal forms: (*a*) that which depends upon *paralysis* or paresis of one of the external recti muscles, permitting the antagonist internal rectus to exert a preponderating influence upon the position of the eye; and that which depends upon *excessive development* of both interni, in consequence of an error of refraction, whether (*b*) *hypermetropia*, or (*c*) *myopia*.

(*a*) *Paralytic Convergent Strabismus.*—This form of strabismus is met with in all degrees, from the slightest weakening of the affected external rectus to complete paralysis.

Ætiology.—Paralytic convergent strabismus is primarily a nerve-affection, in which, however, the muscle concerned will after a time be liable to undergo degenerative changes. The strabismus usually commences somewhat suddenly, in persons of adult age, and often rapidly increases in degree; the paralysis, which at first was only partial, becoming complete. In the great majority of cases it is associated with syphilis; but it is also met with as a result of impaired nutrition or degenerative change in the nervous centres, consequent upon anxiety or overwork. In some of the syphilitic cases, it appears to be due to central mischief, such as gumma or arterial occlusion; in others to pressure upon the trunk of the sixth nerve by periosteal thickening or other morbid growth.

Diagnosis.—In pronounced cases, the diagnosis is easy; and depends upon the fact that, even when the working eye is closed or covered, the squinting eye cannot be directed outwards by voluntary effort. If the paralysis, although considerable in degree, is not complete, the eye cannot be directed outwards as far as usual; if the paralysis is complete, the pupil cannot be carried external to the middle line of the palpebral fissure. When the affected muscle is only slightly weakened, the nature of the condition may not be at once apparent from the limitation of movement; and the degree of deviation may be so slight that it is not easy immediately to pronounce which eye is affected. This doubt may be removed, and the existence of paresis made manifest, by the following tests. The surgeon should stand in front of the seated patient, and should hold up before him, in the middle line and at a convenient reading distance, some small object, telling him to look at it steadily. By his own hand, or by a piece of ground-glass, the surgeon then cuts off the view of the object first from one of the patient's eyes and then from the other, watching their movements as he does so. When the object is concealed from the squinting eye, the other one, being already rightly directed, will remain stationary to continue the act of seeing, and the squinting eye will also remain stationary; but, when the object is concealed from the working eye, the other, or squinting eye, being wrongly directed, and not receiving the image of the object upon its yellow spot, will make a slight outward movement in order to take up correct fixation. At the same moment, the working eye, behind the obstruction, will execute an inward movement of somewhat greater amplitude than the outward movement of its fellow. Let it be supposed that there is slight weakening of the right externus, producing slight inversion of the right eye. When the object is screened from the right eye, the left still sees it clearly and sharply, and both eyes remain at rest. When the object is screened from the left eye, the right receives the image upon a point of its retina internal to its yellow spot, and sees it only indistinctly. The right eye, therefore, makes an excursion outwards, sufficient in amount to bring the image of the object upon its yellow spot, and to enable it to see better; but the motor impulse by which the necessary movement of the external rectus is called forth is conveyed at the same time to the internal rectus of the left eye, as a result of the habitual association of the two eyes and of their muscles in the act of looking towards the right; and the sound muscle, under a given motor impulse, contracts more vigorously than the weakened one. The result is that the excursion inwards of the working eye is larger than the excursion outwards of the squinting one; and in this way the fact of paresis of the right externus is rendered manifest.

This form of strabismus is at first attended by distressing double vision, which often produces giddiness, but which diminishes in time, as the patient learns to neglect or mentally to suppress the image of the squinting eye. The smaller the deviation, the more distressing will be the double vision; because, the nearer to the yellow spot is the image of the squinting eye, the more definite will it be, and the less readily will it be distinguished from that of the other. In cases of very slight deviation, the equality of the double images renders it difficult to tell the true from the false, and leads the patient into frequent error with regard to the position of the object looked at.

TREATMENT.—The treatment of paralytic strabismus is primarily that of the syphilis or of the nerve-exhaustion upon which the paralysis depends; but it is also necessary to endeavour to minimise the inconveniences of the double vision while it continues, and to provide against permanent degeneration of the paralysed muscle from disuse. The former indication may be fulfilled by covering the squinting eye with a patch, or with an opaque glass in a spectacle-frame; and, as the double vision is only troublesome when the eyes are directed to the side of the affected muscle, it is often sufficient to render opaque, by grinding or otherwise, the outer half of the glass which covers the affected eye. The nutrition of the muscle may be preserved, when the paralysis is incomplete, by systematic voluntary endeavours to call it into action; these endeavours being made three or four times a day for a few minutes at a time. For this purpose, the working eye should be closed or covered, and the squinting eye should be directed as much as possible towards the outer side. When the paralysis is complete, so that the eye cannot be carried beyond the middle line of its eyelid opening, it is necessary to exercise the affected muscle by localised electric currents, after the manner of Duchenne. In cases where there is no response to induced currents, those of a cell battery will sometimes be found effectual. The exercise by electricity should be repeated at short intervals, such as every two or three days, until the nerve-function is beginning to be restored, so that the muscle can again be exercised by the will.

In cases of paralytic strabismus of old standing, it is sometimes necessary to have recourse to tenotomy of the contracted internus, before the eye can be restored to its correct position. It may be laid down as a general principle that every case can be cured, by combined tenotomy and volitional or electrical exercises, as long as the paralysed muscle will respond, in however small a degree, either to the will or to one form or other of electric current; but that where the eye does not move outwards in obedience to the will, and where neither induced nor battery currents produce contraction of the paralysed muscle, no good is to be expected from either operative or medicinal treatment.

(*b*) *Convergent Strabismus due to Excessive Development of both Interni.*

Ætiology. As a result of errors of refraction, about 90 per cent. of this class of cases are due to flat eye or *hypermetropia*. The flat formation of the eye requires, for acute vision of near objects, a strenuous accommodation-effort; and this, by the intimate association which exists between the nerve-centres governing the accommodation muscles and those governing the interni, produces a corresponding effort of convergence. As soon as a child who is born with flat eyes begins to take careful notice of near things, his accommodation muscles and his internal recti are both called into frequent and energetic exercise; and the consequence is that the interni become excessively developed in relation to their antagonists, the externi, so that the normal, or resting position of the eyes, instead of being one of parallelism, becomes one of convergence. The result of this is that the child would receive double images, of equal intensity, of all objects situated either nearer to him, or farther from him, than the point at which the convergent optic axes would meet if prolonged. Let us suppose that this point is one foot distant from the eyes; and that the child wishes to look at an object which is eighteen inches distant. He cannot do this with both eyes, because the externi are unable to overcome their more powerful antagonists. If, however, he combines the right externus with the left internus, as in the act of looking to the right with both eyes, he becomes able to fix the object correctly with his right eye; and if he combines the left externus with the right internus, as in the action of looking to the left with both eyes, he becomes able to fix the object correctly with his left eye. But as, in either case, both eyes start from a position not of parallelism, but of convergence, the effort which carries the right eye from its convergent state to the middle of its palpebral fissure will carry the left from its convergent state to one of much greater convergence, and *vice versâ* with the left eye; so that, while one eye is directed to the object of vision, the other is rolled far inwards. In this way, the image is received upon the yellow spot of the working eye, and upon so peripheral a portion of the retina of the squinting eye that it is easily neglected by the consciousness, and ceases to be a source of confusion or embarrassment.

Diagnosis.—The state of things in an ordinary case of squint beginning in childhood is the following. In a state of rest, as when the attention is not directed to any object, or during sleep, or under an anæsthetic, the eyes are equally convergent; but as soon as any object is looked at, one eye fixes this object and the other rolls inwards. If the degree of flatness is alike in both eyes, and if the muscles in both are of equal power, sometimes one will be the squinting eye and sometimes the other; and in most cases this condition obtains for a time. The squint is then said to be 'alternating.' Generally speaking, however, it is for some reason easier to work with one eye than with the other; either because it is flat in a less degree, or because its accommodation muscle or its external rectus is stronger than the corresponding muscle of its fellow; and then this eye is used in preference to, and gradually supersedes, its fellow; becoming always the working, while that is always the squinting eye. The squint is then said to be 'permanent.'

Treatment.—It would appear at first sight, from the *rationale* of the affection, that the squint which depends upon flat-eye could always be prevented, or even cured, by the habitual use of convex spectacles; but, as a matter of fact, the balance of power between the externi and the interni becomes deranged at so early a period of life that spectacles could not be applied until too late. In every pronounced case of strabismus, it is necessary to perform tenotomy of the interni, sometimes only of one, but far more frequently of both; and the only question to be considered is that of the time most favourable for the operation.

In determining this question, the points chiefly to be taken into account are the state of vision, and the age of the patient. When a squint becomes permanent, the vision of the habitually squinting eye frequently becomes impaired, apparently as a result of the continued mental suppression of the image which it receives; and in a person who is suffered to grow up to adult age squinting, this impairment of vision often falls little short of blindness, and admits of no remedy. No change is discoverable, generally speaking, by the ophthalmoscope; but the power of responding to impressions upon the retina seems to be lost. On the other hand, as long as the squint is alternating, and each eye is used by turns, the sight does not usually suffer.

The immediate effect of tenotomy of one or both interni is to release the eyes from their position of enforced convergence, and to diminish the power of the interni to rotate them inwards. The divided muscles soon acquire new attachments farther back upon the eyeball than their former ones, so that their power is permanently diminished, and this diminution may even be in excess, so as to leave an undesirable preponderance of the externi, and a corresponding tendency to eversion. The surgeon, even by the best planned operation, cannot absolutely determine the future position of the eyes. That determination has to be effected by the muscles themselves under the guidance of vision; and a perfect result after a squint operation, by which is meant the restoration of parallelism when at rest, without impairment of the power of volitional convergence, can only be obtained by an instinctive rearrangement of the muscular forces concerned, a re-arrangement mainly brought about by efforts to avoid double vision, which is often the immediate result of an operation. While, therefore, it is always possible to remove by tenotomy a coarse and manifest malposition, it is only possible to command a perfect result when the recti muscles are well-developed, when the acuteness of vision is equal or nearly so in the two eyes, and when the power of attention to visual impressions is sufficiently active to render double images distressing. The muscular development and the power of attention are both deficient in early childhood; and hence, so long as vision does not suffer, it is better to defer operating for squint until about eight years of age. As long as the squint is alternating, there is no fear that the vision will suffer, and it is then safe and desirable to wait; but as soon as the squint becomes permanent, it is necessary to test the vision of the squinting eye from time to time, and to provide for this eye being exercised every day, by keeping the other closed or covered for short periods. If, in spite of such exercise, the vision of the squinting eye is found to be undergoing progressive deterioration, the operation should be performed without delay, at however early an age; and the parents should be warned that it may perhaps be necessary, for the attainment of perfect harmony of movement between the two eyes, to operate again at some future time.

It will sometimes happen that a child is first brought for advice at an earlier age than eight, in whom the squint has already become permanent in one eye, and in whom the vision of that eye has already begun to suffer. In such cases it is best to devote a few weeks to endeavours to improve the vision of the squinting eye by compulsory exercise; and, if these endeavours should be in any degree successful, to continue them as long as improvement under their employment is perceptible. If no improvement should be produced, the operation should be performed without further loss of time.

(*c*) *The Convergent Squint of Short-sighted People.*—This is not a very common affection, and depends upon the fact that, spectacles to afford distant vision not having been worn, the externi, which produce the approximate parallelism of the optic axes required for distant vision, have not been exercised; while the interni have been constantly exercised in producing convergence for the vision of near objects. The former muscles, therefore, have been suffered to fall into a condition of feebleness from disuse, while the latter have undergone abnormal development. In such cases the eyes are usually equally convergent, such a position giving single vision of near objects; while double vision of distant ones is not irksome, on account of the indistinctness with which they are seen.

TREATMENT.—When the convergent squint of a short-sighted person is of small magnitude, it may sometimes be cured by wearing glasses which correct the short-sight for distance, and call upon the external recti to take up their proper function. More frequently, however, they fail to respond; double vision is produced; and tenotomy, followed by the use of the spectacles, is required. Such cases usually turn out perfectly well.

2. **Divergent Squint.**—This is nearly always a consequence of defective vision of the squinting eye, which wanders outwards for want of guidance from visual impressions. It may also follow from unskilfully performed or excessive operations for the cure of convergent squint.

TREATMENT.—The operation for divergent squint is not a mere tenotomy, but requires the shortening of the internal rectus of the squinting eye, or its advancement to a point of attachment nearer to the corneal margin; and the results of such an operation are less under command than those of tenotomy. The muscle may not attach itself firmly in the new position, or the connecting medium may stretch after a short time. The operation may be undertaken more hopefully, the better the vision of the divergent eye; and it is often very successful. It is nevertheless most prudent, in every instance, to prepare the patient for the possibility of failure, or of only partial success. It is in no case likely that the defect will be increased by failure of the operation; and, as the chief motive for its performance is usually the improvement of appearance, it may be undertaken with propriety in almost every case.

3. **Complex Squint.**—The forms of strabismus in which the deviation is either upwards or downwards are not sufficiently numerous to be brought under any general rule. They depend either upon spasm of the muscle producing the deviation, or upon paralysis or paresis of its antagonist; and every case must be investigated and treated upon its merits, by tenotomy or electrisation, or both combined, according to the particular circumstances. Various irregular forms of strabismus are also seen, in the course of certain acute and chronic diseases of the nervous system, which entail loss or impairment of muscular coördination, such as meningitis and tabes dorsalis; but such forms are usually easily to be distinguished as symptoms of the general disorder, requiring no treatment or consideration apart from it. In chronic diseases, such as tabes dorsalis, it may be conducive to comfort to exclude the squinting eye from vision, for the purpose of obviating the inconveniences incidental to double images.

R. BRUDENELL CARTER.

STRANGULATION (*strangulo*, I choke). In pathology this term is employed to express either the process or the condition of constriction of a tube or pedicle, when it is so complete that the passage of the contents, or the circulation of the blood, is prevented. *See* HERNIA; INTESTINAL OBSTRUCTION; and OVARIES, Diseases of.

STRANGULATION as a Mode of Death (*strangulo*, I choke).—SYNON.: Fr. *Strangulation*; Ger. *Erwürgung*.

DEFINITION.—The act and the effect of constriction of the neck and air-passages by means of a ligature or of manual pressure (throttling). Death results essentially from asphyxia.

ÆTIOLOGY.—Strangulation is chiefly homicidal, but it may be suicidal or accidental. Accidental strangulation may occur in a variety of ways, as in the case of a child by tightening of a cravat round the neck, from the end catching in the wheel of a perambulator; in the case of a drunken woman by fixation and tightening of her bonnet-strings; and in the case of a cripple by a rope attached to a weight accidentally becoming tightened in front of the neck.

It was at one time doubted whether suicide could be effected by strangulation, owing to the fact that the hands relax when insensibility comes on, rendering it impossible to keep up sufficient tension on the ends of the ligature. But when the ligature is wound more than once round the neck, or some method is adopted by which the ligature can be tightened like a tourniquet, as by the insertion of a piece of stick which catches behind the ear or elsewhere, it is quite possible; and numerous instances are on record of suicide so effected. In most cases, however, the presumption is in favour of homicide, and in all cases of strangulation by manual pressure this may be looked upon as certain.

SIGNS.—In addition to the general indications of asphyxia (*see* ASPHYXIA), there are special signs of strangulation which vary with the degree of force employed, and the amount of resistance offered by the victim.

To strangle an individual of normal strength, and in full possession of all his faculties, is barely possible, without causing evident signs of violence on various parts of the body. The existence of injuries of this kind is valuable evidence of the mode of death. Very often cranial injuries are found, from the individual having been first knocked down by a blow on the head. Ecchymoses, abrasions, and other signs of mechanical violence are generally to be found in various parts of the body. If the strangulation has been effected by manual pressure, the front or sides of the neck exhibit bruised marks, corresponding to the thumb and fingers, with, perhaps, curved excoriations corresponding to the nails. The relative size of the marks produced by the thumb and fingers, and the direction of the nail marks, indicate the way in which the pressure has been exerted, and whether with the right or left hand.

When a ligature has been employed, a mark is left on the neck, which varies with the nature of the ligature and the way it has been disposed. Usually it is a transverse, shallow furrow; single, double, or multiple, according to the number of folds; and continuous, or interrupted in places; differing from that of hanging, which is generally single and oblique, and higher up in the neck. The bottom of the groove is generally pale, and not parchmented as in hanging, owing to the pressure not being kept up so long as to lead to desiccation. Ecchymoses in the course of the groove are met with more frequently than in hanging, owing to the great violence frequently exerted.

Very commonly punctated ecchymoses are visible on the conjunctivæ, face, neck, and chest. They are considered by Tardieu to be more frequent in strangulation than in asphyxia from other causes, or from overstraining, which likewise may lead to them. In the subcutaneous cellular tissue, and in the fasciæ of the muscles above and below the hyoid, extravasations are frequently found, as well as on the external surface of the thyroid cartilage and trachea. The lungs vary as regards their vascularity; but on the surface it is common to find pseudo-membranous patches, which are due to the rupture of some of the superficial air-cells and collection of air-bubbles under the pleura. In the substance of the lungs congested patches, or apoplectic extravasations, are often found, varying in size, according to Tardieu's description, from half a franc up to a five-franc piece—extravasations, therefore, much larger than those usually found in suffocation.

TREATMENT.—The treatment of asphyxia from strangulation is that of asphyxia in general. *See* ARTIFICIAL RESPIRATION; ASPHYXIA; and RESUSCITATION.

D. FERRIER.

STRANGURY (*στράγξ*, a drop; and οὖρον, urine).—SYNON.: *Stillicidium Urinæ*; Fr. *Strangurie*; Ger. *Harnstrenge*.

DEFINITION.—A spasmodic condition characterised by a frequent and urgent desire to pass urine, which is voided in drops or in very small quantities, with a sense of painful spasm in the perinæum and anus, and often unaccompanied with feeling of relief.

ÆTIOLOGY.—Strangury can only be regarded in the light of a symptom, as the conditions which give rise to it are many and varied. It occurs in acute nephritis, in tubercular disease of kidney, in renal colic, and in cases of intense congestion of the kidneys, however induced. It is also a diagnostic symptom of poisoning by cantharides, either from the internal use of the drug, or the external application of cantharides plaster or of blistering fluid. It is also met with after the administration of large doses of turpentine and its allies. Many morbid states of the kidneys, ureters, bladder, prostate, and urethra own strangury as a symptom. Especially is it a symptom of acute inflammations of the prostate (abscess in particular); acute inflammations of the bladder; or when the trigone is involved by morbid conditions, such as vesical calculus, growths, and tubercular disease. When acute gonorrhœa involves the *deep* urethra, this symptom is likewise met with. It must therefore be remembered that strangury may be produced by any condition which, directly or indirectly, leads to inflammatory affections of the trigone, or deep urethra; and it is in this way that the affection accompanies stricture of the urethra, enlarged prostate, foreign bodies in the bladder introduced from without, or fæcal fistula.

Apart from inflammatory causes, morbid conditions of the urine, such as are met with in the oxalic and uric acid diatheses, may occasion strangury. Gouty prostatitis is therefore another factor in its causation.

Treatment.—The treatment of strangury is either preventive or curative. If it occurs during the administration or other use of drugs, such as turpentine or cantharides, it is imperative to discontinue their employment.

If we consider strangury as but a symptom of some other morbid condition, we must treat it as we should headache, cough, dropsy, or jaundice—remove the condition on which it depends. To relieve the more urgent and distressing local symptoms, we may have recourse to hot fomentations to the perinæum, warm sitz-baths, suppositories of morphine and belladonna, or the cautious use of hypodermic injection of morphine.

John Harold.

STRATHPEFFER, in Ross-shire.—Sulphur waters. *See* Mineral Waters.

STRICTURE (*stringo*, I bind).—A contraction of a tube, duct, or orifice, for instance, of any part of the alimentary canal, or of the urethra. *See* Urethra, Diseases of.

STRIDOR: STRIDULOUS (*strideo*, I creak).—Stridor is the name given to a peculiar noisy form of breathing, produced in the larynx, trachea, or main bronchus; varying greatly in its character—being either harsh, musical, or crowing; and due to various forms of obstruction. The term *stridulous* is applicable to the respiration, the cough, or the voice, when they possess the characters of stridor. *See* Croup; Larynx, Diseases of; Pneumogastric Nerve, Diseases of; Trachea, Diseases of; and Voice, Disorders of.

STROKE.—A popular synonym for an attack of apoplexy or sudden paralysis. It is also used in the compound words, *sunstroke*, *heat-stroke*, and *wind-stroke*, to indicate severally the sudden effects of these agents.

STRONGYLUS (*στρογγύλος*, cylindrical).—Synon.: Fr. *Strongle*; Ger. *Pallisadenwurm.* — A genus comprising many species of nematoid worms. The large kidney-worm, sometimes called *Eustrongylus gigas*, has only once been found in the human body. The case was undoubtedly genuine, and the specimen is still preserved in the museum of the Royal College of Surgeons of England. *See* Entozoa.

STRONGYLUS DUODENALIS.—*See* Entozoa.

STROPHULUS (*στρόφος*, a twisting of the bowels, or colic).—Synon.: Fr. *Strophulus*; Ger. *Schälknötchen.*

Definition.—A papular eruption of the skin in infants; referable, as the derivation of the word implies, to derangement of the bowels.

Description.—The eruption is a form of folliculitis, quite unimportant and unassociated with constitutional symptoms. Its principal seat is the face, but it may also be dispersed over the trunk of the body and limbs. Its duration will be influenced by the nature of its cause.

Some variety in colour, duration, and cause has given rise to several names applied to the eruption. It is sometimes ephemeral, and has been termed *S. volaticus*; sometimes the pimples are pale or shining, hence *S. albidus* and *S. candidus*. More frequently they are red and inflammatory, and either dispersed or aggregated, *S. confertus*; and occasionally an interpapular hyperæmia or inflammation gives rise to the variety known as *S. intertinctus*. When associated with dentition, this trivial rash is termed 'red gum' and 'white gum'; whilst under conditions of aggravation it is prone to run into eczema.

Treatment.—The treatment of strophulus consists in attention to the general health and condition of the infant. A few doses of magnesia and rhubarb, and even a grain of calomel, may sometimes be found useful, but in general a discreet attention to the food, with rest and warmth, will be all that is necessary. Locally, the rash should be dusted over with fuller's-earth powder, or sponged with a lotion of lime water and oxide of zinc, with or without calamine.

Erasmus Wilson.

STRUCTURAL DISEASES. — Diseases attended by recognisable anatomical organic changes, as distinguished from *functional* disorders. *See* Disease, Classification of.

STRUMA: STRUMOUS (*struma*, a scrofulous swelling). Synonyms for scrofula and scrofulous. *See* SCROFULA.

STRYCHNINE, Poisoning by.—SYNON.: Fr. *Empoisonnement par la Strychnine*; Ger. *Strychninvergiftung*.—The seeds of *Strychnos nux vomica*, commonly known as *nux vomica*, as well as several other plants, owe their powerful toxic (excito-motor) properties to an alkaloid, *strychnine*; and in a minor degree to another alkaloid, *brucine*, which is said to produce the same physiological effects as strychnine. Strychnine is a white crystalline substance, very sparingly soluble in aqueous liquids, to which, however, it communicates an intolerably bitter taste. It is more freely soluble in acid and alcoholic liquids. When mixed with flour and sugar, and coloured by admixture with either soot or Prussian blue, strychnine forms the basis of several well-known forms of 'vermin-killer.' Spite of its repulsively bitter taste, strychnine has been administered with homicidal intent in such liquids as infusions of tea and cocoa, and in other media.

ANATOMICAL CHARACTERS.—The anatomical characters after death by strychnine-poisoning are very ill-marked, and at most consist of some congestion of the vessels of the spinal cord; and even this may be wanting.

SYMPTOMS.—Except when taken in the form of pill, strychnine and all substances containing it produce an immediate and intensely bitter taste, which is also at the same time of a quasi-metallic character, and is very persistent. Since the fatal dose—half a grain of the alkaloid—is small, and the poison is readily soluble in the acid gastric fluid, its physiological effects are, as a rule, not long delayed. They may be unmistakable after the lapse of two minutes; but commonly they are not well-marked till five, ten, or even twenty minutes after administration. They begin with a stage of restlessness, excitement, and a vague sense of impending peril. The special senses, too, are often preternaturally sharpened. A feeling of choking or impending suffocation ensues; then there is a trembling of the whole body; jerkings of the head; and, often in a moment, the whole body becomes stiff and rigid, assuming a bow-like form (opisthotonos), that is, arched forwards and resting perhaps on the head and heels only. The muscles even of the chest and abdomen are tense and fixed, so that respiration is impeded, giving rise to more or less cyanosis. The feet are either incurvated or excurvated. The angles of the mouth are drawn down, so as to give rise to the well-known *risus sardonicus* of tetanus. Attempts to administer medicine by either cup or spoon have been known to result in the patients biting the cup or spoon in two, in consequence of a violent spasmodic closing of the jaws. During the paroxysm, and indeed throughout the intoxication, the cerebral faculties are unimpaired, and the convulsions are purely of spinal origin. The pupils are dilated. In a few minutes, and often in half a minute, the muscular tension relaxes, and there is a complete remission of the spasms. The patient lies exhausted, and bathed in perspiration; the rapid pulse of excitement falls in frequency; respiration becomes more normal; and the dusky lividity of the countenance passes off. This remission is, however, of no long duration. A gentle touch, a footstep, even a breath of air impinging on the patient, results in a new crisis; and often with a wild, despairing cry, a renewed convulsion, similar to but more intense than the preceding one, is ushered in. The patient rarely dies during the first or second paroxysm, but the alternation of convulsions and quiet is repeated again and again till death ensues, usually in half an hour or an hour; or in non-fatal cases the fits become less and less frequent, less intense, and eventually cease. Death takes place commonly during a paroxysm, from asphyxia; but it may also occur in the intervals between the paroxysms, from exhaustion.

DIAGNOSIS.—The characteristics of strychnine-convulsions are so well-marked, as already described, that there is little likelihood of the nature of the case being overlooked; and the only disease with which strychnine-poisoning can readily be confounded is tetanus—traumatic, idiopathic, or hysterical. In the hysterical form of the disease, as described by some writers, the well-marked hysterical symptoms, the closed or half-closed eyes, the desire to be fanned, and the incomplete remissions of spasm, serve for diagnosis. Except in the history, there is nothing to distinguish between the traumatic and idiopathic forms of the disease, so that what is here stated with regard to the diagnosis between strychnine tetanus and traumatic tetanus, applies also to the idiopathic form. In traumatic tetanus the muscular symptoms begin with pain and stiffness of the neck and jaws, gradually passing into spasms; and the jaw is one of the earliest parts affected. The strychnine-symptoms, on the other hand, develop rapidly, and begin in the extremities, or a general convulsion at once seizes the whole body. Moreover, the jaw is usually last affected, and its muscles relax first. The strychnine relaxation is complete, or 'rarely' almost complete; whilst in traumatic tetanus there is permanent muscular rigidity, and no complete remission of spasm. Strychnine tetanus is an affair of minutes, or at most of half a dozen hours; whilst traumatic tetanus never kills within twelve hours, and generally extends over a few days. In strychnine-poisoning the most trivial movement or touch will set up a convulsion; whilst during the spasms firm grasping of the hands, and hard rubbing of the rigid muscles, will often afford grateful relief. This distinction is not marked in traumatic tetanus. An analysis of the urine by Stass's method, which often affords certain indications of strychnine, and may be made in a few minutes, will, in doubtful cases, at once remove all uncertainty as to the nature of the disease.

Prognosis.—The prognosis is at all times doubtful. The patient's life cannot be considered safe till the convulsions clearly exhibit marked decrease, both in frequency and intensity.

Treatment.—Should the convulsions have already set in, the use of the stomach-pump is out of the question. An emetic of warm water with mustard, or carbonate of ammonium, should be given without a moment's delay. The patient should be touched as little as possible, and absolute quiet observed in the sick-room. Excellent results have ensued from the administration of large doses of bromide of potassium; even half an ounce in one dose has been given. The salt serves the double function of rendering the poison insoluble, and counteracting its physiological effects. The gastric irritation produced by such large doses of the bromide as are necessary, militates against its use. Hydrate of chloral in full doses, and the anæsthetic administration of chloroform-vapour, are the best remedies. The free use of chloroform not only alleviates the pain and allays the spasms, but allows time for the elimination of the poison from the system. Nitrite of amyl has been recommended by Dr. Barnes. Strychnine-poisoning more often ends fatally either from the lateness with which remedies are applied, or their non-application, than from their inefficient character.

Thomas Stevenson.

STUPE (*stupa*, tow).—A synonym for a fomentation. *See* Fomentation.

STUPOR (Lat.)—Synon.: Fr. *Stupeur*; Ger. *Stupor*; *Stumpfsinn.*—A partial loss of consciousness. *See* Consciousness, Disorders of.

STUTTERING.—*See* Stammering.

STY (Sax. *steigan*, to rise up).—Synon.: *Hordeolum*; Fr. *Compère-Loriot*; *Orgelet*; Ger. *Gerstenkorn.*

Definition.—A boil on the margin of the eyelid.

Description.—A sty does not differ in any essential respect from a boil in any other situation, but it is usually of small size, and commences in the follicle of an eyelash. Sties are most common in young people, especially in anæmic girls, and are often very troublesome by frequent recurrence, in which case they may create a certain amount of permanent disfigurement by destroying hair-bulbs, and producing bald gaps in the margins of the eyelids. They are mostly associated with some obvious derangement of the general health, which should be made the subject of treatment.

Treatment.—An individual sty, if seen sufficiently early, when it is as yet only a small pimple, may often be rendered abortive by pulling out the eyelash which passes through it, and touching the spot with a fine point of nitrate of silver. When the time for this method has passed away, there is nothing to be done locally beyond the application of a fomentation or poultice, and a touch with a sharp lancet as soon as pus can be seen. Pain is at once relieved by the incision, and the swelling speedily subsides.

R. Brudenell Carter.

STYPTICS (*στύφω*, I constringe).—Definition.—In former years this term was held to include internal astringents, like the famous Ruspini's styptic, of which gallic acid was the principal ingredient; but we now limit its use to agents locally used to arrest hæmorrhage.

Enumeration. — The chief styptics are Cold, the Actual Cautery, Perchloride of Iron, Tannic Acid, Matico, strong Acids, Alum, Acetate of Lead, Nitrate of Silver, and Collodion.

Actions and Uses.—One class of styptics encourages the coagulation of the blood, by supplying a rough material around which fibrin may be deposited, in obedience to a well-known physiological law; the principal of these being matico, tannic acid, and the old-fashioned use of the cobweb. Others, in addition to their primary action in favouring the formation of a clot, coagulate the albumen of the tissues, or, like acetate of lead, and nitrate of silver, cause the bleeding mouths of the smaller vessels to contract.

The use of styptics is usually limited to the general oozing which is observed occasionally to follow the application of leeches, or the infliction of small wounds by accident or for surgical purposes, and may render essential service under a great variety of circumstances. If ice, pressure, rest, or posture fail to check such bleeding, we may have recourse to some of the more potent applications, particularly the caustic point or collodion.

R. Farquharson.

SUBACUTE. — A term applied to a disease when it has characters intermediate between acute and chronic, whether in *course* or in *intensity*. *See* Acute; Chronic; and Disease, Duration of.

SUBCUTANEOUS INJECTION. *See* Hypodermic Medication.

SUBCUTANEOUS NODULES. — *See* Rheumatism, Acute.

SUBSTITUTION.—This word is used in pathology in connexion with degeneration, when a newly formed tissue, inferior to the original in organisation or functional activity, takes the place of the normal structure. *See* Degeneration.

SUBSULTUS TENDINUM (Lat.)—A twitching movement of the tendons, caused by sudden momentary contractions of the muscles to which they belong. This is especially apt to show itself in the tendons about the wrist in the later stages of many low fevers. It manifests itself principally in states of great prostration, and is often associated with delirium or other signs of cerebral irritation. *See* Typhus Fever.

SUCCUSSION (*succussio*, a shaking).—A method of physical examination, which consists in suddenly shaking the trunk of the patient, so that certain sensations or sounds may be elicited, which are indicative of the presence of gas and fluid in a hollow space, such as the pleural cavity. *See* Physical Examination.

SUDAMINA.—*See* Miliaria; and Sudoriparous Glands, Diseases of.

SUDORIFICS (*sudor*, sweat; and *facio*, I make).—A synonym for diaphoretics. *See* Diaphoretics.

SUDORIPAROUS GLANDS, Diseases of.—Synon.: Fr. *Maladies des Glandes Sudoripares*; Ger. *Krankheiten der Schweissdrüsen.*

The morbid conditions of the sweat-glands will be noticed in the following order: (1) Inflammation; (2) Hyperidrosis, including (2*a*) Dysidrosis; (3) Bromidrosis; (4) Chromidrosis; (5) Hæmatidrosis; and (6) Anidrosis.

1. **Inflammation.**—Under certain conditions the sweat-glands may inflame; this generally happens to isolated glands, and often occurs as a sequel to the effects of mechanical irritation, such as scratching. An inflamed sweat-gland appears as a deep-seated movable nodule, which gradually involves the superficial structures, and ultimately suppurates from below. Inflamed sweat-glands, leading to the formation of small abscesses, are most likely to occur in regions where the glands are large, such as the anus, axilla, labia, and scrotum.

The *treatment* is by incision and appropriate dressings.

2. **Hyperidrosis.**—Synon.: Ephidrosis; Idrosis.

Definition.—Profuse sweating.

Ætiology.—The cause of hyperidrosis, though certainly connected with the vaso-motor nerves, is still obscure. It occurs in lesions of the brain and spinal cord, and especially in cases of compression of the sympathetic—as by tumours of the neck, or aneurysms, also as a result of traumatic injury involving the sympathetic, such as gun-shot wounds. The profuse sweating of phthisis and allied diseases probably depends likewise on paralysis of the sympathetic.

Description.—Hyperidrosis may be *general* or *local.*

When *general*, it may occur as an idiosyncrasy; more often it is due to the cachexia of disease, or accompanies acute febrile states. The skin is bathed in sweat, either spontaneously or as the result of slight effort. The nervous excitement and the continued loss of water tend to exhaust the already debilitated patient.

Obstruction to the free flow of the secretion by occlusion of the orifice of the duct may lead to effusion beneath the horny layer, and the formation of closely set, millet-sized vesicles, generally on the neck, chest, or abdomen. These are known as *miliaria crystallina* (sudamina), or, if the contents of the vesicles become clouded or yellowish-white, as *miliaria alba.* Should this retention be followed by inflammation, the regions affected become crowded with discrete vesicles or pustules seated on inflamed bases; the general redness of the skin has suggested the term *miliaria rubra.* The severe sweating which occurs in tropical climates may cause inflammation of the sweat-glands, and so give rise to a secondary obstruction of the secretion. A sudden eruption occurs of minute, acuminate, red papules (*miliaria papulosa*, *lichen tropicus*, or *prickly heat*), with which are mingled vesicles and pustules; these chiefly affect covered regions, and are accompanied by intense pricking or tingling.

Hyperidrosis may occur *locally* in the axillæ, genital regions, palms, or soles. The irritation and decomposition of the sweat may set up intertrigo or eczema of the groins; or, if the feet are affected, may give rise to a sodden, tender condition of the feet, which may impede walking. Sudoral eruptions in infants (*strophulus* or *red-gum*) may simulate the exanthemata, or co-exist with them.

2*a*. **Dysidrosis.**—It is convenient here to mention a disease which was first described by the late Dr. Tilbury Fox under the name 'dysidrosis.' According to Dr. Fox's description, profuse sweating, when occurring on the palms, is often associated with the eruption on the palms and interdigital surfaces of vesicles not formed in the usual way in the rete, but due to distension of the sweat-apparatus by sweat secreted in excess, and which fails to find its way outward upon the free surface. These sweat-vesicles are at first situated beneath the level of the skin, and indeed appear as little boiled sago-grains embedded deeply in the substance of the skin; and, when once seen, are easily recognised again. If they be pricked, a little sweat oozes out. These vesicles are distinct the one from the other at first, and are scattered about the interdigital surfaces or the palms;

or they may be grouped. In some cases their fluid contents dry away, or they enlarge and become prominent upon the surface, or run together into bullæ; and if the sweat secretion is free, large bullæ may form. Usually the cuticle becomes white and opaque from maceration in the fluid which collects beneath it; subsequently it peels off in a membranous manner, leaving behind a dry, reddened surface, but not a discharging one as in eczema. One or both hands or the feet may be attacked. The disease occurs in connexion with nervous debility. It may be attended with much itching or burning pain.

Diagnosis.—The vesicular forms of miliaria can hardly be mistaken for eczema. The sudden outbreak, the even distribution, and tendency to rapid spontaneous involution, are distinguishing characters. In prickly heat the eruption is more like that of eczema; but the sudden onset, the association with sweating and exposure to rapid changes of temperature, together with the peculiar pricking sensation and minute size of the papules, serve to distinguish it. The limitation of the disease to the hands or feet, its tendency to spontaneous recovery (the vesicles drying up, not continuing to exude as in eczema), and its occurrence during hot weather, are characters which serve to distinguish dysidrosis especially from eczema, with which it may be confounded.

Treatment.—The vesicular forms of miliaria and dysidrosis scarcely call for treatment, beyond the administration of saline diuretics, and the application of some protective desiccating powder. Prickly heat may give rise to more trouble. In addition to the above measures, purgatives should be given, and care taken to avoid sudden changes of temperature. Thin woollen underclothing should be recommended; with rest and simple diet. Locally, antipruritic lotions, such as two fluid drachms of Wright's liquor carbonis detergens to eight fluid ounces of diluted solution of subacetate of lead, may be used whenever the irritation prompts the patient to scratch. In other forms of hyperidrosis the general condition may demand tonic treatment by the mineral acids, nux vomica and iron. More specially directed to the disordered function are tincture of belladonna pushed to dryness of the throat; sulphate of atropine gr. $\frac{1}{150}$–$\frac{1}{60}$, injected hypodermically; liquid extract of ergot in doses of half a drachm three times daily; and sulphur, thirty grains twice daily, alone if it can be borne, or combined with aromatic powder of chalk if found to purge too freely. Locally, belladonna ointment or liniment rubbed into the affected part answers well. For hyperidrosis of the feet, strapping with stout lead plaister is recommended. Another plan is to thoroughly dust the boots and stockings every day with powdered boric acid—at the same time introducing into the boots cork socks, which are to be treated with a saturated solution of boric acid daily. This is probably the best method of treating this form of hyperidrosis of the feet. Other suitable local applications that may be mentioned are salicylic acid, quinine, alum, tannic acid, and disinfecting soaps.

3. **Bromidrosis.**—Synon.: Osmidrosis.

Definition.—Offensive sweating, from disorder of the sweat-glands or decomposition of the sweat after excretion.

Symptoms.—Bromidrosis may accompany, and be characteristic of, such diseases as rheumatic fever, syphilis, or uræmia; or it may be idiopathic. It may be general or local, the form which is most commonly met with being bromidrosis of the feet; but it may affect the axillæ and groins.

When the feet are affected, the odour is particularly offensive, and sometimes unfits the subject of the malady for society. It is generally associated with the sodden condition alluded to under hyperidrosis. The sweat is said to alter in character after excretion under the influence of a bacterium.

Treatment.—The method detailed under hyperidrosis—namely, that by treating the socks &c. with boric acid—will be found the most efficacious. Sulphur should be given internally.

4. **Chromidrosis.**—Synon.: *Seborrhœa Nigricans.*

Definition.—Coloured sweating or excretion of sebum.

Symptoms.—Symmetrical parts of the body, but chiefly the face, become covered with coloured sweat or sebaceous secretion, forming a powdery or granular deposit on the skin. The colour is usually black or sepia, but blue, red, green, yellow, and violet have been seen. It is supposed that colourless indican is secreted in the sweat, and oxidised on exposure to the air. The condition is generally accompanied by obstinate constipation.

Green sweat has been observed in individuals who work in copper or iron, the metal having become absorbed into the patient's system. Red sweat sometimes occurs in the axillæ from decomposition after excretion by micrococci. True chromidrosis is a rare affection, but a considerable number of well-authenticated cases have been recorded.

5. **Hæmatidrosis.** — Synon.: Bloody Sweat; *Ephidrosis Cruenta.*—This is a condition in which blood is found mixed with the sweat on the unbroken surface of the skin. The few cases observed have occurred in highly hysterical females, including Louise Rateau, under the influence of violent emotion. In some cases hæmatidrosis has been referred to vicarious menstruation (*menidrosis*).

6. **Anidrosis.**— Definition.—Deficiency of sweat.

All grades of this condition exist, from slight diminution to total absence. When universal, the condition may be symptomatic, as in diabetes mellitus, albuminuria, and fevers, or the absence of the function may be congenital, and due to malformation of the skin, as in xeroderma and ichthyosis. It may be temporary, accompanying the early stage of fevers; or part of a general malnutrition.

On patches of skin affected by leprosy, scleroderma, psoriasis, or eczema, the sweating function is in abeyance. Local idiopathic anidrosis is rare.

Treatment.—When the condition is acquired, tonic treatment is of service, combined with warm and vapour baths and shampooing. Alfred Sangster.

SUFFOCATION (*suffoco*, I stifle).—Synon.: Fr. *Suffocation*; Ger. *Erstickung*.

Definition.—The term 'suffocation' is sometimes employed synonymously with asphyxia. In the strict medico-legal sense it signifies asphyxia induced by obstruction of the respiration otherwise than by direct pressure on the neck (hanging, strangulation), or submersion (drowning).

Ætiology.—Death by suffocation is usually the result either of accident or of homicide, rarely of suicide.

Suicide by suffocation is indeed not unknown. Cases of suicide by immurement in a box or trunk, or by thrusting a pad or other obstruction down the throat, have been reported; and it has been averred that slaves, both in ancient and modern times, have committed suicide by rolling the tongue back into the pharynx.

Accidental suffocation is very common by diseases causing occlusion of the air-passages; by the impaction of pieces of food or other obstacles in the pharynx; by the entry of foreign bodies into the larynx, as a seed, coin, or food, in cases of bulbar or general paralysis, or matters vomited in a state of insensibility; by mechanical pressure on the chest and abdomen, as in crowds, or in falls of earth or heavy bodies; by various diseases preventing the expansion of the lungs; by diseases of the lungs themselves; or by obstruction of the pulmonary circulation. Suffocation of new-born children by smothering under bedclothes, non-removal of maternal envelopes, or overlaying, may happen from carelessness as well as from intent. *See* Overlaying.

Homicidal suffocation is resorted to chiefly in infants, or in the case of persons feeble and infirm, or rendered powerless or insensible by intoxication or narcotics. Closure of the mouth and nostrils by the hands, or obstruction of the mouth and nostrils by a pillow, mattress, or the like, perhaps combined with pressure on the chest, is the method usually adopted. Formerly suffocation by mechanical pressure on the chest was a judicial punishment—the *peine forte et dure*.

Symptoms and Signs.—The mode of death, and the general *post-mortem* indications, are those of asphyxia (*see* Asphyxia). The special indications of suffocation, and the way in which it has been brought about, may be evident from the place where the body is found, and its surroundings; or foreign bodies, or disease obstructing the air-passages or respiratory mechanism, may be clearly evident on *post-mortem* dissection; or there may be marks of violence and indications of pressure on the chest, flattening of the nose, &c., pointing to homicidal violence. The absence of marks of constriction of the neck excludes strangulation and hanging.

But in the absence of all such indications as have been enumerated above—and they may all be absent, especially in cases of infanticide—the question is whether any trustworthy conclusion can be formed as to asphyxia by suffocation.

The condition of the lungs is of especial importance in this relation. The lungs may be congested, or pale, or congested only posteriorly; but the surface is often uneven, owing to an emphysematous condition of some of the superficial air-cells; and in particular the lung looks as if it had been sprinkled with minute drops of a dark purple fluid. These spots, not much larger than a pin's head, are known as 'Tardieu's spots,' and are due to minute capillary extravasations under the pleura. They are not, however, confined to the surface of the lungs, but are found also in considerable numbers on the thymus gland, the base of the great vessels, under the parietal pleura, and also under the pericranium. Tardieu, who first called special attention to these spots, considered them absolutely diagnostic of death by suffocation, as distinguished from other modes of asphyxia. But numerous other observations have shown that this cannot be accepted as correct, inasmuch as similar extravasations have been found in cases of hanging, strangulation, drowning, and deaths from cerebral injuries. It seems, however, fairly well established that they occur most frequently, and in largest number, in suffocation, especially in infants. Their formation depends on excessive vascular tension during the asphyxiating process. Similar spots have been found in the lungs of still-born fœtuses, conditioned by obstruction of the placental circulation; and in the lungs of new-born children, perishing from other causes, extravasations of a like nature have been observed. It would, therefore, be unsafe to rely absolutely on Tardieu's spots as indications of suffocation, though, in the absence of other causes of death, and in presence of these spots in large numbers and in clusters, the opinion of death by suffocation would be fairly justified.

Treatment.—The treatment of impending suffocation is that of asphyxia. *See* Artificial Respiration; Asphyxia; and Resuscitation. D. Ferrier.

SUFFOCATIVE BREAST-PANG. A synonym for angina pectoris. *See* ANGINA PECTORIS.

SUFFOCATIVE CATARRH. — A condition in which the bronchia are filled with abundant secretion; chiefly met with in capillary bronchitis and œdema of the lungs. *See* BRONCHI, Diseases of; and LUNGS, Inflammation of.

SUFFUSION (*suffundo*, I pour down). The process or the result of the unnatural pouring out of a fluid into the tissues; closely analogous to effusion and extravasation. *See* EXTRAVASATION.

SUGGILLATION (*suggillo*, I make black by beating).—The appearance produced by extravasation or ecchymosis of blood. The term is limited by some writers to the appearance of livid spots on the body after death.

SUICIDAL INSANITY. — *See* INSANITY, Varieties of: Impulsive Insanity; and MELANCHOLIA.

SULPHONALISM.—DEFINITION.— A group of symptoms said to be occasioned by the prolonged administration of sulphonal.

Sulphonal is now extensively employed, and is one of the favourite hypnotics in institutions for the insane. Being tasteless and odourless, fairly soluble in such vehicles as hot soups, not productive of digestive derangements, and obtainable without medical prescription, it has become very generally known to the laity; and thus a 'sulphonal-habit' has been met with which demands recognition and treatment.

SYMPTOMS. — The prominent symptoms noted in the recorded cases of poisoning by sulphonal are vomiting, abdominal discomfort, gastro-intestinal disturbance, cephalalgia, tinnitus aurium, drowsiness, incoördination, diminution of reflex excitability, puffiness of the eyelids, ptosis, and more or less mental and physical weakness. The urine, which decomposes slowly, becomes of a port-wine or Burgundy-red colour, possibly with coincident evidences of renal inflammation. This peculiar colour of the renal excretion, which is said to be due to the presence of non-ferrous hæmatin or hæmatoporphyrin (*see* SPECTROSCOPE IN MEDICINE), resulting from extensive disorganisation of hæmoglobin, is thus of clinical significance, serving as a means of recognising the abuse of the drug, and to be regarded as an index for its immediate temporary discontinuance. Of rarer occurrence is a papular, measly, erythematous, or scarlatiniform eruption. Possibly many of the phenomena noted in the recorded cases were symptoms of the disease from which the patient was suffering, and ought not to have been accredited to the drug.

TREATMENT.—The treatment of sulphonalism consists in suspending the administration of the sulphonal until all unfavourable symptoms have disappeared; and by the use of diuretics, promoting the elimination of the drug, at least in cases where it has been taken in large doses. If it should have to be taken regularly for a lengthened period, the use of it should be occasionally intermitted for a few days, another suitable hypnotic being substituted temporarily.

JOHN HAROLD.

SULPHUR WATERS.—*See* MINERAL WATERS.

SUNBURN.—DEFINITION.—Under this designation are included the superficial local effects of exposure to the sun's rays.

Such effects vary greatly with the susceptibility of the individual, the surrounding circumstances and conditions, and the duration or repetition of the exposure. They may be comparatively slight and transient, as is commonly the case; or they may be very severe, and involve considerable and prolonged suffering, and sometimes serious constitutional disturbance.

ÆTIOLOGY.—Delicate, thin-skinned, fair-complexioned subjects are most liable to suffer from sunburn; the thick-skinned and swarthy much less so. The rays reflected from snow or ice (especially through rarefied atmosphere), as experienced by Alpine climbers, or from water surface, sea or river, are most hurtful. Exposure to the rays from powerful electric arc lights may be followed by effects more or less similar to those resulting from exposure to the solar rays (Tyndall, Hewetson).

There is evidence to suggest, if not to prove, that sunburn is due not to the heat rays alone, but further to other influences, especially to those of the violet and ultra-violet rays (Bowles).

SIGNS AND SYMPTOMS.—First, in the slight, familiar cases, there is redness of the skin from vascular congestion (*erythema solare*), accompanied by tingling and sense of heat. This is followed by desquamation and subsequent pigmentation, either uniformly diffused ('tanning') or especially localised in spots, giving rise to freckles (*ephelis*). All these more or less speedily subside, and are the only points to be noted. Pigmentation may occur without previous noticeable erythema, as is evidenced by the 'browning' of patients who have wintered at Davos or other Alpine resorts, or who have been otherwise exposed to snow-reflected sun rays.

Secondly, in the more severe cases, the erythema is followed by vesication, and more or less deeply extending inflammation of the skin. An erysipelatoid condition may ensue, with œdema and considerable swelling of the part, severe pain, and great tenderness. This may be accompanied by constitutional disturbance.

Thirdly, in the worst cases, happily very rare, sloughing and ulceration to greater or less extent occurs. *See* HEAT, EFFECTS OF SEVERE AND EXTREME.

TREATMENT.—In the slighter cases of sunburn little or no treatment is required. Simple powdering with starch, oxide of zinc, bismuth or boric acid, or dabbling with elder-flower or rose water, with a little eau-de-Cologne or solution of acetate of ammonium, may be pleasant. The more severe cases must be treated on general principles. Lead lotion with morphine or cocaine will relieve the heat and pain. The solution of subacetate of lead with glycerine and elder-flower or rose water is also a good application.

It is, however, almost more important to prevent than to cure. The preventive treatment obviously consists in protecting exposed parts from the deleterious effects of the sun's rays. When sunshades, veils, and masks are inconvenient—especially in cases of Alpine climbers and others—Dr. Bowles [1] recommends, with good reason, founded on extensive experience, that the face, arms, and other exposed parts should be painted over with the 'grease paints' used by actors for 'making up.' Brown is the best colour, but pink will serve. Pigments mixed with glycerine of starch would probably be better than those mixed with 'grease.' For sunshades, veils, and similar protections, brown or some shade of yellow is the best colour. The 'tanning' of the skin, which naturally takes place, is the best protective against suffering from subsequent exposure.

In those who have been year by year subject to 'sunburn,' the skin becomes dry and wrinkled, from the effect upon the sudoriparous and sebaceous follicles—as well as browned by pigmentation. Such result may be to some extent prevented by the ancient practice of oiling the skin.

For the freckling and browning of the skin after sunburn, lotions of perchloride of mercury or boric acid, with emulsion of almonds, and glycerine, or juice of cucumber, are extensively used with more or less beneficial effect.

ARTHUR E. DURHAM.

SUNSTROKE.—SYNON.: Insolation; Heat-stroke; Fr. *Coup de Soleil*; Ger. *Sonnenstich.*

DEFINITION.—Certain pathological conditions resulting from exposure to solar or artificial heat.

Three well-marked varieties of sunstroke are recognised, namely: (1) Exhaustion and failure of the heart's action in *syncope*; (2) A condition like shock, in which the nerve-centres, and especially the *respiratory*, are affected, causing rapid failure of the respiration and circulation; and (3) Intense *pyrexia*, due to vaso-motor paralysis, and to the nerve-centres being over-stimulated and then exhausted by the action of heat on the body generally.

ÆTIOLOGY AND PATHOLOGY.—These morbid conditions, being due to heat alone, are not peculiar to any country or climate, and are liable to occur wherever persons are exposed under any circumstances to great heat, whether solar or artificial. Soldiers marching or fighting, when oppressed by weight of clothing and accoutrements, are apt to suffer either from simple heat-exhaustion, or that form of insolation which results from direct action of the sun on the head and neck. This is common enough in India during the hot season, in other tropical countries, and in America; and is not unknown in Europe or even in England during the heat of summer. Workmen, artificers, stokers, and other persons in heated rooms, hospitals, barracks, tents, and even ships, especially in hot climates, are liable to suffer from heat-exhaustion, which may pass into the dangerous condition of fever or insolatio.

But the most frequent cases are those which occur in houses, barracks, tents, ships, by night or in the day, away from the direct solar rays. A form of disease sometimes described as 'ardent fever' in India, is this condition supervening on the ordinary phenomena of ephemeral fever. It seems pretty well understood that heat alone is the effective cause of the so-called sunstroke. Malarial and certain hygrometric or barometric states of the atmosphere have no special influence, beyond that which they may exert on the general vigour of the constitution, or in rendering a person more or less susceptible to heat, and so far predisposing him to suffer from it.

A dry air, such as that of North India, with hot winds, is much better tolerated at a high temperature, than the damp atmosphere of Bengal at a much lower one; for the dry hot air favours evaporation, and thus keeps the body cool, whilst in the damp, heavy atmosphere the natural cooling function is almost in abeyance. Vigorous, healthy persons of moderately spare frame, possessing sound viscera, and leading temperate and regular lives, can tolerate a great amount of heat, in an otherwise pure atmosphere, and are much less liable to suffer from it than those in whom these conditions do not exist. Acclimatisation has also considerable influence in conferring toleration. New arrivals are more prone to suffer than those who have become accustomed to the climate. It is well known that the native can bear an amount of sun on his shorn head, neck, and half-naked body with indifference, if not pleasure, that would very soon prostrate a European. But to a temperature of the air rising above a certain standard, all succumb; and the natives of India suffer like others, and die in numbers every year from *loomarna* or 'hot-wind stroke.'

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[1] *Journal of Dermatology*, vol. v.

The exact amount and duration of toleration of a high temperature depend to a great extent, therefore, on the vigour of constitution and the present state of health. The natural refrigerating powers of the body, when in health, are such as to enable men to support very high temperatures, much above that of the normal state of the body. Thus in the hot dry winds no inconvenience beyond discomfort is felt, so long as transpiration and perspiration are free, which cool down the body, enabling it to resist the great heat. It is obvious that in this there is a great expenditure of force, and when it fails suffering soon ensues. Disordered health, dissipation, over-fatigue, anything in fact that depresses nerve-power, reduces the normal physiological capacity, and consequently renders a man more liable to succumb.

Anatomical Characters.—In cases where death has taken place suddenly, as from *shock*, there is no very remarkable *post-mortem* appearance. The heart may be found firmly contracted, but not always so—it may be flaccid. The lungs and the brain and its membranes may be somewhat congested, but not invariably. As in cases of shock, the venous trunks, specially those of the abdomen and the right side of the heart, may be too full of blood, and the pulmonary vessels overloaded; but the lungs in some cases are blanched from absence of blood, owing to contraction of the pulmonary arterioles. The blood itself is dark and grumous, and is found effused in patches of ecchymoses, indeed rendering the body more or less livid; the coagulability of the blood is also impaired, and it is wanting in oxygen.

In death from ordinary cases of *thermic fever*, the lungs and respiratory organs are often deeply congested; the heart is firmly contracted from coagulation of myosin; the whole venous system is engorged; and the body even before death is marked by petechial patches, or extensive ecchymoses of a livid appearance. The blood is generally more fluid and grumous than natural; its coagulability is impaired; and it is acid in reaction. The red corpuscles, though generally presenting no abnormal change, are somewhat crenated, and have less tendency to form rouleaux than in health; and the quantity of oxygen is much diminished. The body for some time after death retains a high temperature; when first opened, the viscera feel pungently hot, and the incisions drip dark blood. *Rigor mortis* comes on very rapidly, from early coagulation of myosin.

The brain and membranes may be found congested, and in some cases there may be evidence of meningitis. Serous effusions into the ventricles, or hæmorrhage into the brain-substance, may have occurred, and are not improbable in the congested condition sometimes existing in the head; but the cause of death is asphyxia, not apoplexy, and the most important changes are found in connexion with the thoracic viscera.

Symptoms.—(1) **Syncopal form.**—Synon.: Heat-exhaustion.—Simple exhaustion and syncope may occur under great fatigue or over-exertion, or depression from any cause, during exposure to a high temperature. There is depression of nerve-force, and prostration of muscular power; the skin is pale, cold, and moist; and the pulse is quick and feeble. Death may occur rapidly in the state of collapse from failure of the heart. Complete recovery is frequent.

(2) **Asphyxial form.**—Synon.: Sunstroke proper.—Asphyxia and apnœa may come on very rapidly, after certain premonitory symptoms of depression and weakness, though occasionally without prodromata, during exposure, especially of the head and spine, to the direct rays of a powerful sun, when the atmosphere is much heated, and the nervous energy has been depressed by over-fatigue, dissipation, or illness. The brain and nerve-centres, especially the respiratory, are overwhelmed by the sudden elevation of temperature, and respiration and circulation fail, the failure of the latter being probably due to the inhibitory influence of the vagus. When death takes place, as it does sometimes very suddenly, during great excitement or exertion, it has been attributed to rapid *ante-mortem* coagulation of the cardiac myosin. This, however, though it may occur occasionally, is generally a *post-mortem* change, the heart's action being brought to a close by the heat; in the same manner as it has been shown by Claude Bernard and Lauder Brunton that the effect of high temperature on animals is first to accelerate and finally to stop the heart, and especially the ventricles, in a state of contraction. Recovery is frequently complete, but sometimes tedious, and in many cases imperfect, ending in serious impairment of health or intellect, indicative of structural changes caused in the nerve-centres. The symptoms of this form of insolation, the real *coup de soleil*, are those of sudden and violent injury to the nerve-centres—unconsciousness, cold skin, feeble pulse, and all the symptoms of depression; death resulting from rapid failure of the respiration and circulation. If not fatal, reaction may result in a variety of conditions indicative of the injury done to the cerebro-spinal system.

(3) **Hyperpyrexial form.** — Synon.: Heat-fever.—An intense state of fever, the result of the influence of heat on the nerve-centres, and through them on the vaso-motor nerves, and of the heating of the body generally, by the direct action of either artificial or solar heat, may occur, quite independently of the immediate operation of the sun's rays. It comes on as frequently at night, or in the shade, as in the day or in the sunshine, especially in persons who are ex-

hausted by fatigue, overcrowding, depression from any cause, such as dissipation, want of rest, present or recent illness, and notably when the atmosphere is impure from overcrowding or want of cubic space.

The temperature of the body rises to 108°, 110° F., or higher. The brain, medulla, and cord, the nerve-centres generally, and especially the respiratory, suffer from overstimulation, followed by exhaustion. Respiration and circulation fail; there is dyspnœa, with hurried, gasping breathing; great restlessness; thirst; fever; frequent micturition; and a pungent burning heat of skin, which is sometimes dry, sometimes moist. The pulse varies; in some it is full and laboured, in others quick and jerking. The face, head, and neck are congested to lividity, and the carotid pulsations are visible. The pupils, contracted at first, may dilate widely before death. Delirium with convulsions, frequently epileptiform in character, coma, relaxation of the sphincters, and suppression of urine, come on, and are frequently the precursors of death. Recovery not infrequently partially occurs, to be followed by relapse and death; or secondary consequences result in meningitis or cerebral changes, which may destroy life or intellect at a later period, or permanently compromise the whole health or that of some important function.

The premonitory symptoms of this form of insolation often manifest themselves for some hours, and it may be days, before they culminate in the dangerous condition just described. These premonitory symptoms are general malaise; disordered alvine or other secretions; profuse and frequent micturition; restlessness; sleeplessness, and apprehension of impending evil; hurried and shallow breathing; præcordial anxiety; giddiness and headache; occasionally nausea or vomiting; thirst and anorexia; and feverishness, which soon amounts to a pungent heat of skin with high temperature. These symptoms vary considerably, but they point to a profoundly disturbed state of the cerebrospinal nerve-centres, and to pathological changes in the organs or structures whose functions have been so gravely disturbed. Recovery is often incomplete; or is followed by permanent impairment of health, and generally by intolerance of heat and exposure to the sun.

Terminations.—The mortality from sunstroke is about 45 to 50 per cent.: but of those who recover many are permanently injured, and remain invalids for the remainder of life, which is often shortened by the changes induced. There may be some weakness, due to obscure structural change in the cerebrum, or to a chronic form of meningitis which affects the sufferer in various degrees of intensity; or epilepsy, impairment of memory, great nervous irritability, headache, insanity, partial paraplegia, partial or complete blindness, and extreme intolerance of heat—especially of the sun's heat—rendering the person utterly incapable of serving or living in a hot climate, or of enduring exposure to the sun. Or the case may gradually end in complete fatuity, insanity, or meningitis, which accounts for the intense cephalic pain; or, in a lesser degree, in disordered innervation and derangement of the functions generally, thus seriously compromising the general health.

Treatment.—(1) In cases of *simple exhaustion* mild treatment is all that is needed. Removal to a cooler locality, the cold douche (but not too much prolonged), or the administration of stimulants may be beneficial. Tight or oppressive clothing should be removed, and the patient treated as in syncope from other causes. *See* Resuscitation.

Rest, and freedom from exposure to over-exertion, fatigue, or great heat, should afterwards be enjoined.

(2) In that form of sunstroke where the person is *struck down* suddenly by a hot sun, the patient should be removed into the shade. Here a douche of cold water must be allowed to fall in a stream on the head and body, from a pump (or as in India from the mussuck, or other similar contrivance), the object being twofold—to reduce the temperature of the over-heated centres, and to rouse them into action. During the assault on the White House picquet in the second Burmese war, numbers of men were struck down by the direct action of the sun during the month of April. They were laid out perfectly unconscious, in their red coats and stocks (worn in 1852), but were recovered by the cold douche freely applied by the mussuck over the head and body. In some cases flagellation with a broom was added; and all recovered with the exception of two cases, both of which had been bled on the spot where they fell. Mustard plasters and purgative enemata may also be useful.

If recovery be imperfect, and followed by any indication of injury to the nerve-centres, or by the supervention of meningitis, other treatment may be necessary, according to the indications. Much exposure to the sun should be carefully guarded against; and unless recovery be complete and rapid, the sufferer should be removed to a cooler climate, the most perfect rest and tranquillity of mind and body enjoined, and the greatest care observed with regard to extreme moderation in the use of stimulants.

(3) In the cases of *thermic fever*, heat being the essential cause of the disease, the object is to reduce the temperature of the body as quickly as possible, and before tissue-changes have resulted. As the hyperpyrexia is due not only to the direct operation of heat, but to fever set up, remedies such as may influence this disturbed condition have been

suggested. The results have appeared in some cases to justify the theory, and the hypodermic injection of quinine has been considered to produce good results.

Bleeding has now happily been almost abandoned. The congested livid surface, coma, and stertor, which formerly suggested it, are not now so treated. There are cases in which it may still be practised with advantage; but they are the exception and not the rule. In cases where venesection has appeared first to give relief and mitigate the symptoms, the improvement has been often transient, and been followed by relapse into a more dangerous condition, which has terminated fatally. At the same time no absolute rule can be laid down in this disease with reference to the abstraction of blood; and it is quite possible that greater immediate danger to life may exist in an over-distended right heart than in the loss of an amount of blood which might have tided the patient over that state of peril. Each case must in this respect be treated on its merits. The treatment generally consists in the judicious use of cold, either by affusion or by the application of ice to the surface; the reduction of the temperature being watched with a thermometer in the axilla, mouth, or rectum.

Care should be taken not to continue the cold application too long, as danger arises from depressing the temperature below the normal standard. The bowels should be relieved; and quinine may be given internally or in the form of hypodermic injection.

In the epileptiform convulsions that occur so frequently, the inhalation of chloroform or of ether may be of benefit, but their administration must be carefully watched. The earliest and most severe symptoms having subsided, the febrile condition that follows is treated on ordinary principles—salines and aperients being given, but not to the extent of depressing the patient. The diet must be carefully regulated, and of the blandest and most nourishing nature.

As improvement progresses, other symptoms may supervene, indicative of intracranial mischief. Where they are indicative of meningitis, iodide of potassium and counter-irritants may be used with advantage. Removal to a cooler climate is essential. As a general rule, it is desirable that the sufferer should not, for a long period at least, return to a hot or tropical climate; and he should be guarded against all undue exposure to heat, work, or mental anxiety of any kind.

The sequelæ of sunstroke are frequently from such causes most distressing, rendering the patient a source of suffering to himself and of anxiety to his friends.

The less severe symptoms—those, probably, indicative of the slighter forms of meningitis, or of lesions of the brain or nervous system—occasionally pass away after protracted residence in a cool climate; but they not infrequently also cause much suffering, and shorten life. As they point to permanently disturbed, if not structurally injured, cerebro-spinal centres, the treatment required is as varied as the symptoms presented.

Joseph Fayrer.

SUPPOSITORY (*suppono*, I place below).—Synon.: Fr. *Suppositoire*; Ger. *Stuhlzäpfchen.*—A suppository is a solid mass, which is introduced through the anus into the rectum for certain therapeutic purposes. The material of which it is made should be capable either of being dissolved, or of melting at the temperature to which it is exposed in the rectum.

Suppositories may be divided into *simple*, *medicated*, and *nutrient*. Simple suppositories may be exemplified by pieces of soap or tallow-candle, which are in popular use as aperients. The British Pharmacopœia now recognises nine suppositories, one of which may be regarded as simple, the remainder being medicated. The latter are made up either with oil of theobroma, or with glycerine of starch and curd soap, to which starch is added in some instances. Each suppository is cast into a mould of a conical or other suitable shape, so as to facilitate its introduction into the bowel. It may be well to give a list of these official preparations, with the proportions of their active ingredients, as follows:—

S. Glycerini = 70 per cent. of Glycerine. S. Hydrargyri = Mercurial Ointment gr. 5. S. Plumbi Composita = Acetate of Lead gr. 3, Opium gr. 1. S. Acidi Carbolici cum Sapone = Carbolic Acid gr. 1. S. Iodoformi = Iodoform gr. 3. S. Acidi Tannici; S. Acidi Tannici cum Sapone = Tannic Acid gr. 3. S. Morphinæ; S. Morphinæ cum Sapone = Hydrochlorate of Morphine gr. ½.

Besides these official suppositories, others are often prepared and used, containing belladonna, cocaine, and other agents; and the practitioner may employ many drugs in this way with advantage, according to his own judgment.

Nutrient suppositories usually consist of lean meat that has been finely minced and peptonised.

Application.—A suppository must be introduced well into the rectum, beyond the sphincter ani. At first this should be done by the practitioner, or by a competent nurse; but subsequently many patients learn to use suppositories for themselves without any difficulty. The suppository should be oiled, and passed in gradually and gently with a screwing movement and without any undue force. It may be necessary to keep the finger applied for a moment over the anal aperture, until the tendency to expulsive action on the part of the rectum has subsided.

Uses.—A suppository may be used for the following purposes: (1) As a mere aperient, by exciting the expulsive action of the bowel through local irritation, which also has a reflex effect upon the intestine above. (2) On the other hand, to subdue excessive action of the bowel, and thus check diarrhœa. (3) To bring medicinal agents into contact with the rectum in a suitable form, in order to affect some local disease. Astringents and antiseptics are thus used. (4) To influence adjacent organs, the active ingredients of the suppository being absorbed. For instance, a morphine suppository will often produce a marked effect upon the bladder and generative organs. (5) To produce the general effects of a drug upon the system, particularly when it cannot be given by the mouth. This of course occurs only after its absorption through the mucous membrane, and may be exemplified by the effects of morphine or mercury. (6) To nourish patients when rectal feeding is called for.

Frederick T. Roberts.

SUPPRESSION.—The complete stoppage of a natural secretion or excretion, such as the urine; or of a normal discharge, as of the menses. The word is used in contradistinction to *retention*, which signifies that these fluids merely remain in the body unexpelled.

SUPPURATION.—The formation of pus. *See* Abscess; and Inflammation.

SUPRARENAL CAPSULES, Diseases of.—Synon.: Fr. *Maladies des Capsules Surrénales*; Ger. *Krankheiten der Nebennieren.*

Of the morbid conditions of the suprarenal bodies by far the most important is that connected with Addison's disease, which is described separately. *See* Addison's Disease.

Other morbid changes producing neither pigmentation nor asthenia, belong to two categories, namely (1) those beginning *within*, and (2) those originating *without*, the suprarenal bodies. Some of the latter may, however, give rise to the symptoms of true Addison's disease, as when the mischief seems to begin in caries of the spine, and ends in the characteristic suprarenal changes commonly associated with that malady. The bodies may be otherwise extensively diseased, and yet no special pigmentation and no special asthenia make their appearance. Thus there may be the usual *anomalies of development*, amounting even to what has been called total absence, but this probably depended on defective examination. Certainly the bodies may be *hypertrophied.* According to Stilling, if in animals one capsule be removed, the other one undergoes compensatory hypertrophy. Both the organs themselves and their coverings are liable to *inflammation*, especially if the structures connected with the kidney be likewise attacked, and the process spread from them. They may also be the seat of various forms of *degeneration.* Lardaceous degeneration occurs associated with similar degeneration of other organs; more or less fatty degeneration of the cells of the cortex is an almost constant change, as is also pigmentation of the inner layers of the cortex. With regard to *tubercle*, some authorities would have the anatomical change in Addison's disease to be of this nature. Miliary tubercles are sometimes found in cases of acute tuberculosis. *Cysts* sometimes occur, but the exact mode of their origin is not quite clear.

We are on surer ground when we speak of *hæmorrhage* and *malignant disease.* One case of what may fairly be described as *thrombosis* is reported by Klebs from Lücke's *clinique.* There can be no doubt about the not infrequent occurrence of hæmorrhage, however arising. Neither is there any question as to the existence of malignant disease. Cancer occurs both as a primary and secondary growth; the latter is the more frequent. Sarcomatous tumours have occasionally been met with, especially melanotic sarcoma. Adenomatous tumours also occur, formed of true gland-tissue, resembling that of the cortex. Syphilitic gummata have also been found, though very rarely. As a rule, all these changes give rise to no characteristic symptoms during life; and are either accidentally discovered after death, or by careful clinical search. The important point to bear in mind is that not one of them gives rise to the symptoms of Addison's disease.

Alexander Silver. W. Cayley.

SURGICAL KIDNEY.—Definition. This term, although open to many objections, may be conveniently employed to group together the various morbid conditions which arise in the kidney as the result of diseases of the lower urinary tract.

Pathology.—Diseases of the lower urinary tract react on the kidney in three ways: (*a*) by obstructing the passage of urine, and so causing abnormal tension throughout the whole urinary tract above the obstruction; (*b*) by causing repeated disturbances of the circulation in the kidney, through the medium of the nervous system; (*c*) by decomposition of the secretions spreading from without to the bladder, and extending to the pelvis and even into the tubules of the kidney, or by the invasion of the bladder by a pathogenic organism.

(*a*) Obstruction to the free passage of urine may occur in the ureters from congenital malformation; from impaction of a calculus; or from pressure of a tumour growing in the neighbourhood. It may occur at the vesical orifice of the ureter, from the thickening of the wall of the bladder in hypertrophy; from the thickening and induration of the submucous tissue, and the swelling of the mucous membrane in chronic cystitis; or from the growth of villous or cancerous tumours round the orifice. Obstruction of such a nature as to cause secondary renal affection also occurs in any disease in which the bladder is unable to empty itself, and is consequently in a permanent state of greater or less distension, as in hypertrophy of the prostate or atony of the bladder. Stricture of the urethra and stone in the bladder cause obstruction at the vesical orifices of the ureters, by the chronic cystitis to which they give rise. There is no reason to believe that the valvular orifices of the ureters ever become incompetent, so as to allow of regurgitation from the bladder to the pelvis of the kidney. The only force concerned in producing the remarkable degree of dilatation so often met with in the ureter and pelvis of the kidney is the force of secretion. The abnormal tension thus produced extends, therefore, equally from the point of obstruction to the closed extremities of the urinary tubules.

(*b*) Diseases or injuries causing irritation of the lower urinary tract, especially of the trigone of the bladder and the prostatic, membranous, and bulbous portions of the urethra, react on the kidney in a reflex manner, through the medium of the nervous system. The effect produced is a disturbance of the renal circulation, probably a temporary arterial contraction with anæmia, followed by dilatation with hyperæmia. Such disturbances tend to aggravate any inflammatory process which may be going on in the kidney as the result of other sources of irritation. If the kidney be already much diseased, the circulation may become completely arrested by choking of the vessels during the stage of hyperæmia, and total suppression of urine may result, terminating in some cases fatally. The evidence of this reflex disturbance of the renal circulation is derived from the following facts. (1) Many cases have been recorded of death from total suppression of urine occurring as a consequence of operations involving some mechanical irritation of the parts above mentioned. In such cases the kidney has always been found intensely congested. (2) It is a matter of common surgical experience that operations on the urinary organs frequently prove fatal by inducing acute inflammation of the kidneys. This is (as will be presently shown) often the result of the introduction of the micro-organisms into the bladder, followed by extension of decomposition to the kidney. But cases frequently occur in which the patient before the operation was suffering from cystitis, with putrid urine, and had been so suffering for some time; and in these it is evident that the final acute attack is the direct result of the irritation of the operative procedure. (3) By direct observation of the urine passed after such an operation as forcible dilatation of a stricture, evidence of a disturbance of the renal circulation may be obtained. In the most typical cases there is temporary suppression of urine, probably corresponding to a period of anæmia of the kidney, with contracted vessels. This may last from one to three hours. It is followed by a gradual increase in the quantity of urine, which now frequently becomes uniformly tinged with blood, the amount of blood often increasing for some hours, and then slowly diminishing. This blood cannot be supposed to flow at so late a period from a lacerated wound, such as is produced by forcible dilatation; it is uniformly mixed with the urine and free from clots. The presumption is, therefore, that it comes from the kidney. In most cases the period of suppression is too short to be noted, and in others an immediate increase in the flow of urine has been observed. The rigor which frequently occurs within a few hours of an operation on the lower urinary tract is, in many cases, doubtless due to this disturbance of the renal circulation.

(*c*) The final fatal inflammation of the kidney is, in most cases, due to extension of decomposition of the urine from the bladder, or to infection of the urinary tract by a pathogenic organism. Decomposition of the urine is a process of fermentation due to the presence of an organised ferment—a micro-organism. Microscopic examination of foul urine always shows that micro-organisms of various kinds are present. The most constant of these is the *bacterium* or *micrococcus ureæ*. In the urine it commonly occurs as a micrococcus, singly or in chains. It frequently forms irregular masses embedded in a hyaline gelatinous matrix or zooglœa. In cultivations, it grows at first in the form of short rods, which subsequently break up into chains of cocci. This organism is supposed to be the special ferment causing ammoniacal fermentation of urine. It is not pathogenic, but the products it gives rise to in its growth are extremely irritating. Many other varieties of microscopic fungi are commonly found in decomposing urine. Short bacteria, showing active movements, are very common; bacilli containing spores may be met with, and more rarely spirilla. Owing to the mixture of these various organisms in the urine, their accurate study by cultivation is very difficult. There is no reason to believe that the majority have any pathogenic properties, the mischief they do being solely by means of the chemical products of their growth. On the other hand, it seems equally probable that these pathogenic organisms may invade the bladder, and spread thence by the lymphatics to the kidneys; or, by entering the blood-stream, may cause general infection. It is not uncommon, in fatal urinary cases, to find a patch of varying size in the bladder covered with a membrane closely resembling that of diphtheria. Microscopic examination shows that this membrane is composed of a coagulated exudation containing cells, apparently leucocytes, and multitudes of micrococci. The tissues of the bladder-wall beneath this membrane are infiltrated with leucocytes, and micrococci are abundantly present in the lymph-spaces. It has been shown by Dr. Lindsay Steven that a spreading lymphatic inflammation may start from such a point of infection and reach the ureter or kidney. He has demonstrated that the lymphatics beneath the capsule of the kidney and in the superficial part of the cortex can be injected from those of the ureter, and that these again are continuous with those of the bladder. He has also demonstrated, in a case of fatal cystitis, the presence of the micro-organisms in the lymphatics of the bladder, ureter, and kidney. An organism which thus widely invades the lymph-spaces is evidently pathogenic. In its mode of invasion and spreading it closely resembles the micrococcus of erysipelas. It was long ago suggested by Dr. Goodhart that some cases of secondary nephritis might be erysipelatous in character; and he brought forward evidence to show that pyelo-nephritis occurred with greater frequency during epidemics of erysipelas than at other times. There is no doubt also that it is very common to find streptococci indistinguishable from those of erysipelas in foul urine. It is quite probable, therefore, that some cases of secondary nephritis may be due to the same virus as phlegmonous erysipelas. The septic and pathogenic organisms which are the immediate cause of these fatal complications of disease of the bladder may find their way into the urine in two ways. Entering by the alimentary canal or respiratory passages, they may be eliminated from the kidney; or they may enter directly by the urethra. The former mode of entrance is undoubtedly of rare occurrence. Watson Cheyne has shown that, after injecting large quantities of micrococci into the veins, they are found in the renal tubules and urine; but any condition analogous to this is extremely rare in the human subject. The ordinary staphylococci of suppuration have been found in the urine in ulcerative endocarditis with multiple abscesses throughout the body. On the other hand, very numerous observations have shown that in health and in disease the urine is, as a rule, free from organisms unless it be contaminated from without. Under normal conditions, the entrance of organisms by the urethra is prevented by the regular washing of the canal with healthy acid urine. It has, moreover, been shown by experiment that, unless there is previously some slight catarrhal inflammation of the bladder or urethra, it is difficult for the organisms to obtain a lodgment. The presence of mucus adhering to the passages, which is not washed away at each act of micturition, is almost an essential condition for infection of the bladder by the urethra. The development of the organisms is also favoured by an alkaline condition of the urine. In cases of catarrh of the bladder due to gout, stone, stricture, &c., it is very difficult to prevent decomposition of the urine, as the passages are always lined with a layer of mucus, and the organisms may thus find their way in without the introduction of any instrument. They are, perhaps, more frequently carried in by impure catheters or other instruments; and it must be remembered that the passage of an instrument sets up commonly in a urethra not accustomed to it a slight catarrh, which is favourable to the invasion of micro-organisms. The organisms having found their way in and established septic cystitis, the mischief commonly remains limited to the bladder, as the valved orifices of the ureter, which are never incompetent, prevent its further extension, in the great majority of cases, otherwise septic cystitis would be much more fatal than it is. Extension to the ureter seems most probably to be due to catarrh of the pelvis of the kidney and ureter, in consequence of which threads of mucus may come to lie with one end in the foul bladder and the other in the ureter; and by means of these the organisms may find their way into the upper urinary passages, and afterwards extend even into the substance of the kidney. In such cases we find, after death, ammoniacal urine in the pelvis of the kidney. Microscopic examination shows the presence of micrococci in the renal tubules. Whenever acute inflammation of the kidney with multiple abscesses is found, secondary to disease of the lower urinary tract, it is now practically proved that the process is due to the invasion of the organ by micro-organisms. From what has been said above, it will be seen that these organisms may reach the kidney by three paths—first, by direct extension from the bladder along the ureter (this is a simple septic process, and not truly infective); secondly, by the lymphatics (this is an infective process, resembling some forms of erysipelas); and, thirdly, by the blood-stream from a local centre of ulceration or suppuration in the bladder (this is pyæmic, and does not come within the scope of the present article).

ANATOMICAL CHARACTERS.—There are four forms of renal affection which may result from the foregoing sources of irritation.

I. *Chronic interstitial inflammation, followed by absorption of the medullary portion, and later on by stretching and thinning of the cortex, without pyelitis.*—This condition is the uncomplicated effect of obstruction to the free flow of urine, and of the consequent increased urinary pressure. It is most frequently met with in cases of pressure on the ureter from without. In diseases of the bladder and urethra it is almost always complicated by an acute attack of interstitial inflammation, which is the immediate cause of death, and which more or less conceals the appearances about to be described. In the early stage there is slight dilatation of the ureter and pelvis of the kidney. The kidney itself is increased in size; the capsule separates without difficulty, but may leave the surface somewhat wanting in its natural smoothness. The venous stars on the surface are often clearly marked, the cortical substance being of a pale pinkish white or sometimes yellowish colour. On section the cortex is found to be wider than natural; sometimes considerably so. The medullary portion is usually pale, like the cortex, but the large veins at the cortico-medullary junction are often distended with blood. The kidney-substance is tougher than natural. The Malpighian bodies can usually be clearly seen, sometimes as red dots. Microscopic examination shows an overgrowth of the interstitial connective tissue. Between the tubules, and especially around the Malpighian bodies, are crowds of small round cells. In consequence of this new-growth, the kidney is somewhat squeezed within its capsule, and as soon as the heart's action ceases the smaller vessels empty themselves. Hence the distended condition of the veins, and the anæmic appearance of the cortex. The epithelium shows no change. The next stage observed is commencing absorption of the medullary portion; the ureter, pelvis, and calices become still more distended; the papillæ are first flattened, and then the pyramids become hollowed out. This is a process of pure absorption, there being no ulceration. The cavity formed by the dilated calyx, and the hollow left by the disappearance of the pyramid, are lined by a continuous smooth layer of opaque white mucous membrane. In the final stages the cortex in its turn becomes thinned and stretched, until at last the whole kidney may be dilated into a large sac, one side of which is smooth, being formed by the thickened walls of the dilated pelvis, the other deeply sacculated, each sacculus corresponding to a lobe of the kidney. On this side the wall is formed of the thinned and stretched cortex, sometimes no thicker than a shilling, to which the capsule, now thickened and opaque, is firmly adherent. In the later stages the microscope shows the same abundant small-cell infiltration, with the development of a greater or less amount of fibroid tissue. The Malpighian bodies show marked changes. The capsules, instead of being delicate and membranous in structure, become greatly thickened, apparently by dense fibroid tissue formed round them in concentric layers. As this change progresses the vessels may become strangulated and finally obliterated; and the corpuscle then shrivels, and comes to be represented by a circular body almost homogeneous in the centre, but marked by a few curved lines indicating the situation of the obliterated vascular tufts. Round this centre is a concentrically laminated layer, formed by the thickened capsule. Even in the most advanced stages the epithelium of the convoluted tubules shows remarkably little change beyond being somewhat flattened.

If at any stage obstruction to the free flow of the urine be removed, the process ceases. The new tissue between the tubules undergoes development into dense fibroid tissue, the process being accompanied by great contraction. The kidney, from being increased in size, may thus become much smaller than natural, excessively tough and puckered, and irregular in form. If the distension have reached the most extreme stage before the primary disease is relieved, the kidney may come to be represented merely by a small nodule of dense fibroid tissue.

II. *Acute diffuse interstitial nephritis without suppuration.*—In this variety both kidneys are usually affected. The kidney is increased in size, and the surrounding fat is sometimes œdematous and adherent to the capsule. When removed, the capsule separates without difficulty, but often leaves the surface coarse; it is somewhat opaque, and often marked with ramifying vessels. The surface is usually of a pale, yellowish-white colour, often mottled with dark red, or in some cases the red may greatly predominate. The mottling often corresponds to the bases of the lobules of the gland, some of which are paler than others, in consequence of the more advanced condition of the interstitial inflammation. On section, the cortex presents the same colour and mottled appearance as the surface, and is evidently swollen. The pyramids may be pale, but are often dark red, contrasting strongly with the paler cortex. The Malpighian bodies are usually clearly visible, and may show on the cut surface as red dots. The consistence of the kidney-substance is unnaturally soft, unless previous to the acute attack it has been indurated by the chronic process first described. The pelvis may be merely dilated, its mucous membrane opaque, and its contents free from decomposition, but more commonly it is marked by ramifying vessels, and presents evidence of chronic congestion, in the form of pigmentation, thickening, and induration. In other cases it is intensely injected, and sometimes covered with a membranous exudation mixed with phosphatic deposit. In these cases the urine and mucus it contains are in a state of decomposition. In consequence of the pallor of the kidney sometimes met with as a result of the emptying of the vessels after death, this form of kidney may, without the microscope, be confounded with the large white or the fatty kidney.

On microscopic examination the following conditions are found. Between the tubules is a very abundant accumulation of small round cells. These are especially abundant round the Malpighian corpuscles. So far it is merely an intensification of the condition described as resulting from increased urinary pressure. The change is not uniform; every field of the microscope varies. In one part the renal structure may appear almost normal, and close by the new cells may be heaped up to such an extent as nearly to conceal the tubules. In the pyramidal portion a similar condition is met with. The renal epithelium throughout is slightly more cloudy than natural, and somewhat swollen, but the nuclei of the cells are readily to be seen in sections prepared in the ordinary way. The adhesion of the epithelium to the membrana propria is somewhat lessened, so that unless considerable care be taken it will wash out in preparing the specimen. Fibrinous casts may be seen here and there in the tubules; and occasionally small round cells, resembling those outside the tubule, may be seen within it. Signs of previous chronic change are often met with, such as dilatation of some of the straight tubules, and obliteration of some of the Malpighian corpuscles.

III. *Acute interstitial nephritis with scattered points of suppuration.—Suppuration of the kidney*, *Suppurative nephritis*, *or, when accompanied by pyelitis*, *Pyelo-nephritis* (*Rayer*); *Uroseptic kidney* (*Dickinson*); *Parasitic kidney* (*Klebs*).—This form of surgical kidney is by far the most common. It is the usual cause of death in fatal cases of disease of the bladder or urethra, in which putrefaction of the contents of the bladder has occurred. It thus comes to be one of the most common fatal complications in cases of injury or disease of the spinal cord, with paralysis of the bladder. It has been frequently stated that it is invariably associated with putrid urine in the pelvis of the kidney, and septic pyelitis; but cases are undoubtedly occasionally met with in which the condition is well-marked, and yet the pelvis is free from inflammation, and its contents are healthy. The naked-eye appearances of acute suppurative nephritis are the following: The surrounding fat may be œdematous and unnaturally adherent to the capsule. The whole kidney is considerably swollen, and its substance soft. The capsule is opaque and thickened, and marked by fine ramiform injection. It separates easily, but tears the kidney-substance in so doing. As it peels off, yellowish-white spots, surrounded by a red zone, come into view. Some of these are minute drops of pus escaping from the small abscesses as the capsule is stripped off, others are on the point of breaking down into pus, but are still solid. These abscesses are grouped together in areas corresponding to the bases of the lobes of the kidney. If the veins can be recognised, the abscesses will often be seen to correspond to the points at which the interfascicular veins appear on the surface. On section, the cortex is seen to present much the same appearance as in the last form of kidney, but in addition yellowish streaks are seen passing from the points of suppuration deeply into the cortex, and often into the medullary portion. These streaks correspond to the course of the interfascicular vessels. They differ from embolic infarcts in their great length compared to their breadth. The pelvis is usually in a condition of most intense inflammation, and the mucous membrane is often covered with a layer of exudation mixed with phosphates. Its contents, composed of urine, blood, and mucus in a state of decomposition, are excessively foul. Cases, however, do occur in which a similar condition of suppuration in the kidney is met with without pyelitis. In these it is probable that the pyogenic irritant has reached the kidney by means of the lymphatics.

Occasionally the kidney is found to be surrounded by a large abscess, arising from a perforation of the pelvis. More frequently one of the superficial abscesses in the cortex bursts beneath the capsule, and gives rise to a large collection of pus separating the capsule from the kidney.

The microscope shows the small-celled infiltration between the tubules in a still more intense form than in the varieties before described. In the areas of suppuration the kidney-substance has entirely disappeared, and its place is occupied by leucocytes packed closely together. In the central parts of these accumulations of small round cells the intercellular substance has softened, and the formation of pus has taken place. The amount of general interstitial change varies considerably; sometimes between the areas of suppuration the kidney-substance is almost healthy, in other cases there is a very marked general interstitial inflammation. The epithelium appears to take no part in the formation of the new cells. It is cloudy and swollen, but undergoes no proliferation. In the straight tubules it is often found to have been thrown off. Wherever suppuration is taking place micrococci can be demonstrated, and for this reason Klebs, who was the first to observe this fact, suggested the name of 'parasitic nephritis' for this condition. They are found chiefly in the tubules. In those cases in which decomposing urine is present in the pelvis of the kidney, many of the straight tubules are found completely plugged with dense masses of these organisms, and a similar condition may be found even in the convoluted tubes of the cortex. The micrococci are also found in the lymph-spaces between the tubules in the pale streaks reaching from the medulla to the cortex. In pyæmia, colonies of micrococci are very commonly to be seen plugging the looping vessels of the glomeruli, and occasionally some may have found their way into the tubules; but in the form of suppuration of the kidney that we are now considering the organisms are not found in the blood-vessels. The various ways in which the organisms may reach the kidney have been already described. That the diffuse inflammation and suppuration in pyelonephritis are due to the invasion of the kidney by these micro-organisms, and to the irritation caused by the chemical products of their growth, is now universally accepted as true.

The lines of inflammation, as before stated, follow the course of the interfascicular veins, and the lymphatics also follow the same direction. In the pyramidal portion thrombosis of the small veins is occasionally met with, but this is probably merely secondary.

If such an acute condition as is above described be set up in a kidney already altered in form by dilatation from increased urinary pressure, the appearances will, of course correspondingly differ.

IV. *The cicatricial kidney.*—This is the result of recovery from one of the preceding conditions, probably only from one or both of the first two, as, if the disease reach the stage of suppuration, the patient is hardly likely to survive. The kidney is shrunken, irregular in form, and marked by deep cicatrices. The substance is excessively tough, and the capsule firmly adherent. Small cysts may be scattered through its substance, which are supposed to result from strangulation of the tubules. The microscope shows a great excess of dense fibroid intertubular substance, and numerous obliterated glomeruli are met with.

The varieties of kidney here described may be combined in various ways. Thus a dilated kidney may suffer from acute diffuse interstitial inflammation, with or without suppuration; or a cicatricial kidney may, from a return of the primary disease, again suffer from an acute attack. It seems probable that increased urinary pressure, combined with considerable reflex irritation, is quite sufficient to give rise to a degree of interstitial nephritis which is incompatible with life; but suppuration only takes place when the kidney is invaded bý septic or pathogenic organisms. The extension of decomposition of urine from the bladder to the pelvis of the kidney is alone a sufficient cause for disseminated suppuration of the kidney; but both the extension of decomposition, and its more serious consequences, are greatly predisposed to by the effect produced on the kidney by the first two causes of irritation; in fact, it is comparatively rare to meet with cases in which septic suppuration occurs in a kidney previously perfectly healthy.

Symptoms.—Simple chronic interstitial inflammation, with dilatation of the kidney from increased urinary pressure, gives rise to but few symptoms, and is very difficult to recognise. The most important signs are, that the quantity of urine secreted is increased, and its specific gravity lowered. To avoid error, the whole urine passed in twenty-four hours should be collected, and the specific gravity taken. Single observations are open to numerous fallacies. There may be a trace of albumen, or it may be entirely absent. In one very marked case discovered after death at University College Hospital, the urine had a specific gravity of 1·009, and was free from albumen. A few hyaline casts may be present, but they are by no means constant. The exact state of the urine is often concealed by the mucus, blood, and pus from the lower urinary tract. It is surprising how much urine is secreted by a kidney which is reduced to a mere sac, with no pyramids and a cortex no thicker than a shilling. In a case that came under the observation of the writer, there had been no diminution in the secretion, and the specific gravity was 1·008. In some cases the distended kidney may be recognised by palpation, but this is not common. There are, in fact, no definite symptoms, either subjective or objective, accompanying this form of renal disease. It is not accompanied by hypertrophy of the heart, nor by marked increase of the arterial tension.

Subacute interstitial nephritis gives rise to more marked symptoms. It runs an irregular course, often lasting for weeks or even months, and terminating either in recovery, or in a final acute attack with suppuration. If the disease arise as the direct result of some operation on the lower urinary tract, its commencement is usually marked by a rigor; in other cases it comes on more gradually, with frequent chills but no actual rigor. The temperature is high at night, reaching 101° to 102° F., but it falls towards morning, so that if it be only taken at that time, the elevation may be completely overlooked. The patient becomes weak and languid, and emaciates rapidly. He loses appetite, and there may be nausea or occasional vomiting. There may be diarrhœa, but this is by no means constant. The mouth becomes clammy, and the tongue foul, with a tendency to dryness. In severe cases the tongue becomes dry and brown, and sordes form on the teeth and lips. The skin is usually moist and clammy, and there is not the dryness so frequently met with in other forms of renal disease. There is no œdema. In some cases the swollen kidney may be felt by palpation in the loin, and tenderness may be elicited on deep pressure, but this is by no means constant. The patient may complain of pain in the lumbar region, but this symptom is of little value, as it is often absent, and may arise from many other causes than renal disease. The pulse presents nothing characteristic. The patient frequently sinks into a drowsy state, somewhat resembling the effect of an overdose of opium; but true coma is rarely, if ever, present, and convulsions never occur. The urine is passed in fair quantity, often in excess of the normal amount. The amount of albumen is never very great, but it is usually difficult to estimate accurately how much is renal, and how much is derived from blood or pus from the lower urinary tract. Microscopic examination may show hyaline casts, or occasionally pus-casts; renal epithelium is also frequently met with; but all microscopic examination is rendered difficult by the presence of mucus and pus from the lower urinary tract. If the primary disease be either removed or relieved by treatment, the symptoms gradually subside; if not, they remain without much change till the patient gradually dies exhausted, or an acute attack, rapidly leading to suppuration of the kidney, puts an end to the case.

Acute interstitial nephritis with suppuration most frequently forms the fatal termination of the variety of disease just described, but it may occur without any previous symptoms. The invasion is marked by a severe rigor, often occurring within a few hours of some operation on the lower urinary tract. The rigor is accompanied by great elevation of temperature, and followed by profuse perspiration, during which the temperature falls, perhaps below normal; but it soon rises again, and remains slightly raised, with evening exacerbations. The rigor may be repeated during the progress of the case at irregular intervals. The general symptoms resemble in every respect those just described as indicative of subacute interstitial nephritis, but they are increased in intensity. The strength rapidly fails, there is great emaciation, the pulse becomes feeble, and the tongue 'like a piece of broiled ham.' There may be occasional vomiting and diarrhœa. As the fatal termination approaches, the temperature falls often considerably below normal, the skin becomes cold and clammy, and the patient sinks into a drowsy condition, seldom deepening into actual coma. Although the patient is often said to be dying of 'uræmia,' there are none of the uræmic symptoms observed in acute Bright's disease. There are no convulsions or actual coma, and no œdema. The urine is usually so foul as to defy accurate examination, either chemically or by the microscope. It is secreted in fair quantity to the end of the case. Pus and blood are always found in it, but it is impossible to say whether they come from the kidney or from the lower urinary tract. Renal epithelium and pus-casts are occasionally met with.

It will be seen from the above description that the symptoms closely resemble those of septicæmia, and it is very probable that blood-poisoning, from absorption of the putrid matter in the pelvis of the kidney and lower urinary tract, is, in fact, an important factor in the disease.

Suppression of urine following operations on the lower urinary tract is a well-recognised, but fortunately rare cause of death. In such cases the kidney is always found to be intensely gorged with blood, and the microscope reveals the signs of previous chronic interstitial inflammation.

Urethral fever is a name given to the febrile disturbance, accompanied by a rigor, which so often follows operations on the lower urinary tract. It is impossible to discuss here the innumerable theories which have been put forward from time to time to explain its origin and nature. It is most probable that it is due to a passing congestion of the kidney arising as a reflex phenomenon, as described in the earlier part of this article. *See* Urethral Fever.

Diagnosis.—As before stated, the diagnosis of the more chronic secondary renal conditions is frequently impossible. A careful observation of the case for a few days will usually suffice to determine the presence of subacute consecutive renal inflammation. The acute form with suppuration may resemble *pyæmia*. From this it may be distinguished by the absence of secondary inflammations in the joints, subcutaneous tissue, and lungs; by the lower temperature, falling towards death; and by the early and excessive dryness of the tongue. Pains 'all over the body' are often complained of in pyæmia, while in suppurative nephritis the patient is usually free from pain, except such as may arise from the local disease. With the greatest care in observation, however, the diagnosis may remain doubtful till death. From *septicæmia* it often cannot be distinguished, for doubtless blood-poisoning from absorption of the putrid matter in the kidney is an important element of the disease in many cases.

Prognosis.—This depends, in the chronic or subacute form, entirely upon the possibility of removing or relieving the primary disease. After suppuration has commenced in the kidney, it is very doubtful if recovery ever takes place. If decomposition has extended from the bladder to the pelvis of the kidney, the patient's chance of recovery is much reduced. It is sometimes possible to ascertain this in the following way: Wash out the bladder carefully with diluted Condy's fluid until the solution as it comes out of the bladder retains its purple colour. Then leave the catheter in for a few minutes, and examine the first drops that flow from it. If these are clear and acid, it is evident that the decomposition is still limited to the bladder.

Treatment.—The most essential element of the treatment is to remove the cause if possible, but the act of doing so is seldom unaccompanied by the danger of increasing the disease, involving, as it often does, severe operations upon the urinary organs, as lithotomy, lithotrity, or internal or external urethrotomy. These operations would of course, if possible, be avoided if the renal symptoms were at all marked. The fatal termination being in almost all cases associated with putrefaction of the urine in the bladder, and extension of the putrefactive process to the pelvis of the kidney, it is needless to point out that our best hope of preventing consecutive renal inflammation lies in the prevention of decomposition in the bladder, by scrupulous attention to cleanliness in the instruments used. This cannot be too much insisted upon in the management of cases of paralysis of the bladder from injury or disease of the spinal cord. Actual cleanliness can only be obtained by the use of antiseptics. For this purpose all catheters should be washed in some powerful antiseptic lotion, and when used should be greased with carbolic oil (1 to 10) or some other antiseptic preparation. Perhaps the best preparation is that recommended by Mr. Lund, composed of carbolic acid 1 part, castor oil 4 parts, olive oil 12 parts. If decomposition should occur in the bladder, antiseptic lotions must be injected, in order, if possible, to restore the healthy condition before extension has taken place to the kidneys. The best solutions for this purpose are 3 grains of sulphate of quinine, 3 minims of diluted sulphuric acid, water up to a fluid ounce, 1 fluid drachm of Condy's fluid to 10 fluid ounces of water; and boracic acid or thymol solution (saturated). Carbolic acid is rather too irritating, as also is chloride of zinc. After washing out the bladder, two or three drachms of an emulsion of iodoform in gum water, 20 grains to the fluid ounce, may be injected and left in. This is especially useful when the urine is very foul.

If the symptoms of subacute interstitial nephritis are present, the patient will frequently derive much benefit from a pure milk diet. At the same time small doses of opium seem to promote the action of the skin, and so to relieve the kidney without producing the dangerous effects so much to be feared in Bright's disease. The action of the skin may at the same time be still further promoted by vapour baths. The bowels should be kept freely open. Counter-irritation, either by dry-cupping or mustard poultices over the loins, followed by hot fomentations, is frequently of use. If the urine is foul, it may be greatly improved by the administration of benzoate of ammonium or benzoic acid in ten-grain doses every six hours. When the symptoms of the acute form are well-marked, operations to relieve the cause only hasten the fatal event. By careful nursing, and the treatment above described, the symptoms may be so far reduced in intensity as to render an operation for the removal of the cause justifiable.

Marcus Beck.

SWEAT-GLANDS, Diseases of.—*See* Sudoriparous Glands, Diseases of.

SWEATING, Disorders of. — *See* Sudoriparous Glands, Diseases of.

SWELLING.—Synon.: Fr. *Gonflement*; *Tuméfaction*; Ger. *Schwellung.*—This term, when employed in medicine, is applied both to the process and to the condition of increase in volume of any part of the body. In a small number of instances swelling is a normal process, and may be periodical; for example, the swelling of the mammæ at puberty, during menstruation, and in pregnancy; of the uterus during gestation; and of the penis during erection. As a rule, however, swelling is a morbid process or condition, and many examples of it are afforded by disease. These may be broadly classified as—(1) *Local* or *circumscribed*; and (2) *General* or *diffused* swelling.

1. *Circumscribed.*—The most important varieties of this kind of swelling are: (1) Simple *hypertrophy*, as of the thyroid gland in some forms of goitre; (2) Swelling due to *disorders of the circulation or inflammation*, as in mechanical congestion of the liver, and in ordinary abscess; (3) *Œdema*, and certain other rarer exudations into the connective tissues; (4) *Extravasations* of blood, urine, gas, and other products; (5) *Dilatation* or *distension* of natural cavities or vessels, as of the serous sacs and joints by effusions of any kind, of the stomach and bowels by gas, of an artery in aneurysm, and of the jugular veins in tricuspid disease; (6) *Disturbed relations* of parts, as in dislocation of the joints, and in hernia; (7) *Retention* and *accumulation* of natural secretions and excretions, as of urine in the bladder, and fæces in the bowels; and (8) *New-growths* or tumours proper, including cysts and parasites. Inflammatory enlargements and new-growths constitute by far the most common causes of local swelling.

2. *Diffused.*—Infiltrations of the subcutaneous connective tissue constitute the principal varieties of swelling that fall under this head. Such are anasarca, myxœdema, general emphysema, and the much more uncommon cases of general swelling of the body which result from the stings of certain plants and animals, and the use of poisonous food.

'*Cloudy swelling*' is a term applied in morbid histology to a condition of the cell, in which it appears at once enlarged and finely granular, as in parenchymatous degeneration or inflammation (*see* DEGENERATION). '*White swelling*' (*tumor albus*) is a popular name for scrofulous disease of a joint, usually of the knee.

The *treatment* of swelling depends entirely upon its cause. J. MITCHELL BRUCE.

SWINE-POX.—A form, possibly, of modified small-pox, in which the pock completes its development imperfectly. It forms a pustule, but the pustule neither umbilicates nor maturates. Willan termed this kind of pock *varicella globularis*; whilst popularly it has also been called 'hives.' *See* CHICKEN-POX; and SMALL-POX.

SYCOSIS. — SYNON.: *Acne Mentagra*; Fr. *Sycose*; Ger. *Bartfinne.*

DEFINITION.—A form of folliculitis confined to the hairy parts of the face.

SYMPTOMS.—Sycosis is a somewhat rare disease. It usually begins on the chin or upper lip, where it is apt to occupy the central part; it is, however, by no means limited to these regions. A similar form of follicular inflammation may attack the whiskers, eyebrows, and eyelashes. In an early stage the eruption consists of acneiform papules or tubercles, which sooner or later develop into pustules with a hair passing through the centre of each. As the number of these increases, the skin assumes a swollen and thickened appearance. In acute cases the infiltration and thickening are considerable, in more chronic forms but slight. In most instances the hairs are not very easily extracted, unless the free suppuration extends deep down into the follicle. In cases of long standing the inflammation leads to a complete destruction of the sac, and the formation of scars and permanently bald spots.

DIAGNOSIS.—In the diagnosis of this disease, the following points should be especially remembered. (1) It is confined to adult males. (2) It generally attacks in the first instance the upper lip or chin, but occasionally the region of the whisker. (3) It is strictly confined to the hairy parts. (4) The papules, tubercles, or pustules each have a hair running through them. (5) It is usually a very chronic affection, spreading slowly and lasting for months or years. (6) The inflammation is attended with pain and burning sensations, but with little or no itching. (7) Ultimately the disease, if not cured, leads to permanently bald patches of scar-like tissue; this, however, is prevented by steady epilation.

Sycosis may be easily confounded with impetigo of the chin, especially when the latter is confined to the hairy parts. Impetigo has, however, a much more rapid development than sycosis, and the discharge and crusts are much more abundant. Moreover, the disease is not usually limited to the hairy parts, which is always the case with sycosis. Another disease for which sycosis may be mistaken is tinea tonsurans of the beard. The chief points of distinction are that tinea generally begins with a circinate patch, and spreads much more rapidly than does sycosis. Subsequently, when suppuration is free, the differential diagnosis is more difficult. The hairs, however, in tinea come out more easily, and present some of the characters of tinea tonsurans of the scalp, and their microscopic examination will readily determine the presence of the fungus.

TREATMENT.—There is only one way of curing chronic sycosis with any certainty, and that is by steady epilation. The best plan is first to remove all crusts with oil and poultices. This softens the skin and renders epilation less painful. The hair of the part affected should be cut rather short with a pair of scissors, and then, wherever a yellow point is seen, the hair passing through its centre should be pulled out with a pair of depilatory forceps. These hairs usually come out with their sheaths attached. When this has been done over a limited area, dilute citrine ointment should be applied. At first, epilation should be confined to extracting those hairs only which pass through pustules; afterwards, however, the parts affected should be completely denuded of hairs by the extraction of a small number every day. This process is attended with considerable pain, and the patience and perseverance of the patient are severely taxed. The young hairs which appear some time after epilation should be also removed, and the process continued until the skin is healthy; after each removal, mild citrine ointment may be applied. Perseverance in this plan of treatment invariably cures the disease; whereas, if left to itself, it leads in the end to the total destruction of the hair, and the formation of permanent cicatrices. The process of cure, however, is extremely tedious. ROBERT LIVEING.

SYMMETRY, in Relation to Disease.—Certain diseases and degenerations manifest themselves in changes of structure which are arranged symmetrically in correspondence with the symmetrical construction of the body. They appear most frequently in bilateral symmetry, in corresponding parts of the right and left sides. More rarely they appear, not only in this bilateral symmetry, but in an arrangement accordant with the homologies of parts in their relations to the longitudinal vertebral axis of the body, as the soles and palms, the knees and elbows.

The most marked symmetry is found in the group of senile degenerations; as in thinning of the hair and baldness, in wasting and wrinkling, and the arcus senilis. It is scarcely less complete in the less simply degenerative changes of atheromatous arteries, and the wasting and increasing fattiness of senile bones. In atheromatous arteries, also, the homologous symmetry, as well as the bilateral, is often seen; the changes in the radial corresponding with those in the peroneal, and those in the ulnar with those in the anterior tibial.

Among symmetrical diseases, the best examples are seen in chronic rheumatic arthritis or osteo-arthritis, rickets, psoriasis, ichthyosis, pityriasis, neurotic pigmentations, the eruptions of secondary syphilis, and those produced by iodide of potassium and some other medicines or poisons.

Chronic rheumatic arthritis shows the best instances of symmetrical changes coincident in many different structures; for instance, in the fibrous degeneration and wasting of cartilage, the thickening and fringed growths of synovial membrane, the nodular formations on the bones. In psoriasis, whether syphilitic or not, there are often good examples of the coincident homologous and bilateral symmetries.

Instances of symmetrical diseases less marked or less constant than these are seen in the deformities of gouty hands and feet, in the thickenings and contractions of palmar fasciæ, in scrofulous lymphatics of the neck or groin, in scrofulous hands and feet, in many cases of eczema, in symmetrical gangrene, and in cartilaginous tumours of the hands and feet.

Significance.—The chief interest of the study of symmetrical degenerations and diseases is in their illustration of some principles of pathology.

The symmetry of senile degeneration is an indication and result of the exact and perfectly maintained uniformity of bilateral changes occurring in the natural life of each symmetrical body. As the two lateral halves, from the embryo state onwards to the state of fullest vigour, pass through changes which are, in each half, progressive at the same rate and in the same method, so that (speaking generally) the two halves are always alike in size, structure, and composition, so is it in decay or degeneration. From beginning to end of normal life the two lateral halves keep time in their similar and equal changes: the changes which are symmetrical are as exactly synchronous. Thus, the senile or timely degenerations of structures are in accordance with the laws of healthy life; and their uniformity is the more notable because they indicate, as do some symmetrical diseases, that the two lateral halves of the body are more alike in method of life and probably in composition than they are in size and shape. Exact similarity in shape and size in the two lateral halves of any organised body is, indeed, hardly to be found. Leaves are never mathematically symmetrical. The corresponding limbs are very often unequal in length and circumference. The difference in the lower limbs is often sufficient to give an appearance of spinal curvature. And in faces exact symmetry is very rare: one eyebrow is commonly higher than the other; the septum of the nose is rarely median; the mouth often not horizontal, especially in emotional movements; or one half of the lower jaw is less nearly rectangular than the other, and that side of the face is the smaller or the more oblique. Yet, in parts unlike in shape or size degeneration may appear in perfect symmetry. It is in the exact similarity of composition and method of life, thus shown to exist in corresponding parts of the two halves of the body, that we find the explanation of most of the symmetrical diseases.

In the list of those diseases which has been given, and which includes the best examples of the group, some may, perhaps, be regarded as instances of 'monstrosity by excess,' deviating very widely from the normal type. Such may be the irregularly symmetrical cartilaginous tumours of the hands and feet. The rest may very probably be ascribed to alterations in the blood or in the nervous force, or in both.

Among the conditions necessary to the normal state and life of each part are the due relations between it and the nutritive materials supplied to it in the blood. In symmetrical and exactly similar parts these relations are exactly the same; and as the healthy blood equally supplied to any two symmetrical parts enables them to maintain their similarity in health, so an unhealthy blood may produce in them an equal similarity in disease. It may often be impossible to find what is really the morbid condition of the blood in symmetrical disease; but the existence of such a condition is nearly proved in the eruptions produced by iodide of potassium, in many cases of urticaria, in lead-poisoning, and in cases of gouty and syphilitic eruptions.

Similar considerations may show that symmetrical disease is due to an altered state of the nervous force. A certain healthy state of this force is a necessary condition of the healthy maintenance of every part; and as the cerebro-spinal nervous system and the ganglionic nerves associated with it are arranged in a bilateral symmetry, so it may justly be held that, as a rule, the nervous force is in all symmetrical parts present in exact likeness. A general disturbance of the nervous force, or any central disturbance transmitted along symmetrically arranged nerve-fibres, would, therefore, generate symmetrical disease; and this, whether we believe that there are special trophic nerves and nerve-centres, or that the trophic nervous influence is exercised through some special condition of the vaso-motor or other nerve-fibres. In either, or in any case, as a healthy nerve-force in the parts is a necessary condition of their healthy symmetry, so may or must a morbid nerve force produce a symmetrical disease.

The instances of such diseases in which the disturbance of nervous force is most clear are the symmetrical gangrenes of fingers, preceded by intense neuralgia, and the neurotic pigment-marks of the face and forehead. It is not yet possible to tell whether the disturbance is of vaso-motor or of trophic influence, or whether (unless in a few instances) it is of central origin, or reflected from some previously existing peripheral disease, or is due to some affection of peripheral nerves. But the facts of symmetrical diseases are among the chief of those proving the influence of the nervous system in the production and method of organic disease; and they are mutually illustrative with those of unilateral diseases, such as herpes zoster, whose distribution accords with that of certain nerves, whose disturbance is further indicated by neuralgia.

There thus appear to be among the symmetrical diseases some which may be ascribed to morbid states of blood, and some due to morbid states of nerve-force. But it is probable that in yet more, if not in all, both blood and nerve-force are at fault, the latter chiefly determining the localities, the former chiefly the method and obvious characters, of each disease. The phenomena of many of the diseases may be thus explained better than by referring them to only one disturbing force. There are, indeed, few diseases in which the respective shares taken by blood and by nerve-force in morbid processes can be better studied; few, from the study of which we may more justly hope to attain the means of reconciling the often antagonistic doctrines of a humoral and a neural pathology.

James Paget.

SYMPATHETIC (σύν with; and πάθος, suffering).—This term implies that a part or organ suffers in sympathy with some other part or organ which is diseased. Many disorders which seem, and are popularly supposed, to arise in this way can be traced to obvious pathological causes. Thus, a morbid process may extend directly along blood-vessels, lymphatics, or other tissues; a morbific agent may be conveyed by the blood or lymph from one part to another; or a secondary lesion may be produced by direct nervous influence. There are other cases, however, in which the connexion is not so evident; but it is quite intelligible that organs which are physiologically related may be sympathetically disturbed in pathological conditions. The sympathetic disturbance may be indicated by pain or other subjective sensations; by functional derangements, as of secretions or actions; or by positive organic lesions. The occurrence of such phenomena in corresponding parts on both sides of the body, when a disease has commenced on one side, is sometimes very curious, especially as regards organic lesions. As illustrative of the associations in which the word 'sympathetic' is employed may be mentioned *sympathetic pain*, *sympathetic headache*, *sympathetic cough*, *sympathetic vomiting*, *sympathetic bubo*.

Frederick T. Roberts.

SYMPATHETIC SYSTEM, Disorders of.—Synon.: Fr. *Maladies du Nerf Sympathique*; Ger. *Krankheiten der Nervus Sympathicus.*

Introduction.—This subject can only be treated in a brief and tentative manner, owing to the fact that a wide basis of positive knowledge does not exist. The physiology of the different departments of the sympathetic system of nerves is now only beginning to shape itself, whilst on the side of pathology and morbid anatomy there is even still less of definite knowledge. Thus it happens that for the most part only conjectures, often very insecurely based, are current, or can be said to exist, in regard to the dependence of definite sets of symptoms, or distinct diseases, upon disordered actions or morbid changes occurring in one or other part of the sympathetic system of nerves. These problems are now, however, receiving the attention of many workers, so that before long it is to be expected that our knowledge on this important subject will have become both more extensive and more definite. The present article will, therefore, be confined to some general remarks concerning the anatomical relations and the functions of the sympathetic system of nerves; to the modes in which disorders of its several parts may arise; and to little more than a mere mention of the various morbid conditions which may be principally or in part occasioned by defective or otherwise abnormal activity of one or other department of this great system of nerves. We shall thus be enabled to indicate some of the best-established facts or relations in this direction which have already acquired a clinical importance, and also to indicate the directions in which further advances are to be looked for.

Whilst the sympathetic system of nerves, with its double ganglionated cord and great ganglionic plexuses, is to a certain extent an independent nervous system, its roots, nevertheless, penetrate deeply into the cerebro-spinal axis. The two nervous systems are connected, on each side of the spinal column, by means of double sets of filaments, passing between each of the sympathetic ganglia and the respective anterior spinal nerves with which they correspond, as well as with most of the nerves attached to the medulla oblongata. The fibres in all these filaments of communication are partly afferent and partly efferent. Thus, just as ingoing or centripetal impressions, instead of being reflected from some of the sympathetic ganglia, may pass on to spinal and medullary centres, so may motor or inhibitory impressions pass outwards from these cerebrospinal centres, so as to modify the subordinate motor or secretory influences, emanating from some one or other of the sympathetic ganglia themselves.

From the ganglionated cord on each side of the spinal column, numerous internal branches are given off, which unite with one another, with those of the opposite side, and often with filaments of the pneumogastric nerves, so as to form great plexuses with or without well-marked ganglia, with which the various glandular organs and hollow viscera of the body are in connexion by means of afferent and efferent fibres. Along the course of these visceral nerves many smaller ganglia, constituting subordinate centres, are to be found.

The sympathetic nerves are conducted to and come from the viscera, principally upon and along the course of the blood-vessels.

Some of the nerve-fibres on the visceral blood-vessels, and a much larger proportion of those on vessels going to other parts of the body, belong to a special set of the sympathetic fibres, which, from the nature of their functions, are known as *vaso-motor* nerves. Some of these fibres must have 'afferent' functions for the conveyance of impressions to vaso-motor centres; while others of them will transmit 'efferent' impulses; the two sets together serving to regulate the calibre of the blood-vessels, and consequently the amount of blood flowing through the different vascular territories. These vaso-motor nerves are connected with small ganglia distributed along the length of the blood-vessels, from which, in response to afferent impressions, motor stimuli may issue to such vessels and their branches. Such peripheral ganglia are, however, in subordinate relation with spinal vaso-motor centres, situated along the whole length of the cord, and these in their turn are dominated by a still higher regulating centre, situated in the medulla oblongata (near the lower extremity of the fourth ventricle), which appears to be in relation with all the vaso-motor nerves throughout the body. Modern observations would seem to show that there is another vaso-motor centre in the cerebral cortex, but its exact situation and the nature of its relations with the medullary centre are as yet uncertain.

Dr. Gaskell has shown (*Journ. of Physiol.*, vol. vii.) that all the vaso-motor nerves of the body leave the spinal cord in the anterior roots of the spinal nerves from the second dorsal to the second lumbar inclusive, passing thence into the lateral ganglia of the sympathetic, where these vaso-motor fibres lose their medullary sheaths.

Other fibres of the sympathetic system are intermixed on the vessels with those having a vaso-motor function. These others vary in function and in numerical proportion, according to the nature of the organ to which the vessels are proceeding. Thus to and from the liver, the pancreas, the salivary glands, and other allied organs, would proceed nerve-fibres regulating the secretory and other vital actions taking place in the tissue-elements of the several organs; also from and to such organs there would proceed afferent and efferent fibres for rousing and regulating the activity of the contractile tissues in their respective gland-ducts. Again, there would lie on intestinal arteries, in addition to vaso-motor fibres, many other sympathetic fibres for the innervation of the muscular layers of the intestine, and many also for the different glandular elements of its mucous membrane. Lastly, in such an organ as the bladder, vaso-motor nerves, and nerves for the supply of its own proper muscular tissues, would exist in abundance, while those in relation with glandular elements would be comparatively scarce.

If, therefore, we consider the functions of the sympathetic system of nerves as a whole, we find that it has to do with the degree of contraction of the pupil; with the calibre of the blood-vessels generally; with the activity of all the glandular organs; with the movements of all the hollow viscera, and gland-ducts; and possibly in some special manner with the nutrition of all the tissues. And inasmuch as the nerves pertaining to this system, if not both the nerves and ganglia, are to be found in all parts of the body, it is to be expected that its functions may be more or less locally deranged, or its structure more or less damaged, by almost every form of disease, be it local or general. Every local inflammation must be associated with a perverted activity and deranged structure of sympathetic nerve-fibres in the inflammatory focus; whilst every fever will entail widespread and varied perversions in the functions of this system of nerves throughout the body. Owing, however, to the fact of the intimate structural relations existing between the sympathetic and the cerebro-spinal nervous system (*see* NERVOUS SYSTEM, Diseases of), it is more especially in diseases of the spinal cord and of the brain that we are accustomed to meet with definite sets of signs and symptoms referable to disordered or arrested action of portions of the sympathetic system. In the present article, therefore, the disorders of the sympathetic system will be very briefly considered as they occur: (1) in association with diseases of the spinal cord and brain; and (2) independently of affections of the cerebro-spinal nervous system.

1. Diseases of the Sympathetic System in connexion with the Cerebrospinal System.

(*a*) *The Spinal Cord.*—Lesions of the *cervical* region of the spinal cord may be associated with extreme contraction or extreme dilatation of the pupil on one or both sides; with increased heat and redness, or the reverse, of the head and neck; with perverted respiration; with perverted action of the heart; and possibly with an exalted febrile heat of the whole body (*see* SPINAL CORD, Diseases of, § 7, (*b*), (1–4). Though we regard these phenomena as signs of disease in this particular portion of the spinal cord, it is none the less true that such phenomena are due to altered activities in those root-portions of the sympathetic system of nerves which take origin in, or traverse, this region of the cord. This is shown by the fact that similar sets of symptoms are produced by injuries, tumours, or other morbid processes implicating the cervical sympathetic itself.

It will be well to cite here the phenomena commonly associated with *irritation* or *paralysis* of the cervical sympathetic nerve, on account of their importance as diagnostic indications.

The signs dependent upon *irritation* of the cervical sympathetic in its *oculo-pupillary* fibres are—dilatation of the corresponding pupil with sluggish action, widening of the palpebral fissure, prominence of the eyeball, feeling of tension in the eye (as in glaucoma), and a scanty secretion of tears and mucus; whilst in its *vaso-motor* fibres they are—lowering of temperature of the side of the face and head, diminution of sensibility, an absence of perspiration, with (if the irritation continue) a tendency to slight atrophy of the side of the face. The signs of *paralysis* of the cervical sympathetic in its two sets of fibres are the direct opposites of those just cited, so that it is not necessary to enumerate them. Of these signs, those dependent upon irritation or paralysis of the oculo-pupillary fibres are usually much more constant and durable than those which depend upon irritation or paralysis of the vaso-motor fibres. These latter signs are, for reasons at present unknown, often transitory and fitful. Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ*. It has been definitely determined that injury in the lower cervical region of the cord, and as far down as the level of the *second dorsal* nerve, may give rise to the oculo-pupillary signs of one or other kind; and, on the other hand, that damage to the cord in these same parts, or as low down as the *fourth dorsal* nerve, may give rise to the above-mentioned vaso-motor signs.

When the *dorsal* and *lumbar* regions of the spinal cord are the seats of disease, other groups of phenomena will doubtless, after a time, be more fully recognised as results of irritation or paralysis of those roots of the sympathetic system which have their origin in or which traverse these particular regions of the spinal cord. It is therefore important to bear in mind the place of origin and the distribution of the different internal branches from the lateral sympathetic cords, which proceed from these regions to the different glandular organs or hollow viscera. Diarrhœa, sickness, obstinate constipation, sexual defects, and bladder-troubles, are among the symptoms which have such an origin, as well as undue heat or unnatural coldness of the lower extremities.

The recent researches of Dr. Head (*Brain*, part lxi., 1893) lead him to believe that sensory nerves are received from the viscera and enter the spinal cord over areas very similar to those from which, as Gaskell has shown, motor and inhibitory fibres issue. His conclusions are as follows: 'The sensory fibres enter the central nervous system in three great groups. The highest of these is in the head and neck; the middle group lies between the first dorsal and the first lumbar segments of the spinal cord; the lowest group extends from the fifth lumbar to the fourth sacral segments. . . . Thus there are two gaps in the spinal cord which are not in connexion with sensory fibres from the viscera. The higher of these consists of the fifth, sixth, seventh, and eighth cervical segments, whilst the lower corresponds to the second, third, and fourth lumbar segments.'

He has found, and Dr. J. Mackenzie has arrived at very similar conclusions (*Med. Chron.*, Aug. 1892), that in association with disease of different viscera there are for each certain definite sites of pain, and that these are situated in this or that segmental skin-field, throughout which in certain cases of visceral disease marked tenderness or *hyperalgesia* is to be found. In this way they have been enabled to connect the nerve-supply to different viscera with definite spinal nerve roots.

(*b*) *The Brain.*—In different portions of the brain some of the signs and symptoms of disease are also referable to direct or indirect interference with the functions of the sympathetic system of nerves; but they constitute (apart from vaso-motor derangements, which are very common and often well-marked) far less distinctive aggregates, owing to the fact that the sympathetic system of nerves has a much less extensive relation with the brain than with the spinal cord. In this direction, however, and in connexion especially with diseases of the medulla oblongata, we have to bear in mind the occasional occurrence of diabetes, polyuria, or albuminuria; also of some cardiac and respiratory derangements.

2. Diseases of the Sympathetic System proper.—Where disease exists in the ganglia of the sympathetic system itself, or where it involves them, we get groups of symptoms more clearly referable to disordered activity of this system of nerves alone.

These will differ in particular cases, according to the nature of the morbid change, that is, according as it is destructive or merely irritative; and according to the number or particular combinations of ganglia and fibres affected. The ganglia and related plexuses may either be implicated by *intrinsic* morbid processes, or may be variously involved *from without* by morbid processes having their origin in other adjacent tissues.

(*a*) *Intrinsic changes.*—The principal intrinsic morbid processes which have been hitherto recognised *post mortem* in some one or other of the sympathetic ganglia are: Pigmentary degeneration; cirrhotic overgrowth of their connective tissues, with or without secondary atrophy (the ganglia in such cases being either smaller or larger than natural); a highly congested and varicose state of their blood-vessels; effusion of blood into their substance; new-growths starting from their substance; and fatty degeneration, with more or less marked atrophy. It is unnecessary to repeat here the statements relating to the pathology of such changes, which have been made under Nervous System, Diseases of.

(*b*) *Extrinsic disease.*—Different parts of the sympathetic system may become involved in new-growths or in abscesses; or they may be simply pressed upon by aneurysmal or other tumours occurring in contiguous regions of the body.

Besides the pathological conditions already enumerated, it should be borne in mind that in altered blood-states, whether cachectic or of febrile origin, we commonly have, and especially in the latter class of cases, a greatly perverted activity of the sympathetic system throughout the body—as evidenced by the altered vascular conditions, increased tissue-metamorphosis and body-heat, together with the perverted activity of most of the glands in the body. *See* Fever.

But to what extent the actual structure of glandular or blood-making organs may be perverted by primary or secondary morbid changes in related portions of the sympathetic system, we have yet to learn. Waxy degeneration of the liver or spleen may, for instance, be a result of certain perversions of the normal life-processes taking place in the elements of these organs, primarily induced by changes in the quality of the blood, such as occur in many cachexias. But whether this altered blood acts directly upon the tissue-element, and brings about the structural change known as waxy degeneration; or whether cachectic states of the system entail upon the sympathetic centres a perverted nutrition, and a consequent perverted influence upon the tissue-elements of related organs, whereby they, being at the same time fed only by impoverished blood, lapse into those lower modes of vitality which result in the degenerative change above mentioned, are unsettled questions, well worthy of consideration. These remarks, with suitable modifications, are applicable, as regards the possible instrumentality of related portions of the sympathetic system, in causing other varieties of morbid change in other organs of the body.

The principal disorders other than those due to structural diseases of the cord and of the brain, in which derangements of the sympathetic system of nerves exist, or are believed to exist, and in which such derangements have either wholly or in part a causal relationship to the principal signs and symptoms of the respective disorders, are as follows: Epilepsy; convulsions; migraine (hemicrania); exophthalmic goître; unilateral hyperidrosis; progressive facial hemiatrophy; angina pectoris; asthma; diabetes mellitus; Addison's disease; gastralgia; enteralgia (colic); neuralgia cœliaca; neuralgia spermatica; and uterine neuralgia (see *Phys. and Pathol. of Sympath. Syst. of Nerves*, by Eulenberg and Guttmann, 1879; and Long Fox, *The Influence of the Sympathetic on Disease*, 1885). Among the affections more doubtfully or partially related to disorders of the sympathetic, we may mention glaucoma; neuro-retinitis; progressive muscular atrophy; pseudo-hypertrophic paralysis; locomotor ataxy; diphtheritic paralysis; and so-called 'reflex paralysis.' In the special articles on most of the first group of affections, the reader will find references to the dependence of such conditions upon disorders in one or other department of the sympathetic system.

H. Charlton Bastian.

SYMPTOM: SYMPTOMATOLOGY. — *See* Disease, Symptoms and Signs of.

SYNCOPE (*συγκοπή*, a faint).—Synon.: Fainting; Fr. *Syncope*; Ger. *Ohnmacht.*

Definition.—A state of suspended animation, due to sudden failure of the action of the heart.

Ætiology.—Syncope may be due to any condition which interferes with the action of the heart, whether acting (*a*) *intrinsically*; (*b*) through the *nervous system*; (*c*) through the *blood*; (*d*) through *more than one* of these channels.

(*a*) Syncope due to *intrinsic* cardiac conditions is chiefly seen in structural diseases of the heart, especially fatty degeneration. Amongst other examples of this class of causes may be mentioned compression of the heart by diseased conditions, or by tight articles of dress; excessive heat, whether natural or artificial, as in sunstroke and the warm-bath; lightning; and certain drugs and poisons, including chloroform and tobacco.

(*b*) The most common *nervous* causes of fainting are of an emotional kind, such as fear, grief, or joy, in nervous or hysterical women. Sudden injury of the central nervous system, as in concussion of the brain, has partly the same effect. In a larger number of instances the nervous causes of syncope act reflexly, and are to be found in conditions of the stomach or intestines (corrosive and irritant poisoning, indigestion, worms, scybala); in the liver, kidneys, or uterus (injuries, calculi, displacements); or in the limbs or body generally (painful injuries of any kind). Spasm of the arteries, due to reflex irritation of the vaso-motor nerves (cold and certain poisons), may also lead to syncope.

(*c*) Of the causes of syncope connected with the *blood* the most frequent is hæmorrhage. Chronic anæmia, as seen in idiopathic and pernicious cases, or accompanying chronic constitutional diseases, is a common cause of serious fainting.

(*d*) In a large number of instances, however, the causes of syncope are *complex*. Thus in fainting from hunger and exhaustion the heart is depressed directly, as well as through the nervous system, and through the blood; and in severe injuries, such as railway accidents, there may be a combination of depressing causes, including fear and grief, hæmorrhage, painful lesions, cerebral concussion, and shock. Fainting in a hot impure atmosphere appears to be due partly to the direct effect of heat upon the circulation; partly to the interference with respiration, and indirectly with the heart, produced by carbonic acid and other excrementitious products.

In a person subjected to any of the predisposing causes of syncope already mentioned, the occurrence of fainting may be determined by a very slight exciting cause. It is thus that in serious cardiac disease, in hysterical subjects, and in persons suffering from anæmia, the smallest excitement or exertion, unpleasant sights or smells, or exposure to an impure and heated atmosphere, may cause faintness, and in some instances even fatal syncope.

ANATOMICAL CHARACTERS.—In death by syncope the organs generally are found to be anæmic; and this condition is particularly marked if hæmorrhage have occurred. The state of the heart varies with the cause of its failure, the ventricles being either dilated and full of blood, or empty, as in cases of fatal hæmorrhage, and possibly contracted.

SYMPTOMS.—A syncopal attack presents three stages, namely: (1) *a period preceding loss of consciousness*; (2) *a condition characterised by insensibility*; and (3) *a period of recovery* from the fainting state.

(1) A person about to faint is observed to turn suddenly pale; he staggers, or leans against the nearest support; the eyes roll upwards, whilst the eyelids tremble or close; and consciousness and general sensibility are impaired. The pulse fails, generally becoming weak, small, and frequent; in other instances it is infrequent, irregular, or intermittent. The respiration is irregular and feeble. Vomiting may possibly occur.

At the same time the patient has a number of subjective sensations. The most urgent of these are a sense of 'sinking' in the epigastrium, a feeling of increasing debility, 'giddiness' in the head, and a tendency to fall. Vision becomes indistinct; the hearing is usually impaired—rarely more acute, or tinnitus is present. Mentally there is a rapid fading of sensory impressions and of consciousness; whilst in cases of fainting from loss of blood there may be restlessness, agitation, and delirium.

(2) The phenomena of the first stage are now complete. The muscles are relaxed; the patient falls; and consciousness is completely lost. The surface is pallid, and possibly cold and clammy; the eyes are closed, and the pupils dilated; the pulse and the cardiac impulse and sounds are nearly or quite imperceptible; respiration is indistinguishable, or occurs as occasional weak sighs; and the vital functions generally appear to have ceased. In cases of syncope due to severe hæmorrhage general convulsions may occur.

(3) Recovery from syncope is marked by signs of gradually returning consciousness, increase of the pulse at the wrist, and restoration of the functions generally. The first obvious signs of improvement are usually slight movements of the hands and features, and deep sighing. Thereupon the pulse becomes more distinct; the cardiac impulse and sounds are found to be stronger; the senses of sight and hearing can be excited; colour returns to the face and lips, and warmth to the extremities; and intelligence is gradually restored. Very shortly the patient may be able to resume the sitting posture; and the seizure is at an end.

DURATION AND TERMINATIONS. The duration of the several stages of syncope varies greatly, from a few seconds even to hours. In many instances the attack does not pass beyond the first stage; in rarer cases insensibility may last for an almost indefinite time. The most common termination is in recovery; but syncope is one of the ordinary modes of death, especially in hæmorrhage and organic disease of the heart. In nervous subjects partial recovery may be quickly followed by the return of the fainting state, the patient being said to 'pass out of one faint into another.' Where referable to organic disease or to hysteria, syncope may recur at intervals for many years.

PATHOLOGY.—Syncope consists essentially in sudden failure of the action of the heart, originating in any of the causes already mentioned, and leading to the condition of acute general anæmia. Whether from some affection of the heart itself, from sudden interference with the nervous impulses which regulate its action, from failure in the regularity of the supply of blood within its cavities and in its substance, or from a combination of such causes, the systolic contraction suddenly becomes short and feeble. If there has been no hæmorrhage, the result is distension of the cardiac cavities with blood, and further embarrassment; but if profuse hæmorrhage has occurred, the heart may be deprived of blood, and thus of the natural stimulus to contraction. In either case fatal cardiac paralysis may be the result, unless the contractile power be speedily restored.

The acute general anæmia that results specially affects the central nervous system. In the erect posture the circulation fails first within the cerebrum, producing rapid disturbance and then loss of consciousness, and depressing the centres that regulate the heart, vessels, respiration, and stomach. The general muscular paralysis which occurs at the same time is also partly of central origin. Similarly, the convulsions which may ensue in cases of hæmorrhage are probably referable to sudden circulatory disturbance within the basal ganglia and cord. The senses are further obscured by anæmia of their special organs; the heart is more depressed by failure of the coronary circulation; the paralysis of the muscles is increased by want of blood within them; and the temperature falls from failure of the circulation generally.

In non-fatal cases recovery naturally occurs by restoration of the cerebral circulation in the recumbent position, and consequent stimulation of the cardiac centre. Other circumstances favour the recovery of the general circulation, such as the relaxation of the arteries, and the partial restoration of the respiratory and other functions, which quickly re-act upon the heart.

Diagnosis.—Syncope has to be diagnosed from other conditions in which loss of consciousness is a prominent symptom; and chiefly from epilepsy, 'apoplexy' from any cause, concussion of the brain, shock, and poisoning of many kinds, including suffocation by certain gases, and drunkenness. From such of these conditions as commence in the brain, and from poisoning (unless the poisons act as cardiac depressants) syncope is distinguished by the characters of the pulse. Certain cases of hysterical 'faints,' which are strictly cerebral, not cardiac, in origin, are also readily diagnosed by the pulse, which is of good volume and force. The diagnosis of shock, which usually produces a degree of syncope, is described in the article on that subject. *See* Shock.

Prognosis. — The prognosis of syncope depends upon its cause, and upon the practicability of immediate treatment. If due to structural disease of the organs of circulation, or to serious injury, acute poisoning, excessive heat, or profuse hæmorrhage, the case may be serious, and prove fatal unless treatment be instantly applied. If, on the other hand, the cause of the faintness lie in an excitable nervous system, momentarily depressed by some passing emotional disturbance, or by impurity of the atmosphere, the attack may be pronounced free from danger, although liable to recur.

Treatment.—In the treatment of syncope two indications are equally urgent, namely, removal of the cause of faintness, and restoration of the action of the heart. If the patient should not have fallen, he must be immediately laid flat on his back; the atmosphere should be rendered as pure as possible, by throwing open the windows and doors, or by removal to the open air, and by preventing people from crowding around; and the dress should be loosened about the neck, chest, and abdomen. If hæmorrhage have occurred, means must be taken to stop it. Cardiac stimulants, direct or indirect, must then be employed. The most available and powerful of these is alcohol, in the form of brandy or other spirit; and this may be given either pure or in water, and in an amount which will vary with the individual case, as estimated by the immediate result. Sal volatile, ether, and eau-de-Cologne are equally valuable cardiac stimulants, if available. Should the patient be unable to swallow, these substances, as well as warm liquids, must be given at once as enemata; or ether may be injected under the skin. Carbonate of ammonium ('smelling salts') and other strong smelling compounds, including perfumes, fanning, cold douches, and refrigerant applications of eau-de-Cologne or other spirit to the temples and hand, are other ready methods of exciting the heart reflexly through the nervous centres. If these measures fail after a fair trial, the condition of the patient is very serious. The systematic employment of efficient means of resuscitation must then be had recourse to, including friction of the limbs and trunk, inversion, galvanisation of the region of the heart, and even transfusion of blood. *See* Resuscitation (A.).

In cases ending favourably the patient must be careful not to assume the erect position too hastily, or to undergo much exertion, until some rest have been obtained, or some stimulant or nourishment administered.

The occurrence of syncope is sometimes the first indication of the existence of serious organic disease of the heart or other organ; and it should suggest a careful examination of the patient, and the adoption of measures likely to prevent the return of such a dangerous symptom—that is, the avoidance, as far as they are avoidable, of the principal causes already mentioned.

J. Mitchell Bruce.

SYNOCHA.—*See* Synochus.

SYNOCHUS (συνέχω, I hold or keep together).—Synon.: *Febris Continens.*

Synocha and synochus are now obsolete terms, which were used for many centuries as epithets of two distinct types of fever, but in different senses at different periods. A complete history of their varying meanings would occupy much space; a few illustrations of it only need be given. *Synocha* does not occur in Galen's extant writings; and *synochus* is by him contrasted with πυρετός συνεχής, and defined to be a fever whose course is steady and uniform from its beginning to its end. Under it, in his *Method. Medend.*, lib. ix., cap. iii., he admits three varieties, namely, (1) when the temperature remains steady; (2) when it rises steadily; and (3) when it falls steadily, during the whole course of the fully established disease. The meaning of the term has no reference to the duration of the fever. πυρετός συνεχής, on the contrary, is a fever with paroxysms and remissions. Galen, *Definit. Med.*, 186–7.

In the second edition of Stephen Blanchard's *Lexicon*, A.D. 1717, from which the etymology given above is taken, synocha is a continued fever, of several days' duration, with paroxysms and remissions, attended by remarkable heat, and sometimes putrid. It may be either quotidian, tertian, or quartan. By this he seems to mean that exacerbations may take place on those days; but the fever is remittent, not intermittent. Synochus is a continuous fever (*febris continens*), often lasting several days, unattended by serious symptoms, and is either simple or putrid, according to its severity.

Linnæus in 1763, and De Sauvages in 1768, both define synocha to be a fever not lasting more than a week, synochus one not lasting more than two or three weeks.

Cullen, in 1785, dissatisfied, he says, with the previous use of the words, gives to them a special meaning of his own. In his nosology synocha is a fever with very high temperature; a frequent, strong, hard pulse; red urine; and very little disturbance of the sensorium. Synochus is a contagious disease, in which the fever combines the symptoms of synocha and of typhus; beginning as synocha, towards the end it becomes typhus.

With this variety of meaning, it is not surprising that the same disease is placed under 'synocha' by one author, under 'synochus' by another. As the further use of these terms, apart from their incongruity with modern systems of classification, can only perpetuate this confusion, they may be allowed to become obsolete.

James Andrew.

SYNOVIAL DISEASES. — *See* Joints, Diseases of.

SYPHILIS (etymology uncertain. Perhaps from σύν, with, or σῦς, a swine; and φιλέω, I love; or from σιφλός, crippled, maimed). Synon.: Vulg., Pox; Fr. *Vérole*; Ger. *Lustseuche.*

Definition. A specific general contagious disease; communicable by contact of its virus with a breach of surface, or by hereditary transmission. Syphilis is characterised by a period of incubation; and, in the acquired form, by certain changes at the seat of contagion, and in the proximate lymphatic glands. These are followed by an eruption on the skin and mucous membranes, and sometimes by lesions of the deeper tissues and viscera.

History. The origin of syphilis is unknown. In India and China there is little doubt that the disease existed centuries ago; but the time at which it first appeared in Europe has given rise to much discussion, and is still the subject of dispute. Some writers maintain that syphilis was introduced by the followers of Columbus from the West Indies, on their return from the discovery of Hayti in 1493. Others, again, hold that it first broke out among the French soldiers during the siege of Naples in 1494–5. There can be no doubt that syphilis of a very severe character was prevalent in Southern Europe towards the close of the fifteenth century, when indeed it seems to have been first clearly recognised and described; but it is also probable that the disease had existed even in Europe long before that time.

Ætiology.—The various phenomena of syphilis are caused by the absorption of an infective virus into the blood, and its diffusion throughout the body. It was formerly taught—a doctrine for which John Hunter was largely responsible—that syphilis, the soft chancre, and gonorrhœa were due to one virus. This was more or less generally accepted until 1838, when Ricord's researches confirmed the conclusions arrived at long before by Balfour (1767), and Benjamin Bell (1793), to the effect that gonorrhœa had nothing whatever to do with the other two disorders. The next step was completed in 1852, by the publication of Bassereau's evidence, based on the comparison of a large number of cases of venereal sore with their source of contagion. The results of these observations tended to show that the 'soft chancre' was a local affection, quite distinct from the general disease syphilis. This is the view most generally held at the present day, and those who hold it are now called *dualists.* A small number of authors, however, still maintain that syphilis and the soft sore are products of the same virus, and to such the term *unicist* is applied. The discussion of *unity* and *duality* does not come within the scope of this article. It will be sufficient to state that it is from the more generally accepted or *dualist* point of view that the present account is written. Consequently, when the term 'syphilis' is used, the constitutional disease is always to be understood. The local suppurating sore or soft chancre is described elsewhere. *See* VENEREAL SORE.

One attack of syphilis usually affords protection against a second throughout the lifetime of the individual, but in rare instances, as in other contagious diseases, the same person suffers more than once.

Besides being capable of contaminating others by inoculation, the subject of acquired syphilis is also liable, during a variable period, to transmit the disease to the offspring; but whether the inherited form of syphilis be further transmissible to the next generation remains doubtful.

It is probable that many persons, though exposed to contagion, escape syphilis as they escape other diseases, from want of susceptibility. The reason of such peculiarity is not yet understood.

PATHOLOGY AND ANATOMICAL CHARACTERS. The essential nature of the syphilitic poison is unknown. Certain micro-organisms have been reported from time to time as found exclusively in the blood or tissues of syphilitic persons; but evidence is still wanting to settle the question, one difficulty in the way being that syphilis seems not to be communicable to the lower animals. Syphilis resembles the exanthemata in having a period of incubation, in the development of a rash, and in the protection commonly afforded by one attack against subsequent contagion; but it differs from them in its long duration and liability to relapse, in not being infectious through the atmosphere, and in its capability of being greatly influenced by certain remedies.

When the syphilitic poison has been absorbed, it multiplies until the whole body becomes pervaded by it. How soon this absorption takes place is not known. Excision of the initial lesion has been extensively practised with the object of preventing further development of the disease; but the evidence at present available, from observation as well as from experiment, indicates that by the time the initial lesion appears the virus has already passed some distance at any rate beyond its boundaries.

The changes produced by syphilis have been well described by Dr. Gowers as depending partly on a process of inflammation, and partly on a process of tissue-formation. These two are generally combined in varying degree according to the lesion and according to the stage of the disease. The inflammatory element is most marked in the early eruptions of the skin and mucous membrane, and is also probably the chief factor in causing certain early functional disorders of the internal organs. The process of new-growth is most distinct in what is called *syphiloma* or *gumma*. The change begins by the production of a small-celled growth, which at first resembles granulation-tissue — hence named by Virchow *granuloma*, but which soon shows a marked tendency to vascular occlusion and consequent degeneration.

The new-growth may develop in a diffused infiltrating form, or in the circumscribed masses known as gummata. Any of the structures of the body may be attacked, most commonly, perhaps, the skin and subcutaneous connective tissue; but bone, muscle, the blood-vessels, and the viscera are all liable to suffer; and although the morbid growth is essentially the same wherever it is developed, it presents differences in appearance, as well as in behaviour, according to the tissue or organ affected, and the period at which it occurs.

A *gumma*, which is the most characteristic product of syphilis, in its typical form appears as a yellowish, tough, somewhat elastic, and sharply defined mass, which is often caseous in the middle. Gummata vary greatly in size, from a mere granule to a duck's egg, or even larger still. They may be single or multiple, and are frequently associated with the diffused form of growth, which after a time becomes converted into a tough fibrous tissue; this finally contracts, and thus puckers, deforms, and often seriously affects the functions of the organ in which it grows.

Besides the changes that have just been described, *albuminoid disease* is also caused by syphilis, especially in cases where long-standing suppuration has been present. *See* ALBUMINOID DISEASE.

CONTAGION.—Before considering the different ways in which syphilis may be propagated, it is necessary to mention the vehicles of the virus. These are—

1. The discharge of the initial lesion.

2. The secretions of all the secondary eruptive lesions, especially of those known as mucous patches or tubercles.

3. The blood, during the earlier stages of the disease.

The secretions of the later or tertiary affections have not been proved to be inoculable, nor have the physiological secretions of a syphilitic person—for example, the saliva, sweat, tears, milk—unless mixed with the secretions of syphilis or with the blood, even though the disease be in an early stage. The semen, however, though apparently not contagious in the ordinary way, seems to be capable of infecting the ovum during a period which probably varies considerably in different cases. Lastly, the secretions of other diseases from which a syphilitic person may be suffering are not always contagious. This at least is the case with regard to vaccinia; for healthy children have been often vaccinated from syphilitic ones without contracting syphilis.

Modes of Communication. — The sources of contagion being so numerous, it is easy to understand that the modes of communication must be so also. They may be described under three heads: (1) *direct contact*; (2) *mediate communication*; and (3) *hereditary transmission*.

1. *Direct contact.*—In the great majority of cases syphilis is imparted during sexual intercourse—first, because the genital organs are the most frequent seat of the contagious lesions; secondly, because the delicate epithelium of these organs is especially liable to abrasion during coitus. Hence syphilis is usually described as a venereal disease, but it should always be remembered that it is not necessarily so. Wherever the poison comes in contact with a broken surface, it may thence be absorbed, and general infection follow. Instances of syphilis being conveyed quite independently of sexual relations are unfortunately far from rare. Perhaps the most frequent mode of extra-genital contagion is the contamination of a nurse by a syphilitic child, or of a child by its nurse. The disease may also be spread by kissing, contagious syphilitic lesions being very common about the lips and in the mouth. Again, medical men and midwives not infrequently contract syphilis by attending diseased women in labour; and surgeons by examining or operating upon syphilitic persons.

2. *Mediate communication.*—When syphilis is communicated indirectly, the medium may be of almost endless variety. Articles which are used in common by different persons, such as spoons, drinking-vessels, pipes, &c., are perhaps the commonest media; implements used in various trades—the tubes used in glass-blowing, for example — have also acted in the same way. Again, through the performance of tattooing, cupping, catheterisation of the Eustachian tube, or other operations, by ignorant persons and quacks, the disease has been communicated. It has also happened during vaccination; but in this country, where that operation is performed only by duly qualified medical men, such an accident is of extreme rarity. The mode of communication in which the fœtus is believed to be the medium of contagion between husband and wife, is noticed under the next heading.

3. *Hereditary transmission.*—Our knowledge is still imperfect respecting the transmission of syphilis from parent to child; and the questions involved are much too wide for discussion in this article. Consequently, no attempt will be made to do more than state briefly the facts which are generally accepted, and the most usual course of events when syphilitic persons become parents.

In the first place, it must be remembered that a child born of syphilitic parents does not always show signs of the disease. When the infection of both parents is recent, however, the offspring almost invariably suffers, and this is also the case if the mother alone be diseased. Under such circumstances abortion or premature birth is common. When the father alone is syphilitic, and especially if his disease be not of recent date, both mother and child may escape. Some believe that a syphilitic father may procreate a diseased child while the mother escapes, but it appears most probable that the mother of a syphilitic child does not really escape contagion, although she may show no characteristic signs of the disease. The most weighty evidence in support of this view is that known as 'Colles's law'—namely, that the mother of a syphilitic child does not become infected by it after birth. In the cases where the mother does not show the earlier signs of acquired syphilis, it is believed that the ovum becomes diseased directly by the father, and in turn infects the mother during gestation (syphilis by conception, or '*choc en retour*'). If the mother acquire syphilis during the earlier months of pregnancy the child commonly suffers. If she be infected after the seventh month it is said that the child may escape, but further and more exact evidence on this point is required.

The duration of the transmissive power varies according to the influence of treatment and other circumstances; but the liability to transmit syphilis to the offspring seems to last longer than the ability to infect by inoculation. It is often stated that the children born nearest to the date of parental infection suffer most severely; but this is not always the case. A healthy child may be born while the mother is under the influence of mercury; but a subsequent one may be tainted, if treatment have been discontinued, and the disease have resumed activity. There are also periods of quiescence in syphilis independent of treatment, during which apparently healthy children are sometimes born.

Symptoms.—The symptoms of syphilis are usually divided into three groups—*primary*, *secondary*, and *tertiary*. And although such division is really artificial, it is useful to retain these terms for the purpose of description; but it must be borne in mind that in the great majority of cases tertiary symptoms do not occur at all; that they sometimes appear quite early in the disease; and that the signs proper to all three periods may be present at the same time.

1. **Primary Syphilis.**—A patient is said to be suffering from primary syphilis as long as the initial manifestation, and the accompanying glandular enlargement, remain the sole signs of the disease.

When the syphilitic poison, unmixed with any irritating matter, has been inoculated, the abrasion quickly heals, and no further change is observed for three weeks or a month. This interval is called the period of *incubation.* Its average length, judging from cases of experimental inoculation, is about twenty-four days; but it may perhaps be as short as ten, or as long as forty-six days, or even longer still. After this a small red spot appears at the site of inoculation, which is called the *initial manifestation* or *lesion.* Later, this may assume one of several forms, and is often termed a hard, or indurated, or infecting chancre. The initial lesion presents certain differences in appearance, according to its position, and according as it has or has not been irritated. Its chief characteristic is the presence of induration at its base; and the aspect of the sore is much affected by the degree in which this hardness is developed. Sometimes the lesion is observed as a hard desquamating papule; sometimes as a prominent ulcer, having a hard well-defined base and thickened adherent margins (the so-called *Hunterian chancre*); but most commonly as an erosion or shallow ulcer, with an amount of induration which varies much in different cases, and which is not always easily appreciable unless care be taken. Sometimes the induration develops in a thin layer, like a piece of parchment, or even paper; hence the term 'parchment sore' often applied to this form of the initial lesion. In rare instances, especially in women, induration appears to be absent altogether. The secretion is thin, scanty, non-purulent; and though not readily inoculable on the bearer, it has nevertheless been successfully inoculated in certain cases during the primary stage. The syphilitic primary sore is usually *single,* contrasting strongly in this respect with the local venereal sore, in which multiplicity is the rule. The sore is indolent and mostly painless, and tends to disappear spontaneously.

The *seat* of the initial lesion is most frequently the genital organs, but, as has already been stated, absorption of the poison may occur in any situation where a breach of surface exists. Consequently the initial lesion may be found on any part of the body, as about the lips or mouth in children, on the breast in nurses, or on the hand or finger in the case of doctors and midwives.

If, as frequently happens in practice, irritating matter of any kind have been inoculated as well as the syphilitic poison, the course of events will vary according to the nature of the irritant. For example, if the pus of the local chancre have also been absorbed, the incubation period of syphilis will be occupied by the course of the suppurating sore, which may or may not have healed at the time the change peculiar to syphilis occurs. If the sore be still present, induration will develop, and the lesion will for a time assume the characters of both kinds of sore; but if it have healed, the cicatrix will harden and eventually assume more or less closely the appearance of one or other of the forms of initial lesion which have just been mentioned.

The initial lesion in rare instances may disappear in a few days, but its duration usually varies from two or three weeks to several months, according to its size and the influence of treatment. It sometimes breaks out again after cicatrisation; and induration may reappear, even repeatedly, without fresh contagion. If the sore, from irritation of any kind, be made to suppurate, the secretion may become freely inoculable on the bearer. When the chancrous and syphilitic poisons have both been inoculated, the resulting lesion has been termed by Rollet a 'mixed chancre.'

Glandular enlargement. — On whatever part of the body the initial lesion may be situated, the nearest lymphatic gland or glands become perceptibly enlarged in from seven to fourteen days after its appearance. When the glands themselves are multiple, the whole group is usually affected; but the gland most directly connected with the point of contagion enlarges first, and often attains a greater size than the others. In the absence of inflammation of the surrounding parts, each gland can be felt as a separate distinct indolent swelling, usually about the size of a marble, the cellular tissue and skin remaining free. At this time the enlargement commonly remains limited to the nearest group, but later is sometimes general. When the genital region is the seat of the initial lesion the glands of both groins are in most cases enlarged, though often to an unequal extent. Suppuration of the glands probably never occurs unless there be some source of irritation in addition to the syphilitic poison; the abscess in such cases is of a simple nature, unless the local chancre be present as well, and absorption of chancrous pus take place (*see* BUBO). Besides the glands, the *lymphatic vessels* leading to them—those of the penis, for example—can sometimes be felt as hard cords, freely movable beneath the skin. These cords have been found in certain cases to contain thickened blood-vessels.

2. Secondary Syphilis.—After the development of the initial manifestation, with its accompanying adenopathy, another interval occurs before further signs appear. This is sometimes called the *second incubation,* to distinguish it from that which intervenes between contagion and the appearance of the initial lesion. This second period of quiescence, counting from the appearance of the initial lesion to the appearance of the general eruption, is usually about six weeks. Thus, as a general rule, it may be stated that, in the absence of specific treatment, the rash appears from sixty to seventy days after contagion; from forty to fifty after the initial lesion; and from thirty to forty after enlargement of the proximate lymphatic glands.

During the earlier part of this period the patient commonly does not feel ill; but towards its close, and shortly before the appearance of the eruption, some patients, especially women, if they be not already under the influence of mercury, develop certain symptoms of constitutional derangement which have received the name of *prodromata*. Thus the patient may become pale and anæmic, and may suffer from shortness of breath and lassitude. In addition, headache, loss of appetite, malaise, pains in the limbs and back, rise of temperature, and other symptoms known under the name of 'syphilitic fever,' may be present. During this period also, as was first pointed out by Ricord and Grassi, whose conclusions have since been confirmed by others, the proportion of red blood-corpuscles is diminished. The prodromata are usually mild in degree, but occasionally they are severe. Thus, headache may be agonising, and in rare instances the amount of constitutional disturbance is so great that the onset of one of the acute fevers may be suspected.

Cutaneous system.—At the end of this second interval of quiescence, then, and having been preceded or not by some of the symptoms just mentioned, the first eruption appears. This, in the vast majority of cases, takes the form of roseola, consisting of rosy red spots, varying in size from a hempseed to a shilling, fading on pressure at first, but afterwards becoming dull red or brownish, and finally disappearing altogether, sometimes with slight desquamation of the cuticle. The spots usually appear first about the flanks and abdomen. The face and hands generally escape. The extent and duration of roseola vary much in different persons. It may be limited to a few faint spots on the anterior surface of the trunk, or the whole body may be covered with the rash, in which case it often resembles that of measles. Roseola may appear suddenly and disappear quickly; or it may last for several weeks, and indeed occasionally for months, if untreated. It sometimes recurs, but in that case is usually, though not invariably, limited to a few blotches or rings on the forehead, trunk, or limbs.

As the macular eruption fades, papules not uncommonly appear, so that a maculo-papular eruption is often seen in early syphilis. The papules are raised, bright red at first, but later often assume the so-called 'coppery' hue, which, however, is much more like that of raw ham. Finally, the cuticle desquamates, leaving a silvery border or 'collarette' round the base of the papule. The papules are very liable to relapse, and to become scaly. When they fade, a brown stain is often left, which gradually disappears without leaving any scar. At this time also crusts are frequently present on the scalp among the hair, which itself becomes dry and withered, and at a later period often falls out, either generally or in patches. Syphilitic alopecia is in most cases limited to a temporary general thinning of the hair of the head, but all the hairy regions of the body may suffer. The nails also are liable to be attacked in several ways. *See* NAILS, Diseases of.

Though the macular and papular syphilides are by far the most frequent forms of early rash, vesicular, pustular, rupial, and ulcerating eruptions sometimes appear during the secondary stage, the last two being most common in patients of bad constitution.

The earlier eruptions are usually superficial, and widely spread. Except perhaps in the case of the earliest rash, the papule forms the base of the spots. Irritation and itching are usually absent. The eruption has certain favourite seats, namely, the anterior and lateral surface of the trunk, the flexor surface of the limbs, the border of the hairy scalp. Several forms of eruption are often present at the same time; most commonly maculæ and papules, but sometimes papules and vesicles or pustules. They all tend to disappear spontaneously, and, except the pustular form, without leaving any scar.

Pigmentary changes in the skin are common in syphilis. Temporary excess of pigment may follow any syphilide, and this again may be followed by its loss, so that sometimes yellow or brown stains are seen, and sometimes white spots. A much rarer change, which differs from those just mentioned in that it does not follow another lesion on the same site, is that known as the *pigmentary syphilide*. It consists of irregular brownish patches situated chiefly about the sides of the neck, and observed mostly in women. Opinions are divided as to whether this is an essentially syphilitic affection or not. It lasts a long time, and is but little affected by antisyphilitic remedies.

Mucous membrane.—Besides the affections of the skin, lesions of the mucous membrane, particularly that of the mouth and throat, are nearly always present during the secondary stage of syphilis. Erythema, excoriations, or shallow ulcers are very common about the fauces and tonsils, as well as on the buccal surface and tongue, during the early portion of this stage; and the nasal and laryngeal mucous membrane is also liable to be similarly affected. Equally common, though usually somewhat later, are mucous patches or tubercles — condylomata (*see* MUCOUS PATCH). They may occur on any moist surface, but are most frequently seen about the mouth, genital organs, and anus. The initial lesion also sometimes assumes the appearance of a mucous patch or tubercle.

These affections of the skin and mucous surfaces are often accompanied by more or less deterioration of the general health, with pallor, lassitude, and loss of weight. Aching in the muscles, bones, or joints (osteocopic pains), and sometimes periosteal swellings or synovial effusions, also occur, as well as more or less general enlargement of remote lymphatic glands, particularly those of the neck and beneath the jaw; but the axillary, epitrochlear, and indeed all the glands within reach, may be enlarged. Iritis is also liable to come on about this time, and, later, choroiditis. Sometimes, but more rarely, affections of the auditory apparatus are present. *See* EYE, AND ITS APPENDAGES, Diseases of; and EAR, Diseases of.

Enlargement of the epididymis, chiefly its head, is another, though rare, phenomenon in secondary syphilis. Temporary albuminuria and jaundice also sometimes occur during this stage.

The number, extent, and severity of the secondary manifestations vary greatly in different persons. In some cases roseola and slight redness and excoriation of the throat are the only signs that appear. In other instances roseola is succeeded by papular and scaly syphilides, and by obstinately recurring lesions of the mouth, throat, genital organs, or other parts of the body.

After the lapse of a period which varies usually from six to eighteen months, the secondary stage comes to an end, and in most cases the disease troubles the patient no longer. But supposing this not to be the case, there may be an interval of months or years during which no symptoms appear. Sometimes, however, symptoms continue to develop from time to time, which partake of the characters of both the secondary and tertiary stages, and which gradually merge into the latter without any strict line of demarcation between the two. Examples of these intermediate signs are thickened scaly patches on the skin, which often take a circular or serpiginous form, and sometimes ulcerate; obstinate eruptions of the soles and palms (the so-called plantar and palmar 'psoriasis'); ulcers and induration of the tongue; periosteal swellings; orchitis; and affections of the choroid and retina.

3. **Tertiary Syphilis.**—While the secondary stage of syphilis is mainly characterised by the occurrence of superficial lesions, more or less widely spread over the surface, and tending to spontaneous disappearance; the main features of tertiary affections, on the other hand, are that they usually attack only a limited area, that they have a tendency to extend and to cause destruction of tissue with consequent contraction and scarring, and that they do not tend to spontaneous recovery.

The lesions classed as tertiary are due to invasion of some part of the body by the granulomatous or gummy growth which has been already described. The tertiary period, also, is often attended by severe cachexia, with a peculiar pallor of the skin.

The syphilitic growth may assume a diffused or a circumscribed form; but in either case, unless checked by treatment, degeneration is usually rapid, leading to obstinate ulceration when the superficial structures are attacked, and to the production of tough contractile fibrous tissue when the viscera are the seat of the new formation. Of the internal organs those belonging to the nervous system are most frequently affected.

When the gummy growth attacks the skin or mucous membrane in a diffused form, it produces hard, flat plaques of varying extent. The skin after a time becomes purplish-red and adherent, and finally breaks down at several points; an ulcer is left, which sometimes creeps over the surface (serpiginous ulceration), healing in the middle and extending at the margins, until a considerable amount of tissue is destroyed. When this diffused infiltration occurs in the pharynx, air-passages, or rectum, the disease is very obstinate, unless actively treated at an early stage, and the subsequent contraction may produce incurable and fatal stricture in any of those situations.

When the circumscribed form develops in the skin itself, it is often called a *syphilitic tubercle.* Gummata in the cellular tissue, when discovered early, appear as small hard nodules, movable beneath the skin; but after a time they enlarge, soften, and become adherent to the discoloured integument, which finally gives way, exposing a mass of yellowish-white material, which is gradually cast off in the form of *débris*, and thin ill-formed pus. The cavity then heals by granulation, leaving a depressed scar.

Irritation or injury seems often to determine the appearance of both the earlier and later syphilitic lesions; for example, the effects of smoking and broken teeth in the case of the throat and tongue, and a blow or squeeze in the case of the bones and testes.

The syphilitic affections of the other tissues, and of the various organs of the body, will be found described along with the other diseases of the several parts under their proper headings. *See* BRAIN, Syphilitic Disease of; BONE, Diseases of; LIVER, Syphilitic Disease of; and TESTES, Diseases of.

Malignant Syphilis.—It has already been mentioned that the division of syphilis into a secondary and a tertiary stage is to a great extent artificial; indeed, it is sometimes impossible to say under which title certain lesions ought to be classed. There are again cases, fortunately not common, to which the term malignant or galloping syphilis has been applied, in which the disease from the first pursues a rapid, destructive, and sometimes uncontrollable course. Skin-eruptions, which partake of the secondary stage in their widespread character, and of the tertiary in their tendency to ulcerate—rupia, for example—appear early, even while the initial lesion is still present. Deep ulcers form also in the mucous membrane, and the gummy growth may develop in the internal organs, and cause death, or the patient may die worn out by exhaustion, or from some intercurrent inflammation.

Inherited Syphilis. Syphilis is a very frequent cause of *abortion*, especially if the parental infection be of recent date, or treatment have been neglected. If the child be carried the full term, it may be born dead, with or without signs of syphilis; most commonly, however, if the child be born alive, it does not show any signs of the disease at birth.

In inherited syphilis the initial manifestation is of course absent, and the disease appears to begin at the secondary stage. With this exception, the symptoms of the inherited are in their main features similar to those of the acquired disease, allowance being made for the difference between the actively growing tissues of the child and the fully developed organs of the adult. There are, however, two points that deserve notice. The first is the frequency with which the nasal mucous membrane is attacked, giving rise to one of the earliest and most characteristic symptoms, namely, snuffling. If the inflammation extend to the deeper structures, flattening or other deformity of the nose may follow. The second peculiarity is a tendency, much more marked in inherited than in acquired syphilis, to mingling of secondary and tertiary symptoms. Lesions of the bones and viscera, for instance, may occur, not only with the earlier skin eruptions, but even during intra-uterine life. These changes have been particularly described by Wegner, Parrot, R. W. Taylor, Barlow, Lees, and others. The bones most liable to be attacked are those of the cranial vault, and the long bones of the extremities. *See* BONE, Diseases of; and SKULL, Diseases of.

Supposing the child to have been born alive, it usually shows no evidence of disease for a period ranging between two and six weeks, rarely longer, after birth. It then, as a rule, gradually loses its healthy appearance, begins to snuffle, becomes fretful, and wastes rapidly. The child's skin assumes a dull dirty colour, and, though loose, dry, and wrinkled, is very brittle and easily breaks round the mouth and nose into chaps and fissures, the scars of which often form a characteristic sign in after-life, if the child survive. Macular, papular, vesicular, or pustular rashes, resembling those seen in the adult, also appear; and mucous patches are nearly always present, sooner or later, about the orifices of the body. Affections of the hair, the nails, the testes, and the viscera, similar to those of acquired syphilis, are also found in young children. Pemphigus is seen only in severe cases; it appears very early, and is frequently fatal. It is important to remember that the earlier lesions of inherited syphilis are just as contagious as those of the acquired form of the disease.

In later life, inherited syphilis may manifest itself by a number of symptoms which were formerly ascribed to scrofula. The forehead is prominent, and the bridge of the nose sunken. The growth is checked, the individual being stunted, weakly, ill-nourished, and of low vitality. The skin is soft and pallid, and perhaps ulcerated, or scarred by previous ulceration. The permanent teeth, especially the central upper incisors, as was first pointed out by Mr. Hutchinson, may be dwarfed, narrowed towards the cutting edge, and notched at the centre of the free border (*see* TEETH, Diseases of). The cornea is liable to a form of diffused inflammation (interstitial keratitis), leading to opacity and more or less impairment of vision; the iris and the deeper structures are also liable to be invaded; and deafness is sometimes present. These affections of the eye and ear are, according to Mr. Hutchinson, much more common in girls than in boys (*see* EYE, AND ITS APPENDAGES, Diseases of; and EAR, Diseases of). The bones of the palate and nose may be diseased; and nodes may appear in various situations; as well as a form of chronic synovitis, most frequently affecting the knee-joints. The fingers and toes also, and, more rarely, the metacarpal and metatarsal bones, may become enlarged. This form of dactylitis is most common in early life; but it has been observed after puberty, as well as in connexion with acquired syphilis. The soft palate and pharynx may be the seat of ulceration, which sometimes becomes phagedænic. The deeper tissues and the viscera are also liable to be attacked by processes similar to those which occur in the acquired disease, giving rise to a variety of symptoms, and sometimes leading to a fatal issue. Some authors (Mr. Hutchinson and M. Fournier, for example) believe that early life may be passed without symptoms, and that these later affections may constitute the first signs of inherited taint.

COURSE, DURATION, AND TERMINATIONS.—The course of syphilis varies very much, according to the individual, and according to the treatment adopted. In the majority of cases the disease runs its course within a year and a half or two years; but in certain rare cases it appears to end with the first eruption; sometimes, perhaps, even earlier than this. When tertiary symptoms ensue, the commonest period for their appearance is probably from three to five years after contagion; but they may be delayed for ten or twenty years, or even longer. On the other hand, as has been already stated, the secondary may run on into the tertiary stage without any appreciable interval. When tertiary symptoms have once appeared, the duration of the disease is uncertain, depending greatly on the habits and constitution of the patient, and on the effects of treatment. In some cases the patient continues to suffer throughout his life.

The usual termination of syphilis is in recovery, and this in many cases without treatment, if the patient suffer only from the more superficial forms of disease. In syphilitic disease of the viscera, unless it be recognised and treated, the termination is frequently fatal.

In *inherited syphilis*, if the child be born with signs of syphilis it usually dies; but when it remains healthy for some weeks after birth, the disease mostly ends in recovery within a year, provided proper treatment be carried out. In later childhood, however, or in adolescence, even up to the thirtieth year according to Mr. Hutchinson, further symptoms may develop; in which case the duration and termination will depend greatly upon their due recognition and appropriate treatment. When the disease is neglected, death is a frequent termination, especially among the ill-fed children of the poor.

Besides what, for want of knowledge, we call idiosyncrasy, the course and duration of syphilis are also influenced by many other circumstances—for example, climate, age, pregnancy, and the hygienic surroundings of the patient.

The greater or less severity of the disease, or the stage at which it may have arrived in the person from whom it is contracted, does not appear to have any appreciable influence on the course of acquired syphilis.

COMPLICATIONS.—*Phagedæna* is an occasional complication of the initial lesion, but more frequently of the later ulcerating syphilides. The *local chancre* is another complication, giving rise to what has been termed the 'mixed chancre.' *Erysipelas* sometimes attacks syphilitic patients, and is said to act beneficially in causing the disappearance of certain obstinate eruptions. This influence, however, is only seen in some chronic cases when the patient is otherwise in fair health. If erysipelas attack a cachectic person, with rapidly spreading lesions, the complication is a serious one, and may prove fatal. In *scrofulous* and *tuberculous* patients syphilis is often obstinate and severe. The skin-affections in such persons are prone to ulcerate, and syphilis seems in some cases to rouse the constitutional disease into activity. The *gouty* diathesis also influences the course of syphilis. The skin-eruptions often assume the scaly form, and resist treatment obstinately. *Bright's disease* is a serious complication. Patients whose kidneys are diseased are liable to suffer severely, both as regards the superficial tissues and the internal organs. *Alcoholism* is detrimental in two ways: first, by its injurious influence on the system generally; secondly, by preventing the proper action of specific remedies.

DIAGNOSIS.—In the diagnosis of syphilis much will depend on the stage at which the disease has arrived when the patient comes under observation. Before the incubation-period has come to an end the diagnosis will of course be impossible; but when the initial manifestation with its accompanying glandular enlargement has appeared, there is usually no difficulty, unless some local complication be present. The initial lesion is distinguished by its indurated base, the indolent superficial character of the ulceration when that is present, the thin serous discharge, and the indolent painless enlargement of the nearest group of lymphatic glands. The points of difference between the initial lesion of syphilis and the local chancre are considered elsewhere. *See* VENEREAL SORE.

The diagnosis of the early rashes does not, as a rule, present much difficulty, if the general characters already mentioned be attended to. In some cases, however, when pyrexia and general constitutional disturbance precede the outbreak of the eruption, the symptoms may be mistaken for those of some other disease. Syphilitic roseola has been mistaken for measles or scarlatina, and a vesicular syphilide for small-pox. The various forms of drug-eruption, especially that due to copaiba, should also be borne in mind. In doubtful cases, careful attention to the temperature, and the condition of the tongue, throat, and air-passages, together with the presence or absence of other signs of syphilis, will usually decide the question in a few days. The colour of a syphilide or scar, no matter how coppery it may be, is by itself of little value from a diagnostic point of view.

It is, however, at a later stage—perhaps many years after contagion, and long after the disappearance of outward signs of the disease—that the diagnosis presents most difficulty to the physician. For example, a patient comes with obscure symptoms, pointing to some lesion of the nervous system, lungs, liver, or other viscus. In such cases the skin and mucous membrane, particularly that of the mouth and throat, should be carefully inspected, and the bones and testes examined for irregularity or swelling. The eyes may afford important aid, by the detection of iritic adhesions or changes in the deeper structures. The presence of local paralyses, especially of the ocular muscles, is a valuable diagnostic sign. The absence of signs or characters distinctive of other diseases—cancer or tuberculosis, for example—is often also of value in doubtful cases.

When no conclusive information can be gained from any of these sources, the history becomes of the greatest importance. A venereal sore with lumps in the groins, and followed by a rash on the skin, sore throat or tongue, loss of hair, pains in the bones worse at night, and bad eyes, are some of the points that should be inquired into, and in women the occurrence of abortion or of still-birth.

In investigating the history of a supposed syphilitic person, it should be borne in mind that syphilis is not necessarily a venereal disease, and that consequently the initial lesion may have been far away from the genital organs; also that the early manifestations, particularly in women, may be so slight and so evanescent as to escape observation. Again, some may have forgotten that they have suffered from earlier signs; and others who do remember, obstinately conceal the fact. However this may be, the practitioner frequently fails to elicit any clear history of earlier manifestations in those who suffer from visceral syphilis. Sometimes also, for various reasons, the history cannot be inquired into. If neither the symptoms present at the time, nor inspection of the patient's body, nor the method of exclusion, nor the history of the case, separately or combined, suffice to render the diagnosis clear, specific remedies should be administered, and their effect awaited before an opinion is given. But it is well to be cautious in drawing conclusions from such evidence. The failure of specifics, in an affection of the nervous system for instance, does not prove that the case is not syphilitic, for they may not have been given early enough to check the disease. Again, improvement may occur under mercury or iodides in cases where there is no syphilis.

In the diagnosis of *inherited syphilis* at an early stage, snuffling and coryza, when well marked, are of much importance. Radiating cracks around the mouth and nostrils are also valuable signs. Besides the eruption on the skin, especially that of the buttocks and soles of the feet, mucous patches should be looked for about the mouth, anus, and genital organs. Pemphigus of the palms or soles is nearly always syphilitic, but it is rare. Enlargement of the spleen is a valuable corroborative sign. The bones of the skull and limbs should always be examined for osteophytes or epiphysial enlargement. It must be remembered also that, though pallor and wasting are common, a syphilitic child who suffers but slightly may retain a healthy appearance throughout.

In later childhood and adolescence the most valuable diagnostic signs are the low stature and puny development; the dull, pasty complexion; radiating scars about the mouth; the prominent forehead; the broad and sunken bridge of the nose; signs of present or past mischief in the cornea, iris, or choroid; the dwarfed and notched median upper incisors; deafness without otorrhœa; nodes on the bones; unhealthy ulceration, often closely resembling lupus, or its scars, especially of the face or throat. Here, again, if no conclusive signs be present, the history becomes most important, both of the patient himself and of his immediate relations, and here also the diagnosis has occasionally to be postponed until antisyphilitic remedies have been administered. Lastly, it is too often forgotten that syphilis in children is not necessarily inherited, but that it may have been acquired by suckling or in some other way.

Prognosis.—This, in the great majority of cases, is favourable, if the patient be otherwise in good health, of temperate habits, and especially if his disease be properly treated at an early period. The effect of other constitutional diseases has already been indicated among the complications of syphilis. Probably nothing tends more to prolong and aggravate the course of syphilis than habits of drinking. In persons given to alcohol, therefore, the prognosis should always be guarded.

An interesting question, and one on which further information is needed, is whether any trustworthy data as regards prognosis can be gained from the character of the early manifestations. Neither the length of incubation, nor the amount of induration or ulceration of the initial lesion, has been shown to afford any trustworthy evidence as regards prognosis. Early *general* glandular enlargement is often an unfavourable sign. Persons thus affected become anæmic, and consequently more liable to grave affections. As regards the early syphilides, it may be mentioned that the ordinary general macular and papular eruptions appear to be less common precursors of late visceral affections than early rashes that are ill-marked and scanty. Obstinate, frequently recurring lesions of the skin and mucous membrane also are rarely associated with visceral disease. In connexion with this may be mentioned the frequent failure of the physician to elicit any history of early symptoms in those who suffer at a later period from grave visceral affections, especially from syphilis of the nervous system.

In the cases of malignant or galloping syphilis, in which ulcerating and rapidly spreading lesions attack the skin and mucous membranes, and are associated with a tendency to phagedæna and great prostration at an early period after infection, the prognosis should be guarded; the patient may die worn out by the pain and profuse discharge of the superficial lesions, or of some acute affection. In syphilitic disease of any of the internal organs, the prognosis will depend greatly on its early recognition and treatment.

One of the most important points to be considered in prognosis is the way in which the patient has been treated. For, although we do not yet know any certain sign—save re-infection—which proves that syphilis has come to an end, it may with much confidence be stated that if mercurial treatment have been begun at an early period, and continued a sufficient length of time, and if the patient be constitutionally robust and of temperate habits, the chances are very greatly in favour of complete subsidence of the disease within two years after contagion.

Much of what has been said as to the prognosis of acquired syphilis applies also to the inherited form of the disease. A child in whom symptoms do not appear until several weeks after birth, who is well cared for, properly fed, and who receives proper medical treatment, will probably recover; one who is ill-fed and neglected will most probably die. Indeed, among the children of the poor, syphilis is one of the most fatal diseases of infantile life.

TREATMENT. — 1. **Preventive Treatment.**—At the present time there are unfortunately no State regulations to check the spreading of venereal diseases in this country.

Among individuals the strict daily observance of cleanliness, too often neglected by both sexes, constitutes the best protection against disease, and by preserving the epithelial surface in a sound and healthy condition would of itself, if generally practised, do much towards reducing the prevalence of syphilis.

There is no trustworthy evidence that syphilis can be cut short by removal or destruction of the initial lesion.

Every person who contracts syphilis should be warned of the danger of communicating it to others. Sexual intercourse should be prohibited while the disease remains active. This direction should never be omitted, as many patients are unaware that they are liable to communicate the disease after the initial manifestation has healed.

The contagious nature of the lesions of the mouth and throat should also be pointed out, and the consequent risk of contagion by kissing, or by the use of drinking-vessels, pipes, towels, or other articles in common with other persons.

The question of *marriage* in relation to syphilis is one of great importance, and it is the duty of the practitioner to prevent the contamination of a healthy person, or the procreation of syphilitic children, whenever it is in his power to do so. No person who shows signs of active syphilis should be permitted to marry, however long a time may have elapsed since contagion; for although communication of the disease is probably rare after two years have gone by, it may take place after ten years, or even longer in neglected cases. It has already been stated that syphilis usually ceases to be active within two years after contagion; but this is not always so. After the last symptoms have disappeared, there should be an interval of at least a year before marriage takes place; but the period between contagion and marriage should never be less than three years. If the treatment during the early stages have not been systematic and prolonged, it will often be advisable to subject the candidate for marriage to a course of mercury for about three months, and after this to keep him under observation for a year before the marriage takes place.

The spread of syphilis from children to nurses, and *vice versâ*, must also be guarded against, and the practitioner should never allow a syphilitic child to be entrusted to a healthy wet-nurse, nor a syphilitic woman to suckle a healthy child.

2. **Curative Treatment.** — The treatment of syphilis may be divided into (*a*) *general*; (*b*) *specific*; and (*c*) *local treatment.*

(*a*) *General treatment.*—Syphilis is essentially a debilitating disease; hence it is most important that the general health of the patient should be supported by nourishing diet, good air, warm clothing, extreme moderation as regards alcoholic liquors, cleanliness, cheerful society, and moderate exercise in the open air. In most cases the patient may follow his usual employment, unless it involve prolonged exposure to damp and cold. The skin should be stimulated to act freely, by the frequent use of soap and water, and an occasional vapour or Turkish bath if thought desirable. Some woollen material should be worn next the skin, and chills avoided as much as possible. Smoking in moderation may be allowed, as long as the mouth and throat remain free; but when syphilitic lesions are present, it should always be discontinued, and if they show a tendency to recur smoking should be abandoned altogether. Regular action of the bowels is also important.

(*b*) *Specific treatment.*—Besides attention to the general health of the patient on ordinary principles, the administration of certain drugs which are known to have specific influence over syphilis should never be omitted, however mild the earlier manifestations of the disease may be. For although syphilis tends in most cases to subside spontaneously, it does not do so in all; and in the present state of our knowledge we have no certain means of distinguishing at the onset the cases which will get well, from those in which tertiary symptoms will follow. There is also much evidence to show that, when proper and sufficient treatment has been carried out in the earlier period, the danger of later manifestations is very much less than in cases that have been untreated, or treated only by ordinary means. Again, in some of the gravest cases of visceral syphilis the history of early signs is defective, suggesting that they have been so slight as to have been overlooked, and consequently untreated.

The special drugs now almost exclusively used in the treatment of syphilis are *mercury*, and the various salts of *iodine*. Probably the former only can be looked on as a permanent remedy. The iodides are of great value in some of the earlier as well as in most of the later manifestations of syphilis; but the effects are not always lasting, and therefore they cannot be trusted to alone.

Much of the prejudice against the use of *mercury* has arisen from the fact that in former times its administration was carried to a poisonous extent. It is now known that salivation is hardly ever necessary, and that if the drug be properly administered in suitable doses, it acts as a tonic, syphilitic patients rapidly improving in health and gaining weight under its use.

As soon as induration at the site of contagion, and multiple indolent enlargement of the proximate lymphatic glands, make the diagnosis of syphilis certain, mercury should be given. For all the symptoms of the secondary stage, also, mercury is appropriate. And in the later stages it should be used in conjunction with iodides, as well as in cases where the iodides fail to relieve. Mercury may be given to almost all persons when its use is indicated, but its effect must be carefully watched if the patient be in feeble health, or the subject of disease of the kidneys.

Before a mercurial course is begun the mouth should, as far as possible, be put in a healthy condition. Unsound teeth should be stopped or removed, and tartar got rid of. If the gums are spongy, an alum mouth-wash should be used frequently. The patient should also be warned that fruit and green vegetables may cause diarrhœa during a course of mercury. Milk usually agrees well, and may be taken freely.

When mercury is taken in syphilis, the patient usually improves rapidly. If a rash be present it soon begins to fade, and ulcerated surfaces begin to heal. All the necessary results are usually attained without any, or with only the slightest, visible effect on the gums.

Mercury should be given for at least a year after contagion. During this period it will be necessary to omit the drug from time to time, and perhaps to vary its form; but what should be the length of each course, and what the length of the intervals, are questions that must be decided according to the symptoms that appear, and according to the effects of mercury in each case. After the first year no general rules can be laid down. As long as there are signs of syphilis treatment must of course be carried out; but the particular drug to be chosen, its dose, and the length of time it should be continued, ought to depend on what has been learned beforehand about the patient and his malady, as well as on the treatment he has already undergone.

Mercury may be introduced into the system in various ways—by the stomach, rectum, vagina, skin, or subcutaneous tissues; but its action is essentially the same by whatever channel it is administered.

In the majority of cases mercury may be most conveniently given by the mouth. In early syphilis blue pill usually fulfils all the requirements of the case; and the writer has found this more generally useful and less likely to disagree than grey powder. If no urgent symptoms be present, a grain of one or other of these preparations may be given, with a little extract of gentian, three or four times a day, immediately after meals. Quinine or reduced iron may be added, if thought desirable, but opium is usually unnecessary. In such small doses mercury rarely causes either stomatitis or purging, but the possibility of both should always be mentioned to the patient. If, however, a rapid effect be desired—in iritis, for example—2 or 3 grains of blue pill, with $\frac{1}{4}$ or $\frac{1}{3}$ grain of opium, may be given three or four times a day, the patient being kept indoors, until the requisite effect is produced, after which the drug should be given less frequently, or be reduced in quantity. If a mild degree of salivation be inadvertently set up, the mercury should be discontinued for a time, a purge administered, and the mouth washed out frequently with an alum or chlorate of potassium gargle. *See* MERCURY, Diseases Arising from; and SALIVATION.

The green iodide of mercury is an active salt, which is largely used on the Continent, especially in France, but it is more liable to decomposition and to cause irritation than the forms just mentioned. It may be given in doses of $\frac{1}{4}$ to 1 grain, with a little opium, twice or thrice a day.

The perchloride of mercury is mostly given in the later and more chronic forms of syphilis, but in the early stages it is sometimes better borne than almost any other preparation. It may be prescribed in doses of $\frac{1}{16}$ to $\frac{1}{8}$ grain, either in a mixture with iodide of potassium or with perchloride of iron, or in a pill, according to circumstances. The red iodide is also useful, especially in cases of relapsing scaly syphilides.

When other preparations purge or otherwise disagree, the tannate of mercury in 1 or $1\frac{1}{2}$ grain doses sometimes answers well.

A mixture of sarsaparilla and aromatics with antimony or mercury, known as *Zittmann's decoction*, is sometimes useful in tertiary syphilis.

Inunction is very effective, but it is troublesome to the patient; hence he often neglects to carry it out properly. It may be employed whenever mercury is indicated, 20 to 60 grains of mercurial ointment being rubbed in every night, or every other night, as required. *See* INUNCTION.

The *mercurial vapour-bath* is beneficial in certain cases, especially those of widespread rash. *See* FUMIGATION.

Subcutaneous or rather *intra-muscular injection* is probably the quickest way of obtaining the effects of mercury, but it is more or less painful, and not altogether free from risk; hence it is only to be recommended when other means fail, or in very urgent cases. Nearly every known preparation of mercury, soluble and insoluble, has in turn been employed, but there is no general agreement as to which is the best. A solution containing 1 part of the red iodide with sufficient iodide of sodium to dissolve it in 64 parts of water answers well. Dose, 6 to 8 minims.

The salts of *iodine* are principally used in the treatment of tertiary syphilis; but it is a mistake to look upon them as adapted only for that stage. In the secondary period, and in cases where the lesions partake of the characters of both stages, the iodides may often be advantageously combined with mercury. Speaking generally, the writer believes that the iodides are indicated when there is evidence of a marked tendency to new-growth at any time after the primary stage. In cases where the symptoms have been controlled by iodine, mercury should, as a rule, be given to complete the cure.

Iodide of potassium is the salt most frequently used; but the iodides of sodium and of ammonium are also employed. The action of all is similar, but the sodium and ammonium salts appear to be less depressing. They may be given separately or combined. The dose of the iodides varies from 2 or 3 to 100 grains or even more. In ordinary circumstances it is best to begin with 3 or 4 grains, with a little carbonate of ammonium, three times a day, and to increase the dose if necessary. In urgent cases, such as those of naso-pharyngeal disease, in which deformity is threatened, as well as in some cases of visceral disease, particularly in syphilitic affections of the nervous system, from 10 to 20 grains may be given at first, and the dose rapidly increased until some effect is produced. In such cases, also, it will often be prudent to carry out inunction, or the subcutaneous injection of mercury, at the same time. The iodides should be given well diluted; and any of the bitter infusions, or tartarated iron, may be added when their use is indicated. Milk is an excellent vehicle, especially in the case of children. Iodides may also be effectively administered *per rectum*.

Donovan's solution (Liquor arsenii et hydrargyri iodidi, B.P.) acts well in many of the later affections of the skin and mucous membranes. The dose is from 10 to 30 minims.

Iodoform is occasionally given internally in the later stages of syphilis; but it frequently causes gastric and intestinal irritation. The dose is about a grain, in the form of a pill.

The bromides of potassium, sodium, and ammonium are serviceable in certain cases of syphilitic affection of the nervous system. They may be given alone or with iodides, according to circumstances.

Besides the foregoing remedies, many others may be required in the treatment of syphilis. Iron and nux vomica or strychnine are drugs that are frequently of the greatest value, either in conjunction with specifics or with quinine. Cod-liver oil also is valuable in many cases. Sarsaparilla is sometimes beneficial in enabling the patient to bear large doses of iodide; it is also often useful during or after a prolonged course of specifics. Mineral acids and vegetable bitters are often of service during the intervals of specific treatment. Opium is sometimes necessary to prevent the purgative action of mercury, especially when large doses are taken, as well as to relieve pain in some of the affections produced by syphilis.

Certain bathing resorts which possess *sulphur* springs—Aix-la-Chapelle, for example—have become noted for the cure of syphilis; and there can be no doubt that great benefit is often derived from the course of treatment pursued at such places. The good results, however, are due rather to a combination of specific remedies and diaphoresis, with strict attention to diet and general hygiene, than to any special virtues of the waters themselves.

When syphilis is complicated with scrofula, gout, rheumatism, or other disease, the appropriate remedies should be given with those proper for syphilis, or temporarily substituted for them according to circumstances.

A certain number of persons are either unusually susceptible or unusually insusceptible to mercury or iodides in ordinary doses. Nearly all such cases, however, can be managed by making the dose small enough or large enough as the case may be, by combining tonics or sedatives with the specific, or by altering the mode of administration, together with strict attention to diet and the manner of living generally.

(*c*) *Local treatment.*—The initial lesion of syphilis usually requires only cleanliness, and the application of a little calomel powder or black wash. If the sore suppurate, it should be cleaned, dried, and dressed with finely powdered iodoform. Phagedæna must be treated by immersion, caustics, or the actual cautery, while the general health receives attention (*see* VENEREAL SORE). If the lymphatic glands become tender or inflamed, warm fomentations should be applied, and the patient kept lying down. If an abscess form, it must be treated according to the directions given in the article on BUBO, VENEREAL.

The early eruptions on the skin rarely require local treatment: oleate of mercury may be used for conspicuous spots. Erosions or fissures may be dressed with an ointment of calomel and vaseline, or with iodoform.

In the scaly affections of the palms and soles, an ointment of ammoniated mercury and oxide of zinc may be well rubbed in at bedtime, gloves being worn during the night. Mercurial plaster also is often a useful application. Mucous patches should be cleansed and dried several times daily, powdered with calomel and oxide of zinc, and covered with dry lint. If they are large and prominent, carbolic acid or acid nitrate of mercury may be applied. Cracks and ulcers about the nails should be dressed with red oxide of mercury ointment.

Ulcers or fissures, or mucous patches of the lips, tongue, mouth, and throat should be touched with carbolic acid, and an alum or borax wash used frequently, especially after eating. Other valuable applications are a mouth-wash of perchloride of mercury ⅛ to ¼ grain to the ounce, or a stronger solution applied with a mop, and a solution of chromic acid, from 10 to 20 grains to the ounce of water. For the later ulcers internal treatment is of great importance.

Ulcers and chinks about the nostrils should be kept moist with red oxide of mercury and vaseline ointment. When necrosis of the nasal or palatal bones has occurred, a lotion of permanganate of potassium or chlorinated soda should be used with a syringe or as a coarse spray, and the fragments removed as soon as they become loose. The early affections of the larynx usually disappear without local treatment. In the later affections general treatment is most important, but tracheotomy may sometimes be required.

Ulcers about the anus require careful cleansing and the application of calomel or iodoform ointment. For ulceration within the rectum iodoform suppositories and astringent injections should be used. In stricture of the rectum careful dilatation by means of bougies may be tried. In extreme cases rectotomy, or even colotomy, may have to be performed.

As regards the bones, the pain produced by early nodes is relieved by painting with a solution of iodine. As a rule, nodes should not be opened. If necrosis take place, the dead bone should be removed as soon as it becomes loose.

In iritis, besides the prompt administration of mercury, a solution of sulphate of atropine (1 grain to 2 drachms) should be dropped into the eye every two hours till the pupil is well dilated. Afterwards a weaker solution may be used to keep up the effect. In interstitial keratitis also atropine should be used. Iridectomy is occasionally necessary. In choroiditis and retinitis leeching is sometimes useful when there is much pain, but constitutional treatment is more important.

In syphilitic orchitis a suspensory bandage should be worn, but other local treatment is usually unnecessary, unless a gumma break down and fungous protrusion occur, in which case support should be given by strapping. Syphilides of the female genital organs should be dressed with iodoform, and the application of strong carbolic acid is also often beneficial. If the cervix uteri be affected, vaginal injections will be needed as well.

Treatment of Inherited Syphilis.—*Preventive treatment.*—If a syphilitic man have a relapse after marriage with a healthy woman, he ought at once to desist from intercourse—indeed, from contact of every kind—and undergo thorough treatment. The wife also should be watched, that treatment may be begun as early as possible, if she have contracted the disease. A woman who has borne a syphilitic child should be treated with mercury whether she show signs herself or not.

Treatment of the child.—Mercurial treatment should always be adopted as soon as symptoms appear. Grey powder may be given in one-grain doses twice a day. Or a strip of flannel smeared with diluted mercurial ointment may be worn round the waist. The ointment should be renewed every night, and the skin cleansed every third day. Some preparation of iron and cod-liver oil are also often useful. Treatment should be continued for a few weeks after all symptoms have disappeared.

Iodide of potassium is most valuable in the later forms of disease. The rules for its employment, alone or with mercury, are the same as in acquired syphilis, but the dose must of course be adapted to the age of the patient.

The *local treatment* of the syphilitic affections of children is similar to that recommended for adults. When the nostrils are obstructed by inspissated mucus, they must be carefully cleansed with a borax and glycerine lotion by means of a camel's-hair brush, and sores dressed with diluted red oxide of mercury ointment.

The *general management* and *diet* of syphilitic children are most important. Whenever the mother can suckle her child, she should do so. If this be impossible, a wet-nurse who has already suffered from the disease is the best substitute. If neither be available, ass's, goat's, or cow's milk must be given. Extreme cleanliness and fresh air are essential.

ARTHUR COOPER.

SYRINGOMYELIA (σῦριγξ, a pipe, and μυελός, the marrow).—A name under which Ollivier grouped numerous cases in which cavities of different kinds were met with within the substance of the spinal cord. *See* SPINAL CORD, Special Diseases of, No. 21.

SYSTOLIC.—Of or belonging to the systole or contraction of the heart, and usually associated with the cardiac impulse or sounds, or with murmurs. *See* PHYSICAL EXAMINATION.

T

TABES (*tabes*, a consumption).—A term formerly employed to denote consumption or wasting of the body.

TABES DORSALIS.—Synon.: Locomotor Ataxy; Fr. *Ataxie Locomotrice*; Ger. *Graue Degeneration der Hinterstränge des Rückenmarks.*

Definition.—A disease of the spinal cord alone, or of the spinal cord and peripheral nerves; manifested, when considerable, by incoördination of movement, peculiar pains, defective sensibility, and loss of muscle-reflex action (myotatic irritability).

Ætiology.—Males suffer more frequently than females, the proportion being about ten to one. A neurotic heredity can occasionally be traced; seldom direct inheritance. Amongst individual causes one greatly exceeds the rest, namely, the influence of syphilis. When every allowance is made for accidental coincidence, it is found that in at least one-half the cases the coincidence must depend upon causal relationship, and it is probable that this is true of a considerably larger proportion. The interval between the primary manifestations of syphilis and the first symptoms of tabes varies from one to twenty years. It is rarely less than three years, although cases have occurred in which the first symptoms have actually occurred during the active stage of syphilis. But syphilis is not the only cause, and in a few cases (less than 10 per cent. of the whole) it can be excluded with confidence. The other causes operative are traumatism, exposure to cold and wet, and over-exertion. Alcoholic and sexual excess are also probable factors in its production; and it occurs sometimes as a sequel to certain acute diseases, such as acute rheumatism, typhoid fever, and diphtheria. Symptoms of tabes also occasionally precede other diseases of the spinal cord, such as myelitis, such sequence being especially common in syphilitic subjects. This constitutes the variety which is known as 'secondary tabes.'

Anatomical Characters.—In most cases the spinal cord presents changes visible to the naked eye. These consist in a grey translucent appearance of the posterior columns. The whole of these columns may be thus changed or only parts of them, the extent of the changes being usually proportional to the severity and duration of the disease. With the microscope this change, or 'sclerosis' as it is called, is found to consist in an overgrowth of the interstitial elements, and wasting at the expense of the nervous elements in the areas affected. In the most common conditions the sclerosis occupies the whole of the posterior columns in the lumbar region, and becomes gradually restricted to the postero-median columns higher up, having thus the character of an ascending degeneration. In rare cases of severe character and long duration the posterior columns are occupied by connective tissue throughout the whole vertical extent of the cord. In slight cases the sclerosis may be limited in the lumbar region to the posterior root zone. Sclerosis may also affect other areas of the cord. The fine fibres of the posterior root described by the authority whose name they bear, Lissauer's tract, are generally affected. The direct cerebellar and ascending antero-lateral tracts may also show sclerosis. In rare cases even the pyramidal tracts are affected. Often in old cases there is a slight general increase of the connective tissue throughout the cord.

Changes in the grey matter are difficult to discover in the milder cases. In more advanced cases some atrophy of the anterior cornual cells may be detected if there has been muscular wasting. The posterior vesicular column may show distinct degeneration, and this is said to be associated with sclerosis of the direct cerebellar tract. The grey commissure also may be atrophied, and the nerve cells and fibres in the posterior horn probably undergo changes which are difficult to detect.

The posterior nerve-roots are also frequently atrophied, and the degree of atrophy depends upon the severity of the affection. The histological changes extend as far as the ganglion. The peripheral nerves are altered, the change consisting in a wasting of fibres which commences in the white substance, and extends to the axis-cylinders. There may be an increase of interstitial tissue, but the change is essentially one in the nerve-fibres themselves. This degeneration is greatest in the terminal filaments, and rarely extends in any marked degree into the main trunks. The sensory elements are alone affected. The changes in these have been chiefly found in the nerves supplying the skin, but Déjérine has demonstrated the presence of similar conditions in the sensory nerves of muscle.

Symptoms.—The most common and characteristic symptom of tabes is the ataxy. This varies in degree in different cases, and may be entirely absent. Before the condition is sufficiently marked to cause the characteristic disorder in movement, it may render standing difficult, especially if the eyes are closed ('Romberg's symptom');

and a still slighter degree may be evidenced only by the startings of tendons in the uncovered feet in the effort to maintain the equilibrium. As the defect progresses, it gradually impairs the patient's ability to get about; and finally locomotion is rendered altogether impossible. As a rule, the affection of the lower limbs is earlier and much more severe, but the arms may be similarly affected. There is a difficulty in fine movements, such as buttoning the coat; the grasp is not sustained; and slow unintended movements may be present in the fingers, when these are kept in one posture by muscular effort, closely resembling those of athetosis. They cease when muscular effort is relinquished.

Among sensory symptoms the most obtrusive are the severe and distressing 'lightning pains.' These are present in the majority of cases, and are characterised by their sudden, acute, stabbing character. The attacks of these pains alternate with periods of entire freedom, varying in duration. Their onset often seems to be determined by the state of the atmosphere. In some cases they are never present, and even in cases in which they have been severe they may suddenly cease and never return. There are also frequently present dull aching pains and sensory paræsthesiæ, such as numbness, tingling, and feelings of 'needles and pins.' Another sensory symptom often complained of is a sense of constriction in some part of the trunk, usually round the waist—the so-called 'girdle sensation.' A similar sensation may be present in the leg or thigh, as if a band or garter were tied tightly round it. Sensory disturbance may also be manifested by impairment of cutaneous sensibility. This is most frequent in the legs and feet. The tactile sense alone may be impaired, or those for pain and for temperature may also suffer. The temperature sense may escape when sensibility to pain is much impaired. The converse rarely, if ever, occurs. Besides the impairment through delay in the transmission of painful sensations—as much as fifteen seconds, according to Eulenberg—there may be, as the result of one prick, rhythmical recurrence of sensation, quick or deliberate. Sometimes localisation is disordered, so that a prick on one leg is referred to the other, or a prick on one spot may be felt in several (*see* ALLOCHIRIA). Sensory loss may also be present in the muscles, so that their contraction or electrical stimulation may be unfelt, and the muscular sense may be so impaired that the position of the limbs is not known unless they are seen.

Reflex action is impaired in tabes. Cutaneous reflex action is usually impaired in proportion to the loss of cutaneous sensibility. But more important is the condition of the muscle-reflex action shown by the state of the knee-jerk, the loss of which, as Westphal first pointed out, is one of the earliest and most constant symptoms of tabes. It is very rare for the knee-jerk to be obtained in any case of true tabes. Its loss may precede for years the onset of ataxy.

There is a large group of ocular symptoms that must be mentioned in connexion with tabes. Of these, the most important is the loss of the reaction of the pupil to light, while it still continues to act with accommodation—the so-called Argyll-Robertson phenomenon. This condition is present in almost five-sixths of the cases of tabes. Often also the dilatation that occurs with painful stimulation of the neck ceases to be produced. The pupils may be very small, but not infrequently they are of normal size. Paralysis of different ocular muscles may also be present, with accompanying diplopia. The muscles supplied by the third nerve are most frequently affected. This paralysis may be transient—lasting a few days or weeks, or permanent. The former is most common in the early stage, the latter in the late stage of the disease. There may be a continued palsy of different nerves, suggesting a cerebral origin, and a condition of progressive ophthalmoplegia may be established. Other cranial nerves may be similarly affected.

Among the more serious and troublesome of the symptoms of tabes the various so-called 'crises' must be enumerated. These are named after the various viscera affected. Thus, the most common are the gastric crises, which are manifested by severe sickness and nausea, often associated with intense epigastric pain. To the severe attacks of dyspnœa, which are not uncommon, the name laryngeal crises has been given. These are associated with bilateral paralysis of the abductors of the vocal cords. There are also vesical, bronchial, and rectal crises, manifested by symptoms referable to the various viscera indicated.

The sphincters are usually deranged in their action. Retention of urine may be followed by incontinence. The latter at first is not infrequently the result of over-distension. When this is not the cause, incontinence is usually associated with cystitis. The trouble with the rectum is usually constipation, but in the later stages incontinence of fæces may also be present. The sexual functions are usually altered. In the early stage there may be increased sexual activity, associated with increase of the cutaneous reflex action, but when the cases come under observation the condition is usually one of impaired or abolished sexual power, though sometimes this is retained to a late stage.

Vaso-motor and trophic disturbances are both interesting and important. Among them may be enumerated local sweatings, disappearance of pigment from the skin and hair, ecchymoses, and altered growth of hair in connexion with attacks of pain. Changes in the epidermis of the sole may be present, and troublesome ulceration of the toes is not uncommon. The so-called perforating ulcer of the foot is almost confined to tabes. Changes in the teeth and nails also occur, leading to partial decay or total loss. Changes in the joints and bones occur, and have been carefully investigated by the late Dr. Charcot. The bones may become brittle, and so render the occurrence of spontaneous fractures easy; but the most important condition is the so-called 'Charcot joint.' This is due to wasting of the articular surfaces and heads of the bones. Accompanying it may be irregular outgrowth of bone, and it is often accompanied by an effusion within the joint and sometimes by œdema outside it. The larger joints are most commonly affected, but the fingers have been known to suffer.

Course and Terminations.—The course of the disease is extremely variable. There are usually three stages—the first one, in which the gait is not yet affected; the second, in which there is distinct incoördination; and a third, in which the ability to walk is lost. The first stage varies in duration from a few weeks or months to as long as twenty-five years; and if the patients are subjected to careful treatment there is no progressive tendency shown in probably so large a proportion as one-half the cases. Some even improve, so that a patient at one time unable to walk was able some years later to get about with a fair amount of ease. When optic atrophy is present, this and the loss of the knee-jerk may remain for many years the only symptoms.

The dangers of locomotor ataxy consist not so much in the rapid spread of degenerative processes in the nervous system, as in the occurrence of kidney conditions secondary to cystitis. Laryngeal crises also constitute an element of danger; and suddenly occurring trophic disturbances have been known to prove fatal. General paralysis of the insane is a not unusual complication, and it runs the usual course, as a rule, within the prescribed limit. Valvular heart-disease is also an occasional complication of the disease, and is probably the result of a syphilitic process. This also may lead to a fatal termination.

Pathology.—In discussing the pathology of this disease it must be recognised that in tabes the main incidence of the marked change is upon the afferent nervous system, and that it is almost certainly a primary degenerative disease of the nervous elements. The symmetry of the lesions suggests a blood-state as the cause, and the very frequent antecedence of syphilis, taken together with the condition of the peripheral nervous system, suggests a somewhat close analogy to forms of peripheral neuritis, which occur after acute specific diseases, and sometimes from alcohol and other causes. The long interval which elapses between the primary disease and its nervous sequela is only in proportion to the chronicity of the primary specific disease; and the general conditions of its occurrence suggest that its immediate cause is the presence of some poison in the blood not itself organismal, but more probably a product of the growth of organisms. This may be a chemical substance and not a living virus, though produced by such. Recent research has brought into prominence the important *rôle* played by such products in the generation of disease, and such a theory would furnish an explanation of the usual inefficiency of antisyphilitic treatment in tabes, to which reference will presently be made.

Diagnosis.—Tabes dorsalis may easily be confounded with alcoholic neuritis. In the latter, however, there is the tenderness along the nerve-trunks, and the sphincters and pupils are unaffected. The history of alcoholic excess will also help in the diagnosis. The latter, and improvement when the cause is withdrawn, are the chief distinctions from the form termed 'alcoholic pseudo-tabes,' which resembles locomotor ataxy very closely. The hereditary form of ataxy offers many points of resemblance to tabes, but is distinguished by the earlier age at which it occurs, and the absence of the usual pain and 'crises.' Diphtheritic paralysis also bears some resemblance, but the history of the onset will usually clear up the point. Other forms of paraplegia, such as ataxic paraplegia, are usually distinguished by the presence of the knee-jerk. Injury affecting the posterior columns, or a tumour pressing on them, may simulate tabes; and a tumour in the cerebellum, by giving rise to ataxy, may raise a question of diagnosis. The difficulty in such a case may be increased by the absence of the knee-jerk; but while this is the almost invariable rule in tabes dorsalis, it is unusual in cerebellar tumour. In the latter condition also the other symptoms of tumour will probably be present, or enough of them to decide the diagnosis.

Prognosis.—This must be based upon the considerations mentioned in the description of the course of the disease. Some cases are obstinately progressive, but this is not the rule as regards the majority. The prognosis is usually good as regards a fair duration of life, for the malady does not itself kill; and it should be borne in mind that many cases show no progressive tendency, and that some greatly improve. The optic nerve atrophy is usually progressive, but not invariably so; and the opinion expressed concerning any case must largely depend upon the ability and willingness of the patient to carry out necessary instructions and treatment.

Treatment.—Much can be done by treatment in tabes, at least to relieve, apparently even to considerably modify the course of the disease. The influence of rest and hygienic surroundings in doing so is very great. The avoidance of mental worry and fatigue is also a powerful factor in obtaining benefit. Exercise should be gentle, and should always stop short of fatigue. The avoidance of sexual excess is of the greatest importance. Indulgence may lead to the most disastrous consequences. Great care should be directed to the avoidance of dyspepsia and constipation, as an attack of either may excite lightning pains or a gastric crisis.

Much also may be done by drugs. The almost invariable inefficacy of antisyphilitic remedies finds an explanation in the view of the pathology already enunciated. Arsenic is probably the most generally useful of all drugs. Others that may be enumerated are nitrate of silver, ergot, Calabar bean, strychnine, and phosphorus. The writer has lately found chloride of aluminium very useful. Counter-irritation to the spine is undoubtedly beneficial in acute cases. The best way to apply it is by means of the mild actual cautery. Electricity has probably little if any influence even in mitigating the pain. Nerve-stretching and suspension, although recently fashionable, are probably valueless and fast passing out of use. It is fortunate that we now have in phenazone and acetanilide means almost invariably reliable for lessening the lightning pains of tabes. Exalgin and phenacetin are less generally efficacious, but may succeed in cases in which the others fail. Hypodermic injections of the hydrochlorate of cocaine are most useful for superficial pains with tenderness of the skin. These may also be relieved by the application of chloroform sprinkled on spongiopiline. Gastric crises may be treated by removing a possible exciting cause, such as an attack of dyspepsia or constipation. Simple food must be administered, and morphine by hypodermic injection if necessary. Laryngeal crises are usually relieved by nitroglycerine or nitrite of amyl. Rarely is tracheotomy necessary, but it is always a possibility. The condition of the bladder must be attended to most carefully. No hesitation should be felt in using the catheter as often or as early as is necessary, if the bladder is imperfectly emptied; and it should be washed out with a weak solution of boric acid if there is turbidity of the urine. The general hygienic conditions should of course be the best possible.

W. R. Gowers.

TABES MESENTERICA (*tabes*, a consumption; and *mesenterica*, mesenteric). An affection attended with marked wasting, and caused by tubercular or scrofulous disease of the mesenteric glands. *See* Mesenteric Glands, Diseases of.

TACHE (Fr.), a spot or patch.—The word is most frequently used in connection with morbid conditions of the skin. *Tache cérébrale* is a term that was specially applied by Trousseau to a streak of hyperæmia, produced by drawing the nail over the skin (usually of the abdomen) in certain cases of cerebral meningitis. *See* Meninges, Cerebral, Inflammation of, Tubercular.

TACHYCARDIA (ταχύς, rapid; and καρδία, the heart). A form of functional disturbance of the heart, characterised by greatly increased frequency. *See* Heart, Functional Disorders of.

TÆNIA. — Synon.: Tape-worm. — *See* Entozoa.

TANGIERS, in North Africa.—*See* Morocco.

TAPE-WORMS.—*See* Entozoa.

TAPPING.—A popular name for paracentesis. *See* Paracentesis.

TARANTISM (*tarantula*, a ground spider).—Synon.: Fr. *Tarentisme*; *Chorée Epidémique*; Ger. *Tarantismus*.

Definition.—An epidemic dancing mania, prevalent in Italy in the sixteenth and seventeenth centuries, originating in fear of the bite of the tarantula, as a remedy for which the dance was adopted. A full account of it will be found in Hecker's *Epidemics of the Middle Ages*.

History.—The Italian dancing mania commenced in Apulia, in the latter part of the fifteenth century, contemporaneously with the St. Vitus's dance in Germany. The ground spider had long been held in dread, as causing, by its bite, symptoms of nervous and physical prostration, which might end in death, or lifelong lassitude. At this period the fear of the frequently recurring epidemics of the Black Death, Eastern plague, and other diseases, caused widespread depression. The tarantula was dreaded throughout Italy, and the aspect of the insect is sufficient to explain the exaggerated opinions regarding it. An unperceived bite was a ready explanation of any symptoms of nervous prostration. The inspiriting influence of music and rhythmical motion was found to dispel, for a time, the depression, which was itself purely psychical in origin. The theory arose that by means of the motion the poison of the spider was distributed over the body, and expelled through the skin. The nervous excitement of the remedy proved, however, a greater evil than the supposed disease. The induced emotion outran control. The dancing became frantic, and was continued until the dancers fell senseless from exhaustion, with the result that, on regaining strength, they were for a time free from the depression. The dancing mania spread by 'moral contagion,' and large numbers of persons, young and old, male and female, became affected. The temporary relief gained by the dance led to the adoption of the remedy at intervals, which ultimately became yearly; every summer the sufferers grew depressed in anticipation of the advent of the annual dance. Strange psychical conditions were induced by the emotional disturbance; other sensory impressions besides music gave pleasure; and certain colours, such as red, or the sight of the sea or even of clear water, exerted a strange fascination. The sexual passion became involved in the tumult of emotion, and the mental excitement occasionally ended in self-destruction. Of longer duration than the dancing epidemics of Northern Europe, tarantism was at its height in the seventeenth century, and gradually died out in the eighteenth, leaving only a designation for a lively dance as its harmless legacy.

W. R. Gowers.

TARASP - SCHÜLS, in Unter-engadin, Switzerland. — Alkaline sulphated waters. *See* Mineral Waters.

TARKASTAD, in Cape Colony.— *See* Africa, South.

TARTAR EMETIC, Poisoning by. Synon.: Fr. *Empoisonnement par l'Antimoine*; Ger. *Antimoniumvergiftung.*— Poisoning by tartar emetic, a soluble double tartrate of antimony and potassium, is not very common. The emetic properties of the salt generally ensure its speedy ejection from the stomach. Poisoning by the salt may be either (1) *acute*, from the ingestion of a large dose; or (2) *chronic*, the patient succumbing under the exhaustion consequent upon its prolonged administration.

1. **Acute poisoning.**—Shortly after taking a large dose of tartar emetic, the patient is seized with intense nausea and faintness, accompanied by depression of the force of the pulse, and increased perspiration. Violent vomiting and retching follow, with a burning pain and sense of constriction in the mouth, throat, and gullet. Vomiting affords no relief to the nausea and pain, and is repeated, the vomited matters becoming bilious, and ultimately perhaps blood-tinged. A metallic taste is felt in the mouth; the abdomen becomes painful and tender; and profuse diarrhœa sets in, the fæces often containing a considerable quantity of blood. The urine is at first increased in quantity; but later it may be scanty, blood-tinged, or suppressed. The circulation is throughout depressed; and the skin cold, clammy, and bathed in profuse perspiration. The muscular system is relaxed; but cramps of the extremities may torture the patient. In rare cases a pustular rash appears, like that produced by the external medicinal application of the drug. In some cases neither vomiting nor purging has occurred, the symptoms being simply those of intense prostration, with embarrassed respiration. In fatal cases death occurs within a few hours.

2. **Chronic poisoning.**—The administration of repeated small doses of tartar emetic causes nausea, vomiting, purging, exhaustion, and debility, which not infrequently prove fatal. These symptoms are accompanied by depressed irregular circulation, profuse perspiration, and disturbances of respiration.

Anatomical Characters. — These are somewhat variable, but on the whole are those of a metallic irritant poison. In most cases there is inflammation of the stomach and intestinal tract generally, not so patchy or marked by such bright redness as in arsenical poisoning. Not infrequently the stomach and small intestines escape, and the inflammation may be confined to the large bowel; even ulceration of the intestines may occur, accompanied by hæmorrhagic extravasations. Hypostatic congestion of the lungs is often prominent.

Diagnosis.—Poisoning by tartar emetic may be diagnosed from other irritants, especially arsenic, by the greater and earlier depression, the profuse perspiration, greater irregularity of pulse, and the more irregular respiration. An analysis of the ejecta or of the urine is always advisable, and often indispensable to complete the diagnosis. In chronic cases an analysis of the urine is the only satisfactory mode of determining the nature of the illness, where tartar emetic is not known to have been administered as a medicine.

Prognosis.—This must always be grave, so long as the ejecta contain considerable quantities of the poison. In acute cases the patient cannot be considered out of danger till not only the vomiting has ceased, but an obvious return of strength has set in for some time.

Fatal dose. — Fifteen grains may prove fatal to an adult. Much larger doses may, however, as a rule, be taken with impunity. The danger is much increased if the poison be taken in conjunction with some substance, such as opium, which deadens the susceptibilities of the stomach.

Treatment.—The stomach-pump may be used, notwithstanding profuse vomiting. The elimination of the poison may be hastened by free administration of diluents, and the stomach protected by mucilaginous drinks, or the stomach may be washed out by means of the siphon-tube. The most effective antidote is tannic acid, which forms an insoluble tannate of antimony. For this purpose tincture of cinchona bark, decoction of oak-bark, or strong infusions of tea or coffee, may be administered; or the stomach may be washed out with similar fluids, or with a solution of half a drachm of tannic acid. Not till after this has been done, or the stomach well and repeatedly cleansed by free vomiting, should opium be administered. The after-treatment will depend upon the symptoms. The treatment of chronic cases consists in cessation of the administration of the poison; in the exhibition of ammonia, stimulants, and tonics; and in careful support of the strength. Nutrient and opiate enemata are of the greatest service.

Thomas Stevenson.

TASMANIA.—A warm, equable, subtropical climate. Mean temperature of Hobart Town, the capital, 54° F. Prevalent winds, N.E. and S.W. *See* Australasia; and Climate, Treatment of Disease by.

TASTE, Disorders of.—Synon.: Fr. *Troubles du Goût*; Ger. *Störungen des Geschmackes*.

Introduction.—Disorders of taste have to be carefully distinguished from disturbances of olfactory impressions, on which all perception of flavour depends. The chief sensations of taste are those called sweet, sour, salt, bitter, and metallic. Flavours are sensations of smell due to an agent which reaches the olfactory mucous membrane through the posterior nares; their cause usually at the same time acts upon the nerves of taste, so that the flavour blends with the gustatory sensation, and seems like a part of taste proper. But if the passage of air into the nasal cavities by the posterior nares is prevented, as by closing the nostrils, no flavour is perceived and taste alone remains. It is also necessary to distinguish disorders of taste from altered appreciation of the sensation—increased or diminished enjoyment of, or disgust at, sensations which are themselves normal.

The sensation is subserved by structures in the mucous membrane on the back of the tongue, the palate and palatine arches, and to a slighter extent by those on the tip and edges of the fore-part of the tongue. In the latter sweet and sour, in the former salt and bitter, are best perceived; but, except for individual peculiarities, all the sensations can be perceived in each region. The sense is related especially to certain 'papillæ' on the back of the tongue, but elsewhere to less differentiated structures of the mucous membrane. Substances must be dissolved to excite the sensation, but the solution may be effected by the moisture on the tongue. A knowledge of these facts is important for testing the sense of taste.

In the front of the tongue the sensation is certainly subserved by fibres from the lingual branch of the fifth, belonging to this nerve, but reaching its root by a circuitous path—the chorda tympani, facial, and Vidian nerves, spheno-palatine ganglion, and thence to the fifth by the petrosal nerve. The nerve-fibres connected with the papillæ at the back of the tongue are those of the terminal branches of the glosso-pharyngeal, but disease of this nerve within the skull does not impair taste, and destruction of the root of the fifth nerve abolishes it, not only on the back of the tongue, but also on the palate. Exceptions to this rule are probably due to imperfect destruction of the root, or to the disease of its fibres being within the pons. Hence it seems that the taste-fibres from the back of the tongue leave the glosso-pharyngeal, just as those from the front of the tongue leave the lingual, and reach the root of the fifth by an equally circuitous path, probably (from other pathological facts) chiefly by the tympanic nerve of Jacobson.

Within the pons, the fibres for taste seem to take a course separate from the sensory roots, and at first near the motor fibres or nucleus, since the writer has met with complete loss of taste and paralysis of the muscles of mastication on one side, without anæsthesia, from disease within the pons. The path ascends to the opposite hemisphere of the brain, but the position of its cortical centre is not known.

1. **Increased Sensitiveness of the Nerves of Taste.**—Synon.: Gustatory Hyperæsthesia; *Hypergeusia.*—This condition is evidenced by detection of a substance too minute in quantity to be perceived by normal taste, or by an abnormally intense impression when a given quantity of a substance is tasted. In excitable states of the nervous system, as in general malnutrition, substances in small quantities in the blood are tasted with great readiness; the bitterness of morphine injected beneath the skin may be at once noticed (Wernich), and, for a long time after a bitter substance has been taken, whatever is tasted may seem bitter. Gustatory hyperæsthesia is often met with in hysterical persons, and sometimes in the insane. It is not usually a symptom of sufficient prominence to demand special treatment.

2. **Perverted Sense of Taste.**—Synon.: Gustatory Paræsthesia; *Parageusia.*—This is not uncommon in neurotic states. Substances excite a different taste from that to which they naturally give rise. A bitter flavour, for instance, is detected in a simple saline. This condition is commonly conjoined with altered appreciation of the taste which is recognised, so that substances commonly considered pleasant are disliked, and those are enjoyed which commonly excite disgust. It is seen in a slight degree in some toxæmic conditions, but more frequently in psychical disturbances. In hysteria it leads to various absurdities in diet. It is also met with as a rare symptom,

in some degenerative diseases, such as locomotor ataxy.

3. **Subjective Sensations of Taste.**—These may occur from disorders of the central nervous system, in hysteria, insanity, and occasionally as the aura of epileptic attacks. The sensation is usually of an unpleasant description, and is probably produced in the region to which the taste-fibres are conveyed by the branches of the glossopharyngeal nerve. It is remarkable (as evidence of the association of the cerebral centres in correspondence with that of the causes of sensation) that distinct flavours and tastes are combined in epileptic aura, but an odour is always separate.

Subjective sensations of taste occur also, very rarely, from irritation of the gustatory nerves. They have been produced experimentally by galvanising the chorda tympani, when this has been exposed by disease of the internal ear; and have also occurred in some cases of disease of the petrosal part of the facial nerve. These subjective sensations have to be distinguished from abnormal sensations due to substances in the blood, or to secretions of the mouth. The treatment of the symptom is that of its cause.

4. **Loss of the Sense of Taste.**—Synon.: Gustatory Anæsthesia; *Ageusia.*

Ætiology. — Diminished sense of taste may be produced by: (*a*) Thickening or other changes in the mucous membrane of the mouth, rendering the nerve-endings less accessible to sapid solutions. This is, however, a rare cause. (*b*) Local applications lessening the irritability of the nerve-endings. Hot or cold applications may temporarily destroy the sense of taste. Cool substances cannot be tasted so well as those which are warm. (*c*) Hysterical and other functional nervous disturbances. It then forms part of 'hysterical hemianæsthesia' as part of the unilateral loss of the special senses, accompanied by anæsthesia of the limbs and half of the trunk on the corresponding side. (*d*) A similar loss, in the same association, has been met with in rare cases of organic disease of the opposite hemisphere. (*e*) Disease of the nerves which conduct the sensation to the sensory root of the fifth nerve, especially of the tympanic plexus, in consequence of caries of the temporal bone. It is also often produced, in the front of the tongue, by disease of the chorda tympani, when a neuritis of the facial nerve passes up its canal.

Symptoms.—Loss of taste involves the perception of bitter, sweet, sour, and saline characters, to which should, perhaps, be added the metallic quality. These may be lost in varying degrees, sometimes entirely; occasionally some are more impaired than others. The loss, from disease of the nerves, may be on the whole or part of one side, according to the relation of the several nerves to the function in different parts of the gustatory region, as already explained. Each part of the tongue possesses the power of recognising every quality, but not in the same degree; bitterness and sweetness are appreciated chiefly by the glosso-pharyngeal at the back, acidity and saltness by the lingual in the fore-part of the tongue, chiefly at the tip and edges. The onset of the defect may be sudden, as in hysteria; or gradual, as in most forms of nerve-lesion. In the latter it is usually unilateral; in rare cases both sides are involved. It is associated with other symptoms of loss of function of the affected nerves, as in the case mentioned, in which there was loss of sensibility in the face and paralysis of the muscles of mastication.

Diagnosis.—Loss of taste has always to be carefully distinguished from loss of smell, since all flavours are recognised by the olfactory nerve, and it is commonly assumed that when these cease to be perceived, taste is lost. The power of tasting must be ascertained by powders or colourless solutions which shall convey no information. Citric acid, quinine, sugar, and salt, in powder or solution, answer well. The tongue must be held out, and the substance or solution placed on the part of the tongue it is desired to test, and after each observation the mouth must be rinsed with water. It must be remembered also that the anterior part of the tongue is almost destitute of the sense of taste, except on the edges and tip. If the loss is unilateral, the powder may be rubbed on the side of the protruded tongue, near the tip, with the finger, and the patient should indicate, by nodding or shaking the head, whether it is tasted, before the tongue is withdrawn into the mouth. The moisture on the mucous membrane is sufficient to dissolve the substance and enable it to act upon the nervous structures.

Prognosis.—This depends on the cause, and the extent to which the morbid condition can be influenced by treatment. It is good in hysteria, less favourable in nerve-affections. The loss due to affection of the facial nerve is frequently recovered from, but may prevail even when the function of the latter is recovered. In intracranial disease of nerves the prognosis is, as a rule, unfavourable.

Treatment. — The treatment in nerve-disease is that of the cause of the symptom. Stimulation of the nerves in the tongue may sometimes aid the recovery of function, and for this faradisation is the most effectual. Hysterical loss of taste, part of hemianæsthesia, is best treated by neglect. Where the loss depends on an affection of the mucous membrane of the tongue, local measures alone are effective, in so far as the treatment can be influenced.

W. R. Gowers.

TEETH, Diseases of.—SYNON.: Fr. *Maladies des Dents*; Ger. *Krankheiten der Zahne*.

INTRODUCTION. The teeth are peculiar organs, both anatomically and physiologically. The three hard tissues of the teeth are of comparatively low organisation, while they are in connexion internally with a structure, the pulp, mainly composed of plexuses of nerves and blood-vessels, and the roots are covered externally with a highly nervous and vascular periosteum.

The functions of the teeth are important. They exercise a large influence in the production of articulate sounds. They have a keen tactile faculty, by which they recognise the texture of food, and detect the presence of foreign bodies. But their most important function is mastication, by which food is comminuted and at the same time insalivated, two essential preliminaries to digestion. The loss of the teeth is with many of the lower animals the limit of life, from the cessation of these processes; and the failure of mastication, through edentulous age, is a frequent cause of intractable dyspepsia in the human subject. This fact cannot be too constantly remembered by the practitioner. The restoration of mastication by means of artificial teeth is often the immediate cure of imperfect digestion, which diet and drugs have failed to influence

The diseases of the teeth are for the most part of a surgical character, and need operative interference. Their pathological conditions are, however, of important interest to the medical practitioner; causing and explaining, as they do, many maladies especially of the nervous system, and having a serious bearing on digestion and nutrition, as dependent on efficient mastication.

Again, the forms of the teeth, and the characters of their tissues, are frequently indicative of former illness, and in many instances are of critical diagnostic value in establishing the existence of a constitutional taint which may modify or develop disease. The teeth are dermal organs, and as such are liable, especially during their development, to be affected by the poison of the eruptive fevers, leading to disastrous consequences to the teeth themselves, and to the immediately contiguous structures.

The teeth, are, moreover, from their peculiar position and surroundings, liable to mechanical injuries, and to chemical and physical changes of the most interesting nature in themselves, and in relation to the vital manifestations to which they lead.

In this article the morbid conditions associated with the teeth will be discussed in the following order: (1) Alveolar Abscess; (2) Caries; (3) Enamel, Pitted; (4) Erosion; (5) Eruption of Wisdom Teeth, Difficult; (6) Hæmorrhage after Tooth-extraction; (7) Irregularity in Number, in Shape, and in Position; (8) Loosening; (9) Necrosis of the Jaw and Teeth after the Eruptive Fevers; (10) Nervous Affections dependent on Diseases of the Teeth; (11) Odontomes; (12) Periosteum, Diseases of Dental; (13) Pulp, Diseases of; (14) Syphilitic Teeth; (15) Toothache.

1. Alveolar Abscess.—*See* 12. Periosteum, Diseases of Dental.

2. Caries.—Caries of the teeth is the most common pathological change to which the human body is liable. It generally affects some of the temporary teeth before they are shed; and there are very few adults in whose teeth caries, in some degree, is not to be found. Dental caries is a softening and disintegration of the tooth's surface, gradually penetrating towards its centre. It is essentially an affection due to external influences, which are partly chemical and partly parasitic in nature.

ÆTIOLOGY. The *predisposing causes* of dental caries are local, and general:—

Local.—These include: (*a*) Defective enamel—pits, &c.; deficiency of lime-salts throughout tooth. (*b*) Irregularity—favouring lodgment of food. (*c*) Want of cleanliness. (*d*) Abnormal condition of secretions; acidity; mucoid condition of saliva in fevers.

General.—Under this head come: (*a*) Heredity—probably through deficiency of lime-salts. (*b*) Pregnancy. (*c*) Occupation: *e.g.* millers, bakers, confectioners, or chemical workers. (*d*) Civilisation—through kind of foods; cooking of food; brain activity. (*e*) Rheumatism, gout, diabetes mellitus, dyspepsia.

The *exciting causes* are—chemical solvents, acids which remove lime-salts, lactic acid produced in transformation of carbohydrates, fruit acids, acids in medicines—especially the mineral acids.

DESCRIPTION.—When the enamel is attacked by caries, it becomes opaque, whitish, or grey; and then gradually stained of a brownish colour. This change is soon followed by still more obvious lesions in the dentine. The latter tissue undergoes more rapid alteration than the enamel; it becomes brown and soft, and the disease penetrates in the direction of the tubes towards the pulp, while it spreads laterally beneath the as yet healthy enamel. These changes occur in endless variety, one form passing into another. The extreme varieties have been described as distinct species of decay, without, however, sufficient justification.

At times the disease advances to a certain stage, and then ceases; the intra-tubular material becomes calcified, and the surface perfectly hard and dull-brown or black in colour. This is called 'arrested,' 'stationary,' or 'carbonised' decay. There is a peculiar and characteristic odour in dental caries, like that of gangrene of the lung; or like the scent of the little neuropterous insect

'*Chrysopa.*' The softening of the dentine is brought about by the removal of the phosphate of calcium in a soluble acid form, and its replacement by water. Carious dentine has an acid reaction.

The results of caries are many and serious, arising from removal of protection from the pulp and specific irritation of it. Toothache, neuralgia, periostitis, suppuration of the pulp, alveolar abscess, and occasionally muscular paralysis, may all arise as consequences of this condition.

TREATMENT. — The treatment of dental caries may be divided into *prophylactic*, and *remedial*.

Prophylactic treatment should be directed against overcrowding of the teeth by judicious extraction; and against want of cleanliness by the use of the tooth-brush and antiseptic washes and dentrifices. The various diseases causing acidity suggest their own treatment. Iron medicines should be taken through a glass tube, and the teeth brushed immediately after with water made alkaline by bicarbonate of sodium.

Remedial treatment cannot be called curative, as there is no restoration of lost tissue; and that which has become decalcified never hardens again. But caries may be arrested, and further decay prevented. The softened tissue should be removed; the hard subjacent structure polished and kept smooth; projecting edges, which might entangle food, levelled and burnished; and above all, cavities should be stopped.

3. **Enamel, Pitted.**—SYNON.: Mercurial Teeth—Hutchinson.

It is of great importance to distinguish between syphilitic teeth and other malformed teeth which have no similar signification. When Mr. Hutchinson first described the characters of teeth which are often associated with inherited syphilis, much unnecessary distress was occasioned by confounding teeth having rocky and pitted enamel with those which were truly syphilitic in their origin; and many persons supposed themselves to inherit syphilis, who merely possessed teeth bearing marks upon them which registered a temporary illness, or a condition of depressed nutrition in childhood when the affected teeth were forming. Teeth with rocky and pitted enamel vary indefinitely as to the extent of their defective formation, from a slight horizontal grooving in the enamel, to a condition in which the whole surface is rocky and rugged, and studded with pits like a thimble. In extreme cases the enamel may be almost entirely wanting; but there is *no narrowing of the apices of the crowns of the teeth, and no crescentic notch in the superior incisors*, as in syphilis. The defects of the enamel are nearly always horizontal in their disposition; and even the pits have such an arrangement in series. This condition is most frequently seen in the permanent teeth, though sometimes in the temporary. It is most manifest in the first molars, the incisors, and the canines. Rarely it affects the bicuspids, near the apices of the cusps; and still more rarely the whole bicuspid crown suffers. But it will be observed that the malformation is symmetrical in the corresponding teeth, and that in the different teeth it has occurred at a point in its development which each tooth had attained at one particular time; and probably the mildest and severest cases are essentially the same in their pathological meaning, the difference being only one of degree. It has been supposed by Mr. Hutchinson that this condition of teeth is the result of the constitutional influence of mercury given in childhood; but it is generally quite unconnected with such supposed cause, as it is extremely rare for mercury to affect the mouth in children. This condition of teeth occurs where mercury has never been given, and equally among people not accustomed to that drug. It is found, moreover, among extinct races, who lived before mercury was used as a medicine. The microscopical structure of teeth, thus degenerated, shows that the condition is essentially one of imperfect calcification of the enamel and dentine; and any influence or disease of childhood, suspending for a time or depressing the nutrition, may be an efficient cause. As this state of tooth is permanent, it remains a record through life of an illness in childhood. These defects in the tissues of the teeth are concurrent with their lamination. The tissues of the teeth exhibit a series of layers due to different degrees of calcification, in which the earthy impregnation has been greater and less alternatingly. This is a normal condition up to a certain degree; but when the laminæ of lesser calcification are extremely defective in earthy matter, histological defects arise, which lead to the appearances in the teeth described.

4. **Erosion.**—Erosion is the name given to the process by which saucer-shaped cavities or grooves are formed on the labial aspects of the necks of the teeth. They are generally placed transversely; and though at times attacking all teeth, are most frequently seen on front ones. The surface of erosion is hard, polished, and often not at all discoloured until the pulp is approached; and the teeth attacked frequently become so weakened as to break off. Erosion seems to be due to a chemical solvent, the source of which is probably the gum margins.

TREATMENT.—The cavities due to erosion should be filled if deep enough; otherwise the sensitiveness generally present should be treated by nitrate of silver, in the form of the solid pencil, or chloride of zinc; or let the patient occasionally paint the parts with sal volatile.

5. Eruption of Wisdom Teeth, Difficult. Insufficiency of room in the jaw for the advent of the wisdom teeth is sometimes attended with very painful, and even serious symptoms. These are confined to those cases in which the obstruction occurs in the lower jaw. The wisdom tooth has insufficient room to come through, and remains impacted at the base of the ascending ramus of the jaw, growing and pressing against the second molar. This gives rise to inflammation, and pain of a rheumatic character, wandering down the neck and arm, the latter being often weakened in muscular power. In acute and neglected cases, abscess forms at the angle of the jaw, and burrows about the cheek. One remarkable symptom is trismus, which is very usual in these cases, and is a characteristic symptom; the masseter muscle becoming contracted and firmly set, so that the jaws can hardly be opened a quarter of an inch. This locking of the jaw sometimes occasions very unnecessary alarm.

Well authenticated instances of epilepsy, delirium, and insanity have been recorded as having been occasioned by the resisted eruption of the lower wisdom teeth, and cured by removal of the cause of irritation. Upper wisdom teeth occasionally give trouble by growing into and ulcerating the cheek.

Treatment. — The treatment depends much on the degree of obstruction. Lancing the gum is sometimes sufficient; otherwise removal of the wisdom tooth is the proper cure. Where there is trismus, it is necessary to force open the jaws with a Mason's gag under an anæsthetic, and then extract the tooth if possible. If it cannot be reached, the second molar should be extracted, when its posterior fang will sometimes be found absorbed. When once an abscess has formed in association with an obstructed wisdom tooth, the removal of that tooth is unavoidable. Though it may be necessary to remove the second molar first, the third must afterwards follow, or the abscess will remain. The trismus vanishes on extraction of the tooth.

6. Hæmorrhage after Tooth-extraction.—Hæmorrhage following tooth-extraction may be either *primary* or *secondary*.

Primary hæmorrhage is rarely persistent. The duration seems to depend on the amount of laceration. The portion of the socket formed by the alveolar plate will often be found to bulge after an extraction. When this occurs, the bleeding is often prolonged, probably because the fracture of the outer plate opens up the cancellous tissue of the bone.

Treatment. — The proper treatment for hæmorrhage of this kind is to squeeze the outer and inner plates together. Very hot or very cold water generally stops the bleeding at once. Should this fail, the treatment should be that for secondary hæmorrhage.

Secondary hæmorrhage is very rare, considering the number of teeth extracted. There is frequently a history of the hæmorrhagic diathesis. It is sometimes, however, associated with menstruation.

Treatment. — Various general remedies have been tried, such as hamamelis, turpentine, and the like. But it is on *local* treatment that the practitioner depends. It is advisable to remove any badly formed and leaking clots. Then syringe the socket with hot water, and examine for torn gum, or alveolar splinters; and a tent-shaped roll (rough side out) of matico leaf should afterwards be inserted into the apex of each tooth-socket.

The following plan is often most effective: Twist a small cone of cotton wool on the sharp end of a straight silver probe. Dip it into Richardson's styptic colloid, and carry it to the apex of each socket. If the cotton wool be firmly but not tightly rolled, the probe can be withdrawn quite easily, provided the point is smooth and straight. The cone of wool rapidly expands and is retained in the conical socket. Hamamelis, or saturated solution of tannic acid in alcohol, may be used instead of the colloid. Should plugging alone fail to stop the bleeding, pressure must be tried in addition. This may be obtained by getting the patient to bite on a pad of lint or cork, and then bandaging the chin tightly up with a four-tailed bandage. Special tourniquets and clamps have been devised for this purpose. The actual cautery has been used, but it is rarely needed.

7. Irregularity in Number, Shape, and Position of Teeth.

(*a*) *Number.*—*Absence* of one or more teeth is common. The deficiency may be caused by removal of the permanent germ, during extraction of a temporary tooth, or possibly by the germ being affected by the diseases of childhood. Hereditary absence of teeth is frequently noted. The modern diminution in size of the lateral incisor and wisdom teeth points to their gradual elimination from their respective series. Non-eruption of the wisdom-teeth is very common. A retained temporary tooth will often be found filling the place of an absent permanent one; and this may sometimes be the cause, and sometimes the effect, of absence of the permanent teeth. *Supernumerary teeth* are occasionally seen. They are generally found in the upper jaw, and are most commonly irregular in shape and position. Their removal is necessary when they cause overcrowding, inconvenience, or disfigurement.

(*b*) *Shape.* The lateral incisor and wisdom teeth are most commonly affected. There seems to be a tendency for the overcrowding in modern jaws to be relieved at the expense of these teeth. Amongst people whose mouths do not show this overcrowding, these teeth are better developed.

(c) *Position.*—Irregularity in position is very common, and overcrowding is the general cause. The human jaw is diminishing in greater ratio than the teeth which have to occupy it. This is partly the result of sexual selection, and partly of want of exercise, brought about by the highly prepared foods of modern civilisation. Possibly also early mental activity at the time the jaw is developing, causes the brain to receive an undue share of the phosphates in the blood-supply to the head. Heredity would also have its influence. Too early extraction, and too long retention of temporary teeth are causes of malposition. Obstructed nasal breathing and thumb-sucking must be included in the same category.

8. **Loosening of Teeth.**—*See* 12. Periosteum, Diseases of Dental.

9. **Necrosis of the Jaw and Teeth after the Eruptive Fevers.** — Necrosis of the jaw and teeth is among the secondary maladies which is apt to occur after small-pox, scarlet fever, and measles in children, and the cases are all singularly alike. They usually occur between the third and eighth years, and the severity of the previous attack of fever is immaterial. The local symptoms, which usually appear from three to six weeks after the primary disease, consist in a separation of the gum around one or more of the temporary teeth; and this continues until the bare jaw is exposed to a depth which corresponds not only to the fangs of the temporary teeth, but to the bony capsules of their immature successors. Transverse ulceration then usually follows; and the temporary teeth, their alveoli, the immature permanent teeth, and their bony capsules are shed. Frequently this occurs on both sides of the mouth symmetrically. There is no swelling or formation of supplemental bone. In the lower jaw, the base of the bone is rarely, if ever, involved; and the consequent disfigurement is singularly slight. These exfoliations occur much more frequently after scarlet fever than after measles; and they are rare after small-pox.

Treatment.—The treatment of these cases should consist in as little local interference as possible. Little need be done, beyond attention to cleanliness and deodorisation, and the removal of the sequestra when quite loose. The general condition of the patient will require careful treatment.

10. **Nervous Affections Dependent on Diseases of the Teeth.**—Affections of the nervous system dependent on the teeth, independently of dentition, have not been sufficiently recognised, and records of them are so few and partial that it is difficult to generalise upon them. These affections are either (*a*) *reflex*, (*b*) *direct*, or (*c*) *complex*. In the first case some portion of the nervous system receives an exaltation of function from the irritation of a tooth-nerve: in the second case some contiguous nerves are involved by the spread of inflammation from diseased teeth, or the pressure of the inflammatory products: in the third case both would be entailed in a mixed and uncertain proportion.

(*a*) *Reflex affections.*—As regards the reflex phenomena of disease dependent on the teeth, we may enumerate pain; muscular spasm; muscular paralysis; paralysis of some of the nerves of special sense; and perverted nutrition. These reflex phenomena have been found to be induced by the following diseases: Caries, with or without exposure of the pulp; exostosis—hypertrophy of the crusta petrosa; nodular developments of dentine in the pulp-cavity; periostitis, plastic or suppurative; impaction of permanent teeth in the maxillary bones; and crowding of teeth from insufficient room.

Small excrescences of dentine occurring within the pulp-cavity (or in the form of small nodules in the substance of the pulp) are apt to produce erratic and widespread pain among the dental nerves of one side of the face. The same symptom not infrequently occurs where the morbid change consists of fine nodular exostoses on the fangs of the teeth. In these cases the pain is radiated from the spot of irritation over a large nervous area; but the tooth containing the offending growth is usually perceptible by tenderness or elongation, or a consciousness on the part of the patient that it is the centre of offence. Where it arises from an exostosis it is apt to be repeated with several teeth one after another. These cases are by no means uncommon, and are often made the subjects of unavailing medical treatment for a long time. Extraction of the tooth is the only remedy.

Wry-neck, epilepsy, and tetanus are three forms of muscular spasm which have been distinctly traced to the irritation of disease of the teeth in the adult. So likewise have been symptoms of angina pectoris.

Among the nerves of special sense which have been affected by reflex nervous action from tooth-irritation are the auditory and the optic; cases of deafness and of complete amaurosis having arisen from these causes.

There is a not infrequent form of muscular and sentient paralysis, affecting one or other of the arms, which has often been wrongly diagnosed, and led to much needless suffering and alarm. It consists of weakness, some pain, and occasionally loss of sensation in the arm and hand in question. Pain frequently commences in the side of the neck, or at the point of the shoulder; and is of an aching, weary character, much increased by any muscular effort of the limb, which usually hangs in a powerless listless attitude by the patient's side. The hand is feeble, and the patient has difficulty in grasping and shaking hands with cordial pressure. These symptoms are sometimes only induced by exertion. Such cases have been frequently supposed to depend on central nervous disease, and have been so treated. They may depend, however, on some irritation of a tooth of the lower jaw, usually a back molar, which is transmitted through the cervical and brachial plexuses of nerves. A carious or impacted wisdom-tooth is often the cause. Extraction of the tooth is followed by complete relief within a few hours. There are also on record some curious cases of perverted nutrition, in which the colour of the iris has been altered, and the hair at certain spots has become abruptly white; and ulcers have formed and refused to heal, in the neighbourhood of the neck and cheeks, all dependent upon dental irritation.

(*b*) *Direct affections.*—Direct affections of the nervous system, caused by tooth-disease, are far less common and less varied than those which are reflex, and their mode of production is more obvious and intelligible. The portio dura of the seventh nerve, the nerves which enter the orbit, and, very rarely, the dental nerves in their tracts in the jaw, are those only which suffer in this way, that is, are entangled in their course by those inflammatory influences and products which diseases of the teeth engender.

The consequences of the direct implication of nervous trunks by the inflammatory results of these diseases are so very grave, especially when affecting the nerves of the eye in their course to the orbit, and the ultimate results are so likely to become permanent when relief is not speedily given, that it is impossible to exaggerate their importance. Great stress must be laid upon this subject, because such cases may be misunderstood; and injuries have thus become permanent and irremediable, which, if correctly interpreted and properly treated at first, would have been easily obviated.

The entanglement of the portio dura leading to facial palsy has arisen from the plastic exudation around an upper back molar, and has been immediately cured by the extraction of the tooth. Instances have also been observed in which the nerves passing into the orbit, and probably within the orbit, have been surrounded with plastic exudation leading to the destruction of their functions, and to temporary or permanent loss of sight. The writers have seen several such cases; some were, and all might have been, completely cured by the early removal of the offending teeth. It is very rare indeed for the dental nerves in their passage through the jaw-bones to be pressed upon and functionally disturbed by the inflammatory products of carious teeth. But such cases have occurred, producing loss of sensation of the front teeth, lips, and chin.

(*c*) *Complex affections.*—In some instances the nervous symptoms are clearly of a mixed character, partly reflex and partly direct. This is no doubt the case in those remarkable and not infrequent examples of trismus in which the jaws are firmly closed by the spasmodic action of the masseter muscle, on the side where a carious or impacted lower molar tooth is keeping up irritation, and which is quickly cured by the extraction of the tooth.

The same may be said of those wide-spread and diffused pains, attended with extreme tegumentary sensibility, which so often accompany ordinary toothache.

11. **Odontomes.**—These are congenital fibro-plastic or osseous tumours, the result of morbid changes, such as hypertrophy and degeneration in the forming teeth.

12. **Periosteum, Dental, Diseases of.**—Under this heading we note the various phases of inflammation—from hyperæmia to suppuration (including a peculiar form of chronic inflammation, probably infective, which has received the name of *pyorrhœa alveolaris*, or Riggs's disease); mention must also be made of associated troubles, such as necrosis, exostosis, and absorption of the tooth-roots. Cysts also may be considered under this head.

(*a*) *Periostitis.* — Synon.: *Periodontitis*; *pericementitis.*—Dental periostitis may be acute, chronic, or diffuse.

When the nerve-pulp is dead and not aseptically treated, or perhaps is inflamed, either by caries, or by fillings injudiciously inserted, or by cold, the tooth may become tender to bite on, and slightly long and loose in consequence of *hyperæmia.* The inflammation may resolve, or the tooth become acutely tender or aching, and the gum over it red and injected; *acute periostitis* is now present. Resolution is still possible, but often suppuration ensues, the nerve, if previously alive, having meanwhile died; and the pain is intense, and worse at night; the gum swells, and pus is seen to be pointing; an *abscess* has formed. Relief is experienced by evacuation; the vent on the gum remains (*gumboil*), and the tooth settles down. A tooth may remain chronically tender, with periodic exacerbations, constituting *chronic periostitis*; and when so affected generally becomes tartar-covered and discoloured from lack of use.

Treatment.—The treatment of dental periostitis should be local and general. Locally, scarification or leeching of the gum is indicated in the early stages. Later stages demand counter-irritation, for instance, by means of a combination of 1 fluid drachm each of Fleming's tincture of aconite and liniment of iodine, and 10 minims of chloroform; which is painted on the gum; or capsicum plasters may be applied over the roots. The pointing of pus should be favoured by fomentation inside the mouth; and an abscess opened directly it points.

The general treatment should be a smart

purge at first, and perhaps tonics later in the case of enfeebled patients.

(*b*) *Diffuse Periodontitis.*—When this disease exists on both sides in both jaws, it is generally due to—(1) *Traumatism—e.g.* violent closure of the jaws by a blow; (2) *diatheses*—rheumatism, gout, syphilis, scrofula; or (3) *ptyalism*—referable to mercury chiefly; but also sometimes to copper, arsenic, or iodide of potassium.

The teeth are raised and tender, and the gum around them is congested. No suppuration occurs.

Treatment.—Hot fomentations of boric acid lotion are indicated for traumatic cases. Iodide of potassium will be useful for most of the others, combined with a mouth lotion of chlorate of potassium. Adynamic cases should have generous diet, port-wine, and quinine.

One or two teeth will sometimes cause tenderness of all the teeth on one side. Usually the cause is obvious.

(*c*) *Pyorrhœa alveolaris.*—This disease was first described by Riggs. It appears to be a chronic inflammation of the edges of the periosteum. It advances slowly in a ring-like manner from the neck towards the apex of the root, whilst ordinary periostitis spreads from the apex. As the alveolar edges are destroyed *pari passu* with the progress of the inflammation, the tooth or teeth become looser and looser, and are finally lost. The disease is probably mildly infective, and tends to spread through the medium of the pus which is constantly oozing from the margins of the gums. There is usually neither tenderness nor pain till a late stage. It attacks front teeth mostly, and when limited, as it frequently is at the start, it appears to have been excited by local irritants—food, tartar, or undue pressure of the bite.

Certain diatheses predispose to pyorrhœa, such as the gouty or rheumatic; and so do the specific fevers and valvular heart-disease, or other conditions in which there is congestion of the vessels of the periphery. Mercurial salivation also doubtless tends to produce it. In some of these cases the disease is present in all the teeth. Mr. Hutchinson calls it *sycosis dentium*; and compares it with *sycosis tarsi*.

Treatment.—This is a very intractable disease. Cure is seldom attained, and continuous attention is necessary to prevent it from getting worse and affecting other teeth. All tartar should be removed. Having painted the gum margins with cocaine solution (20 per cent.), we must syringe each one carefully and forcibly; then apply some strong antiseptic beneath the gum-margins, with a splinter of wood. Aromatic sulphuric acid and sulphate of copper crystals, powdered and mixed into a paste with pure carbolic acid, are favourite remedies. This procedure, alternated with the use of an astringent mouth-wash, such as tannic acid and eau-de-Cologne, seems the best available treatment.

(*d*) *Cysts.*—Cysts are occasionally found in connexion with the roots of diseased teeth as painless, slow-growing, bony swellings. The contents are fluid, often containing cholesterin flakes. Extraction of the tooth is the only remedy as a rule.

(*e*) *Necrosis.*—Necrosis is the term limited by usage to denote death of the cementum at any part, owing to more or less separation of the periosteum. It may be partial; and may exist coincidently with a living pulp and dentine; or it may be complete, in which case the whole tooth (dentine and cementum) is dead, and is soon shed by nature as a foreign substance. Partial necrosis may be due to abscess, pyorrhœa alveolaris, or exposure of a root by gum-absorption. Treatment is only possible in so far as it can combat these causes.

(*f*) *Exostosis.*—Dental exostosis is a disease resulting in an undue thickening of the cementum. It may occur as nodular excrescences; or as a general even thickening of the root. Sometimes it is obviously due to previous inflammation in an isolated tooth; in other instances it is present in several teeth, and has no such apparent connexion with pathological action. Frequently, perhaps most often, this condition may be present without any symptoms, such as pain, to lead one to suspect it; but sometimes it is the cause of tic-douloureux. After excluding other causes of pain, as caries and erupting wisdoms, such cases may appear idiopathic. At times the patient may indicate a certain tooth as the focus, which is apparently quite sound. It is fortunate, indeed, when a slight tenderness on rocking laterally confirms this. An isolated molar, whose well-worn top indicates that it has borne the greater share of mastication, is frequently the subject of exostosis.

Treatment.—The only remedy is extraction. In cases on record the pain has recurred in another tooth when one has been removed, and the roots of all showed this affection to be present. It is suggested that the diffuse periostitis of rheumatism and gout may lead to this wholesale exostosis, and hence treatment may be directed to these diseases.

(*g*) *Absorption.*—A process similar to the physiological one which causes the shedding of temporary teeth may occur pathologically in the roots of permanent sets. This may arise from similar causes to those of exostosis, only perhaps the inflammatory action is not so chronic. An alveolar abscess, or any foreign substances close to or perforating the cementum, so as to irritate the periosteum, may give rise to it. The pressure of the erupting crown of a neighbouring tooth may also cause it, as in the case of second molar roots pressed upon by an erupting wisdom tooth. Cases are recorded in which the cause was obscure, tooth after tooth being shed with apparently sound crowns, the roots of which showed all the absorption-signs of temporary teeth when shed.

The symptoms are obvious loosening of the teeth, with more or less tenderness. Treatment is usually hopeless.

13. **Pulp, Diseases of the.**—These are mostly phases or results of inflammatory action.

(*a*) *Hyperæmia.*—This is generally due to the loss through caries of the protection which healthy tooth-tissue affords against the thermal, chemical, and mechanical irritation of substances in the mouth. Metal fillings, being thermal conductors, are sometimes the cause of this condition.

The symptoms vary from mere discomfort, to sharp pain on taking hot and cold things. Acids and sweets produce similar effects.

TREATMENT.—The best treatment for this condition is to apply carbolised resin on cotton wool until the tooth can be stopped.

(*b*) *Acute inflammation.*—Acute inflammation of the dental pulp is the result of further progress of decay, so that the nerve-pulp is almost, if not quite, laid bare; at any rate the softened dentine probably extends to it. Metal fillings will also cause it—any filling, in fact, put in incautiously near to an exposed pulp. It frequently ends in death of the tooth because of the strangulation which the bony walls of the pulp-chamber produce on the congested tissue. A sharp throbbing pain, worse when the head is low, consequently at night, is characteristic. The tooth is generally not tender.

TREATMENT.—In the early stage a purge is necessary. A leech applied on the gum might possibly stop the pain, and save the nerve. Probably it is just as well to devitalise the nerve at once with arsenic; but this should only be done by the dental surgeon.

(*c*) *Chronic inflammation* has similar causes involved in its production. They act less acutely, and hence the results are different. The pain comes on at intervals, and is only acute when the pulp is actively irritated by food or pressure. A pulp so inflamed by exposure in a carious cavity gradually ulcerates away. Under a filling, or when not actually exposed by caries, it sometimes shrivels and dies.

(*d*) *Hypertrophy or polypus of the pulp* is one result of chronic inflammation. The congested pulp swelling into the carious cavity is irritated into exuberant growth by the sharp edges of the opening through which it protrudes.

(*e*) *Calcification* is occasionally due to inflammatory action, but cannot always be traced to it. It may take the form of general calcareous degeneration, or occur only as bony nodules in teeth often apparently quite sound. These nodules may give rise to neuralgic pains, the cause being suspected only when other possible causes are excluded. Additional testimony is sometimes afforded by the strong conviction on the part of the patient of the identity of the offending tooth. It is possible that the gouty or rheumatic diathesis may give rise to this trouble.

14. **Syphilitic Teeth.**—We are indebted to Mr. Hutchinson for the interesting discovery that children who inherit syphilis are liable to characteristic deformity of certain teeth, and that this is not infrequently associated with specific interstitial inflammation of the cornea. Syphilitic teeth are small, narrow, more or less pointed, and usually of a dirty-grey colour. Both the temporary and permanent sets may be affected; but it is the front teeth of the latter that exhibit the characteristic and most marked deformity. The lower incisors are peggy and pointed; those of the upper jaw are narrowed, instead of expanded towards the cutting edge; and the centrals frequently have a crescentic notch. The other irregularities of shape in the teeth may arise or be closely imitated, where there is no specific taint, but the crescentic notch in the contracted cutting edge of the superior permanent central incisor is believed to be diagnostic of inherited syphilis. As such, it is of great value to the physician in deciding on the nature of doubtful symptoms which may, or may not, have an hereditary syphilitic origin. Mr. Hutchinson considers that these malformations of teeth are occasioned by specific stomatitis. But perverted form and nutrition need not be inflammatory in origin; and it may be doubted whether such action arises in these cases. The teeth are dermal organs, and upon the skin syphilis inflicts some of its chief injuries, which need not be inflammatory.

15. **Toothache.**—The term 'toothache' can scarcely be used with critical accuracy, as it is popularly applied to any pain in or immediately round a tooth, without distinction as to its cause or character. Such pain may be produced by many conditions, the commonest of which is dental caries, with or without exposure of the pulp. But other influences may induce pain, scarcely to be distinguished from that of tooth-decay. Among these causes may be enumerated *impaction of the wisdom-teeth*, especially the lower; *inflammation of the tooth-pulp* and *periosteum*; *rheumatism*; *deposit of secondary dentine* in the pulp-chamber; and *exostosis.*

Excepting where pain is very severe, and of such a character as to assert its exact locality, it is not infrequently referred to a position, and to a particular tooth, other than the one affected. Where this is the case, it is mostly *anterior* to the locality of its origin; and is often only discovered by roughly manipulating or sharply tapping the teeth.

Toothache dependent upon *dental caries* usually arises when the decay approaches the tooth-pulp, and is the result of inflammation of it. The tooth-pulp consists very largely of nerves, and is closely boxed up within unyielding walls, so that its swelling gives rise to great internal pressure; hence the pain is of a very severe and distressing character. Inflammation frequently yields to complete or partial suppuration of the pulp; the escape of the matter being attended with marked relief. This may arise either from the breaking down of the external carious wall of the tooth, or from its finding vent through the orifice at the apex of its fang; and so constituting an alveolar abscess, which ultimately bursts, either as a gumboil within the mouth, or by a fistulous opening upon the cheek.

The *impaction of a wisdom-tooth* produces a form of toothache which is usually of a dull character, and gives a sense of tension and restraint. It arises from want of room for the coming tooth, the growth of which produces pressure on the contiguous structures. The pain often wanders along the whole jaw, and may appear to be especially associated with any other tooth on that side. Occasionally the second molar becomes so eroded, through absorption of its posterior fang by the pressure of the wisdom-tooth, as to cause inflammation of its pulp, in which case there may be acute toothache and loosening of the tooth

Inflammation of the tooth-pulp may sometimes occur spontaneously, and thus give rise to pain.

Inflammation of the periosteum around any particular tooth, the result of disease or any external violence, may have the same effect. It is said also that the inflammation of the fibrous tissues round the teeth may be of a rheumatic character, but of this there is no positive evidence. It may, however, arise from syphilitic periostitis, and from the administration of mercury when pushed to the verge of salivation. Iodide of potassium has sometimes a like effect.

Secondary dentine and *exostosis* may also be associated with toothache, which is frequently of a neuralgic and wandering character, so that it is often difficult to fix upon the offending tooth. It is difficult to say whether the pain results from the pressure of the adventitious growth, or whether they are both the result of some sub-inflammatory condition.

Treatment.—The treatment of toothache consists in attention to the general health; in local applications; and in extraction of the offending organ. Tonics, especially quinine, are often useful where the pains are of an inconstant and neuralgic character. Food and stimulants, especially wine, would also give relief in such cases, where the patient is below par. When the toothache arises from caries, great relief is experienced in the early stages by the application of creasote or carbolic acid. Where pus is pent up within the pulp-cavity it should be evacuated, either by opening the pulp-cavity from above, or by drilling the tooth.

Where the pain arises from impaction of wisdom-teeth, relief from pressure must be given by extraction. If the wisdom-tooth cannot itself be got at, the second molar should be taken out. In all cases where the pain has become excessive and intractable, removal of the tooth is the only remedy.

S. J. Salter. J. Hamilton Craigie.
R. C. Ackland.

TEETH, Grinding of. — Automatic movements of the mouth are common to many diseases, especially in young subjects. In cerebral disorders in children we often notice a vertical movement of the jaw, as if the patient were chewing. At other times the movement is a lateral one, and the teeth are ground together, so as to give rise to a hard unpleasant grating sound. This symptom is not, however, necessarily dependent upon disease of the brain, nor is it peculiar to early life. Grinding of the teeth may be observed at all ages, and in many different complaints. It is frequently spoken of as a symptom of worms, and is, indeed, often present when the alimentary canal is infested with these parasites; but the symptom is in such cases quite independent of the worms, and is to be ascribed merely to the intestinal derangement which is the essence of the disease, the presence of worms being merely an accidental complication. Disordered bowels are by far the most common cause of grinding of the teeth; and therefore, with the exception of cerebral disease, this symptom is almost confined to such disorders as are accompanied by derangements of the alimentary canal. Thus children with tuberculosis often grate their teeth together with painful persistency; but in this disease an acid condition of the contents of the stomach and bowels is an almost invariable complication. Again, in rheumatism and gout, where there is the same tendency to acid fermentation of food, grinding of the teeth is a common symptom in the adult.

The movement of the jaw occurs, as a rule, independently of the will, and is seldom noticed except during sleep. Sometimes, however, children will grind their teeth voluntarily, and apparently with full consciousness of what they are doing. Such cases are, however, rare.

The *treatment* of teeth-grinding consists in the correction or removal, if possible, of the condition upon which it depends.

Eustace Smith.

TEETHING, Disorders of. — *See* Dentition, Disorders of.

TELANGEIECTASIS (τῆλε, far; ἀγγεῖον, a blood-vessel; and ἔκτασις, a dilatation).—Aneurysm by anastomosis. *See* Aneurysm; and Tumours.

TELESE, in Italy (Benevento).—Sulphur waters. *See* Mineral Waters.

TEMPERAMENT. — Synon.: Fr. *Tempérament*; Ger. *Körperanlage.* This term denotes the correlation of grouped differences existing among men, in respect of physical structure and conformation, with differences of functional activity, of mental endowment and disposition, and of affection by external circumstances.

The early writers on medicine, recognising the facts that each individual man is different from all other men in physical appearance; that, again, in every man are found qualities proper to himself, inherent and indestructible; that, again, on a review of many men a constant association of certain qualities with certain variations in physical appearance may be observed, proceeded to make generalisations, tending to the doctrine of temperaments. This doctrine, as fully set forth by Galen, established nine kinds of temperament. First, the *balanced* temperament (*εὐκρασία*, *temperies*), consisting in a mixture of different qualities in such due proportion that none is in excess. Next, four temperaments of simple excess or default—the *hot*, the *cold*, the *moist*, and the *dry*; and then four mixtures of these—the *hot and dry*, the *hot and moist*, the *cold and dry*, the *cold and moist*. Subsequently, under the influence of the humoral pathology, temperaments were classified as *sanguineous*, *bilious*, *phlegmatic*, or *melancholic*, according as the heart, the liver, the head, or the spleen was supposed to be predominant in modifying the humours of the body. More recent writers have again abridged the list, and have given its categories a new interpretation. They mostly acknowledge but three temperaments—the *sanguine*, the *nervous*, and the *lymphatic*. The balanced temperament is not included, because no individual of such perfect structure exists. But it is equally true that the descriptions by which the other terms are defined represent either individuals used as types, and therefore correspond fully only to one or very few of the units of large genera, or are constructive types corresponding to no single existence.

Regarding the method of classification as wholly artificial, yet without denying its usefulness, we propose to preface the generally accepted description of the three temperaments above mentioned by a brief analysis of Galen's picture of the *εὔκρατος*. The thoroughly tempered human being is in his bodily constitution exactly midway between slimness and stoutness, between softness and hardness, between hot and cold. In his mental constitution he exhibits the exact mean between rashness and timidity, between sluggishness and precipitancy, between the sweetness of pity and the bitterness of hatred. Such a one is brave, affectionate at home, and abroad discreet. To these essentials are added, of necessity, temperance in eating and drinking, perfect digestion and assimilation of food, physical and psychical energies without a flaw, the best powers of feeling, the best powers of movement, a clear skin, a good breath. He is neither too much given to sleep nor too wakeful, is midway between baldness and hairiness, between darkness and fairness of complexion. When a child he has reddish rather than black hair, in adult life the reverse.

The three modern categories correspond fairly to Galen's mixed temperaments: the sanguine to the hot and moist, the nervous to the hot and dry, the lymphatic to the mixtures of cold with moist or dry.

The Sanguine Temperament.—Persons belonging to this group are described as being ruddy and bright of complexion, as having strong and salient muscles, a relatively large chest, and a relatively small head. The play of their senses, the determinations of their will, the responses of their muscles to impulses, are energetic and well-directed. Arterial blood abounds in them; their veins are small. The functions of their bodies are rapidly and easily performed. The functions of their minds show a similar vivacity. Rapid thought, quick imagination, brilliant courage, are associated with want of depth and persistence, with elastic forgetfulness even of strong impressions. In illness such people inflame quickly, develop diseases in a complete and regular way, and defervesce quickly, often with well-marked crisis. They are especially liable to gout, acute inflammations, and active hæmorrhages. They are men who dominate their fellows.

The Nervous Temperament. — Herein, as authors tell us, the skin is dark, dull, earthy, or sallow, and is hot and pungent to the touch, instead of being warm and moist. The cranium is large in proportion to the face; the muscles spare and not well-defined; the chest narrow; the circulation languid, with preponderance of the venous system. The face has the lineaments of energy and intensity of thought and feeling; the movements are hasty, abrupt, often violent, in alternation with languor. The affections are violent and persistent, the sexual passions usually very strong. Sensations are intense, far in excess of exciting causes. The mental powers are large and capable of persistent exercise. The bodily organisation favours venous congestion and hæmorrhage, neuralgia, hepatic and intestinal obstructions, and the mental lunacies. Nevertheless, these people are often found to endure long fatigue, privation, and exposure better than the sanguine. They are the people who teach or lead their fellows.

The Lymphatic Temperament.—A heavy ill-proportioned ungainly form of body, large joints, bulky head, large hands, broad flat feet, light or reddish hair, a sallow or pasty complexion, accompany a general slowness and languor of bodily function. The muscles are often large, but their movements are awkward or inaccurately directed; the chest and heart are inadequate in bulk to the rest of the body. With this, there may often be combined much mental firmness, solidity, and constancy—a good judgment if a poor energy. The power of resistance to acute disease is inferior; the tendency to chronic diseases, particularly of strumous and asthenic kinds, is pronounced.

In the sanguine temperament a predominance of blood-making power and of muscular development is asserted. It may, perhaps, be spoken of as the temperament in which the spinal system and the parts directly subordinate thereto are most developed. In the nervous temperament the predominance of the cerebrum is clearly indicated. In the lymphatic temperament, languor or slowness of both nervous and circulatory systems is connected with slowness or default of the general nutrition.

Practically these types comprehend only a part of mankind. If we admit that they can be extended in their application by the recognition of mixtures of them among themselves in various proportions and degrees, we must admit also that there exist, outside of them altogether, numerous correlations of much importance to the physician. Moreover, many of the constituents of temperaments are capable of being changed by age, external circumstances, and habit. New combinations may be introduced by these agencies, or by bodily changes arising in accident or disease. The building anew of a man's temperament by religious enthusiasm, by suffering, by moral control, or by indulgence, is a spectacle daily to be seen and studied. In that analysis of the *κρᾶσις* of the individual which must furnish the interpretation of much of his behaviour in illness, the accurate estimation of many combined influences, native and accessory, has been called the stumbling-block of practice. It may better be called the touchstone of practical skill. That physician does well who carries with him a mental picture of some such perfect human animal as Galen has imagined; and who marks on the diagram, with his patient before him, the lines of original shortcoming, of development, of warp, of injury, of degeneration, so as to arrive at some clear sight of the outcome or resultant of all in the present organisation and reactions of that patient.

William M. Ord.

TEMPERATURE. — Synon.: Fr. *Température*; Ger. *Körperwärme*; *Eigenwärme.*

Introduction.—The human body, like that of all warm-blooded animals, has a heat of its own, which is, to a great extent, independent of the surrounding temperature. As long as the body is in a state of health, the external circumstances must either very materially change, or a change of them must operate for some length of time, before any but a transitory elevation or depression of the blood-heat will occur. But the temperature becomes much more easily altered when the normal action of the nervous system is disturbed, or when, in consequence of disease, or because toxic or infectious substances have been introduced from without, the chemical processes in the body become altered. A change of the blood-heat is often the very first symptom of a disease, and it may occur even before the slightest indisposition is felt by the patient. Hence observations of the temperature may be extremely valuable for diagnosis, and the course of most diseases being accompanied by corresponding alterations of temperature, which in many diseases are quite typical, the great importance of closely watching the course of the temperature becomes evident. Clinical medicine has by the use of thermometry entered on a new phase, having gained the means of a numerical expression for variations of complex states of the system which the practitioner, from the indications of the thermometer, may detect earlier and judge of more correctly than by any other symptom. For an exhaustive account of the changes of temperature which may be observed in health, and especially in disease, the reader may be referred to the classical work of Wunderlich, translated for the New Sydenham Society.

Sources and Regulation of the Body-Heat.—The sources of animal heat must be chiefly sought for in chemical processes, especially oxidation, which are constantly going on in the blood and tissues, above all, as shown by Speck, Zuntz, and others, in the muscles under the influence of the nervous system. To a minor degree various processes of a purely physical nature, such as friction, or the transformation into heat of other forms of energy, themselves the outcome of chemical processes, have also a share in its production. But the generation of heat within the body does not explain the fact of the blood-heat being constantly kept at the same level. This fact presupposes that the amount of heat produced is exactly equalled by the sum-total of the losses of heat which are constantly going on—at the surface of the body by radiation and evaporation, from the lungs by evaporation and by the warming of the colder air taken in at every inspiration, in muscles when mechanical work is done, in the intestinal canal by the warming of ingested cold food or drink, and, lastly, by the dejecta which leave the body. Any disturbance of this equilibrium must be followed either by an increase or by a lowering of the general temperature. But there is another factor, without which the maintenance of this equilibrium, and an equal distribution of the heat throughout the body, would be impossible, namely, the circulation of the blood. By this means a regulation of the loss of heat may be effected whenever required, the blood-supply to the skin varying as the arteries dilate or contract under the influence of the vaso-motor nerves. But not only the losses of heat may be varied, but its production also is capable of being modified, under the influence of the nervous system. Whenever the external temperature would cause too considerable a loss of heat, the peripheral arteries contract, and the circulation becomes slower; heat is thereby retained in the body, but at the same time the heat-producing processes in the muscles are stimulated to increased action, as shown by the quantity of carbonic acid given off being increased. When, on the contrary, the loss of heat on the surface is prevented, as in a very hot room, *e.g.* a hot-air bath, the peripheral arteries dilate; the heart's action becomes accelerated; and a much greater quantity of blood flows through the skin and peripheral parts, the sweat-glands pouring forth an increased quantity of sweat, which, by its evaporation, tends considerably to lower the temperature. At the same time the respiration also is accelerated. Besides the vaso-motor apparatus, there appears, from experiments made by Aronsohn and Sachs, Girard, Isaac Ott, Girard, and Hale White, to exist a centre for the regulation of heat-production in the corpus striatum of the brain, the cortex of which, by voluntary as well as by reflex action, also has its share in the maintenance of the proper heat of the body. Thus a most wonderfully precise reflex-mechanism regulates the heat of the body, by altering the production as well as the loss according to necessity.

Temperature in Health.—The heat of the blood is at every moment of life the result of different forces balancing each other, namely, the heat-producing and the heat-destroying processes and influences. So, also, the temperature of a single part of the body results from the heat-production going on within it and its exposure to cooling influences, and is chiefly dependent upon its blood-supply. The heat of the body is, therefore, most variable on the surface, and is lowest in its uncovered parts, especially in the most projecting ones; almost uniform, on the contrary, in the interior, where only slight differences, amounting to a few tenths of a degree, exist. In the lower animals Claude Bernard found the temperature highest in the hepatic veins and the right auricle. The heat of an organ increases when its functional activity is heightened, as, for instance, when the brain, a muscle, or a gland, is stimulated to increased function.

It is necessary for practical purposes to consider chiefly the temperature in the interior, or the blood-heat. The blood-heat is measured, as nearly as possible, by means of the clinical thermometer. *See* Thermometer, Clinical.

In healthy man the temperature of the body, as measured in the axilla, is about 98·6° F. (37·0° C.) Inside the mouth, underneath the tongue, it is almost the same; whereas in the vagina or rectum it is 0·3° to 0·6° higher. Under special circumstances—for instance, when a considerable cooling of the surface takes place, or when the skin freely perspires—the difference may be somewhat greater, and there may be a difference of 20° between the temperature of exposed parts of the skin and the interior; on the other hand, all parts may be pretty equally warm in the morning in bed, or in a warm room, or when the circulation has been influenced by slight exercise, or by a good meal and a moderate amount of alcohol. Of considerable influence upon the temperature of the surface of the body is the amount of fat in the subcutaneous tissue. In plump children and in very obese adults the surface may be considerably colder than the interior, and in the latter case there generally is yet another and even more effective cause for this difference, namely, weakness of the heart's action.

The temperature of the body is not the same all through the day. Numerous careful observations, of which those of Jürgensen, Liebermeister, and Ogle may be specially mentioned, have shown that the temperature of a healthy person, even when kept entirely at rest in bed, will fluctuate from about 1·8° to 2·3° F. in the course of the twenty-four hours; the mercury standing lowest between 2 a.m. and 6 a.m., and then gradually rising until it reaches the highest point between 5 p.m. and 8 p.m. This rise is mostly not continuous, but becomes somewhat slower, or even interrupted by a slight decrease, in the middle of the day, the afternoon hours showing a more rapid elevation.

This daily fluctuation of the body-heat is a fact of fundamental importance, for it not only takes place in health, but also when, in disease, the whole range of the temperature is either depressed or abnormally elevated. The causes of this daily fluctuation of temperature are not yet fully made out; but this much is certain, that rest and movement, as well as the taking of food, have some share in producing it. Another cause which must not be overlooked, and which was pointed out by Liebermeister, is the force of habit and inheritance.

Race and sex have no influence, to speak of, upon the range of the temperature. Age, on the contrary, has by different observers been found to influence the range as well as the daily fluctuation. In the infant, immediately after its birth, the temperature is slightly higher than later on, its temperature in the rectum having even been found higher than that of the vagina of its mother. A higher range is maintained in the first weeks of life, and there has also been found wanting in infants that steady course of the daily fluctuation which is observed in adults. In children, even somewhat more advanced in age, the temperature is still easily influenced by external changes, and the range of the daily fluctuation is greater. In old age, again, the range is a little higher than in adult life, and here, also, a greater mobility of the temperature under various external causes is observed. The menstrual process, as shown by Goodman, Mrs. Jacobi, and Reinl, causes a slight elevation of temperature, amounting, however, to only a few tenths of a degree in the pre-menstrual period, which goes gradually down again during the flow and after it is over. Pregnancy has no appreciable influence in healthy women. Parturition slightly increases the temperature, evidently by the increased muscular action, an increase which is compensated by a corresponding fall after the birth of the child. If no complications occur, the temperature in the puerperal state generally does not deviate from the normal.

Such, in fact, is the constancy of the body-heat in health, that the general conditions of life, occupation, &c., hardly show any influence upon it, and whenever, by muscular exertion, or by the effect of external heat or cold—as, for instance, by baths of various temperatures—a more considerable deviation from the normal range has for a time been caused, there is a strong tendency in the system to compensate the increase or the loss of heat by a corresponding fall or rise afterwards. This faculty is somewhat altered in disease; and even in those states which are on the borderland of disease, we frequently find a less perfect action of the regulation of the local or general temperature of the body.

Local Changes of Temperature.—Local changes of temperature are brought about by external thermic influences acting locally, or by disease. Local stoppage of the blood-supply or local death lowers the temperature of the part; inflammation, in its first stage, raises it. Considerable local changes of temperature may arise simply from vaso-motor disturbances. Thus, in a paralysed limb the temperature may either be lower or higher than in the corresponding limb of the other side; in hemiplegia the temperature of the paralysed side is frequently found 0·5–1·5° higher than on the normal side. Neuralgia is sometimes accompanied by dilatation of the blood-vessels, and a considerable rise of the local temperature; and, as a purely vaso-motor disturbance, local heat and redness of the skin, due to a passing dilatation of blood-vessels, sometimes occur in hysteria.

Changes of the General Temperature.—Of much greater practical importance than local disturbances of the body-heat are changes of the general temperature, such as occur in many diseases, whether of the nature of *depression* or of *elevation*.

1. Depression.—Depression of the general temperature is observed as a consequence of considerable loss of blood; in starvation from any cause; and in the wasting of some chronic diseases, such as cancer of various organs, or in diseases of the brain and spinal cord. In brain-disease, with the symptoms of melancholia, extreme coldness of the surface and lowering of the general temperature occasionally occur. In a case of hæmorrhage into the medulla oblongata, Lemcke observed a temperature as low as 73·4° F. (23° C.) in the rectum twenty-seven hours before death; and extreme loss of heat, though hardly to such a degree, by vaso-motor paralysis and dilatation of the blood-vessels, may be caused by severe injuries to the upper part of the spine. In a very rapid manner a considerable fall of temperature may take place in the collapse sometimes occurring in the course of typhoid fever, but especially in that of acute peritonitis, and of poisoning by various substances. In the collapse of cholera the lowering of the temperature of the axilla may be considerable—a temperature as low as 89·6° F. (32° C.) in the axilla, and even less under the tongue, having been observed, at the same time the temperature of the interior of the body being generally very high, reaching 104° F. (40° C.), and sometimes much more. In peritonitis a low general temperature may be present for days, even if the peritonitis supervene in the course of typhoid fever. With the collapse caused by alcoholic intoxication great depression of the general temperature occurs when the patient is exposed to cold and wet; and in a case of carbolic-acid poisoning, which came under the observation of the writer, the vaginal temperature fell as low as 93·92° F. (34·4° C.) A temperature of 71·6° F. (22° C.) has been observed in sclerema neonatorum.

In chronic diseases of the respiratory organs, not of an inflammatory or tuberculous nature, as well as in chronic heart- or kidney-disease, the temperature is generally found somewhat below normal; and the same is the case in chronic nephritis, more especially in those cases accompanied by general dropsy. In cases of the latter kind we even sometimes see a febrile temperature, caused, for instance, by tubercular disease of the lungs, become considerably abated, if not entirely reversed, when chronic kidney-disease supervenes; as also when intestinal ulceration becomes more prominent, or leads to peritonitis. From some observations of the writer of this article, it would seem as if intracranial disease, such as softening or tumour, arising during the course of a febrile disorder, *e.g.* pulmonary phthisis, may not only disturb the regularity of the febrile temperature-changes, but, by a kind of inhibitory action, entirely suppress the febrile elevation of temperature.

2. **Elevation.**—Elevation of the general temperature, as part of the febrile process, is the most prominent symptom in most diseases of an infectious origin, with or without inflammation. In both an increased production of heat, no less than a disturbance of the regulation of the temperature, is the effect of the presence in the blood of some foreign substance, acting injuriously on the nervous system, and causing altered chemical processes. Modern research gives the most prominent part in these actions to organised bodies (fungi, bacteria), which, in themselves, or, more probably, by chemical products of their own life-changes, or by the changes which they cause in the fluids of the body, are assumed to be the cause of the febrile process, and thus of the increased temperature.

Some such substances, belonging chemically to the albuminoids and acting as ferments, have recently been extracted from pure cultures of the yeast-fungus by Roussy, and of various bacteria by Koch (tuberculin), Buchner, and others. *See* FEVER.

The proper balance of the heat-forming and heat-destroying processes may also be disturbed by other influences acting upon, and by primary diseases of, the nervous system. When the body is subjected to external cold after it has been fatigued by exercise and already cooled by perspiration—if, for instance, a cold bath were taken under such circumstances, a rigor, with rapid rising of the temperature, may follow; but, no local disease becoming developed, the temperature quickly goes down again amid profuse perspiration, and the whole attack may be over. Or a disturbance of the heat-regulating functions of the nervous system may be caused by the irritation of some nerve-filaments, as by a gall-stone passing the biliary duct, or a stone passing the ureter or the urethra, and a febrile attack will follow. The rigor, leading to a high fever of an evanescent character, which may follow the introduction of a catheter (urethral fever), sometimes belongs to the same group of cases. But generally, in cases of this kind, the nervous system is already in an abnormal state through the previous disease of the kidneys or bladder. The functions of the nervous system may further be deranged by injury; and a rise of temperature has not only been observed in injuries to the brain, but, in a most excessive degree, sometimes after injury of the cervical part of the spinal cord, when temperatures of 110° to 111° F. (43·3° to 44° C.) have been observed (B. Brodie, H. Weber, Teale, and others). In tetanus a very high temperature may occur, rising still higher a little after death; as much as 112·55° F. (44·75° C.) was reached in a case observed by Wunderlich. An alteration of the heat-regulating functions of the nervous system may be brought about by a considerable external heat acting upon the body, especially when combined with moisture of the air. In cases of sunstroke or heat-stroke, it is quite common to see the temperature of the body rise to 108° F. (42·2° C.) and more; and it would seem probable that a febrile elevation of temperature, if going on unchecked for a considerable time, by causing exhaustion of the nervous system, may lead to hyperpyrexia. Thus it is not very uncommon to see the temperature rise excessively in infectious diseases, especially scarlatina, towards the close of life (*proagonic hyperpyrexia*); and the temperature may, in such cases, even rise a little more immediately after death. This is due to the losses of heat being greatly reduced after the stoppage of the circulation, the heat-production going on in the interior for a time; and the gradual failure of the circulation probably also takes a great share among the causes of a proagonic hyperpyrexia.

Hyperpyrexia sometimes comes on in the convalescence from acute rheumatism, even after the fever has entirely subsided, and when the patient is on the point of being discharged from the hospital. An excessive rise has occurred and caused death in severe cases of hysteria; and in hysterical patients hyperpyrexia has occasionally been observed without any of the symptoms which in other cases usually accompany so grave a phenomenon. Cases of this kind are extremely suspicious, and in some of them it was discovered how this hyperpyrexia was simulated. Thus a patient had driven up the mercury by rubbing the bulb of the thermometer between the folds of her night-dress; whilst in other cases the high elevation of the mercury had been brought about by means of a hot poultice, or by the patient having lowered the top of the instrument, so that the column of mercury began moving by its own weight. This, however, is not possible with a thermometer of the thin bore which English thermometers now generally have. A very high temperature, to which the pulse and respiration and the other symptoms do not correspond, must always arouse a suspicion that the rise of the mercury has been artificially produced, and the verification will be easy if the physician carefully watch the mercury as it rises, or by taking the temperature in the rectum or vagina.

The very important part which the nervous system plays in regulating the blood-heat is also seen in the great liability of the temperature easily to deviate from the normal range during convalescence from acute disease, when the weakness of the nervous system, brought on by the previous illness, will show itself in this no less than in other alterations of function. This can frequently be observed in convalescence, not only from the specific fevers, but also from pneumonia and other acute febrile diseases, when trifling external influences may cause a considerable rise of the temperature, which, however, is generally of short duration only, but which, in the case of specific fevers, may cause apprehension lest a relapse be coming on. In a somewhat different manner, and more lasting, a slight sub-febrile elevation of temperature may be observed in the convalescence from acute rheumatism, where it may persist for weeks without any joint or heart symptoms being present.

Significance of Abnormal Temperature for Diagnosis and Prognosis.—The maintenance of the heat of the body at a certain range being so insured, any deviation of the general temperature from the normal standard, however slight in degree, and unless of a very transient nature or brought on by evident external causes, is to be taken as a sign of disease. Such deviation may be of a variable degree, along with symptoms which, in part, are the consequence of the abnormal temperature, such as an abnormal rate of pulse and respiration, and nervous symptoms. The whole range of deviation within which life can be maintained is comprised between 90° F. (32·3° C.) and 110° F. (43·4° C.) A temperature approaching either end of this range indicates a condition of extreme danger, which is already great with a temperature of 95° F. (35° C.), or beyond 106·5° F. (41·5° C.) With reference to the general condition of a patient who presents an abnormal temperature, a few distinctions may be conveniently tabulated.

(1) *Temperature below the normal*:—

(*a*) Temperature of collapse, below 97° F. (36·2° C.)

(*b*) Subnormal temperature, 97–98° F. (36·2–36·7° C.)

(2) *Normal temperature*: 98·0–99·5° F. (36·7–37·5° C.)

(3) *Temperature above the normal*:—

(*a*) Sub-febrile temperature, 99·5–100·5° F. (37·5–38·05° C.)

(*b*) Febrile temperature of moderate degree, 100·5–102° F. (38·05–38·88° C.), morning; 102·2–103° F. (39–39·44° C.), evening.

(*c*) Febrile temperature of high degree, 102·5° F. (39·2° C.), and more in the morning; 105-106° F. (40·6–41·1° C.) in the evening.

(*d*) Hyperpyrexia, 105·8–107·5° F. (41·42° C.) and more. Extremely dangerous.

Single Observations.—Near the ends of this scale a single observation of the temperature of a patient may at once decide the prognosis. Thus a temperature below 93° F. (33·88° C.) or above 108° F. (42·22° C.) is almost always fatal, although cases have recovered by active treatment in which the latter point has been exceeded by several degrees. No less valuable may single observations be for diagnosis, chiefly in a general way, in showing that there is disease when, perhaps, no other symptom points to it, but also for the diagnosis of a special disease in some instances. Where there are other symptoms of disease, the discovery of an abnormally high or a febrile temperature may at once give quite a different aspect to a case, as, for instance, when a patient who has been suffering for some time from a troublesome cough without expectoration, but in whom the most careful examination of the chest could not detect any lung disease, is found to have pyrexia. The suspicion that there is commencing phthisis may thereby be at once confirmed, or aroused for the first time. Or, again, in a case where the patient simply complains of dyspepsia and lassitude, the thermometer may give a degree of heat which would not have been expected either from the looks of the patient or from the temperature of his hands or chest, and the attention may thereby at once be directed to the possibility of the case being one of typhoid or some other specific fever. One reservation must be made with regard to single observations in patients who have not been kept at rest for some time before, for example, in patients who have walked to the physician's house, or who had to undergo a journey to the hospital. In such cases the temperature may be somewhat altered by the fatigue; and it is quite common to find the first temperature in a patient, immediately after his admission into the hospital, considerably higher than after a few hours' rest, or, if he have been exposed to cold, much lower than what would otherwise correspond to his condition.

Systematic Series of Observations. But of much greater value than isolated observations of temperature is the regular and continued watching of the course which the temperature takes in a disease. Many diseases present a deviation from the normal temperature showing a typical course as regards the duration, as well as the daily fluctuations, of the abnormal temperature. The course of its temperature being part of the natural history of a disease, the study of this is of great importance for diagnosis.

Types of Pyrexia.—First, it is *the mode of rising* of the temperature which varies, and by which some diseases may be distinguished. In some diseases a contraction of the peripheral arteries takes place at the onset, which, by diminishing the peripheral circulation and the giving off of heat, leads to a rapid rise of the internal temperature, and is accompanied by a sensation of cold. In pneumonia, therefore, and other diseases commencing with a rigor, the temperature rises rapidly and continuously to a height of 104° F. (40° C.) or more; whereas diseases with a more gradual beginning show simply a slow elevation of the normal range, both morning and evening temperatures becoming gradually higher, the usual daily fluctuation being maintained. Thus, in the first few days of typhoid fever the temperature rises every day about 2° F.; but the temperature going down again in the morning by about 1° F., the maximum of about 105° F. is only attained on the fifth or sixth day.

At *the height* of a disease the temperature may fluctuate round an average temperature of about 103° F. (39·5° C.) or more, whilst it shows the same daily course as in health, that is, being lowest in the morning and highest in the evening. The range of this daily fluctuation may, however, differ considerably in different diseases; and according to the extent of the daily fluctuation three types may be distinguished. When the daily fluctuation of an elevated temperature shows only the normal difference, or even a smaller difference, between the morning and evening temperatures, we speak of *continuous*, or, more correctly, *sub-continuous* pyrexia; when the difference is greater than the normal, the remission having a tendency to a low temperature, and the exacerbation, on the contrary, to a considerable rise, the pyrexia is called *remittent*; and, thirdly, when the remissions reach the normal, or recede even below it, we have the *intermittent* type of pyrexia.

A *continuous* elevation of temperature is observed soon after the commencement of a disease, and during its height.

Considerable *remissions*, or even *intermissions*, of the febrile temperature are principally observed in the decline of some acute diseases, and in chronic inflammatory diseases, especially of a tubercular nature, or in chronic syphilitic affections, in pernicious anæmia and leukæmia, as well as in some cases of lymphadenoma (Hodgkin's disease), the remissions generally becoming more marked as the exhaustion of the patient increases.

The *intermittent* type of pyrexia is most typically shown in malarial diseases, in which the elevation of temperature may follow a quotidian, tertian, or quartan type. The same also sometimes occurs in chronic tubercular disease of the lungs and in pyæmia. Pyrexia of a remittent type may present a peculiarity which is worthy of note, as being of some diagnostic value. Whereas in the great majority of cases the daily fluctuation follows the rule of health, the exacerbation taking place in the evening, we sometimes meet with cases where this order is reversed, the rise taking place in the morning, and the remission occurring in the evening. This 'inverse type,' as Traube called it, of the daily fluctuation of a febrile temperature has been observed in some rare instances in typhoid fever; more frequently in cases of chronic lung-disease. In doubtful cases of inflammation of the lungs it has some significance as to the disease belonging to the class of phthisis.

Slight deviations in the maximum daily rise of a febrile temperature occur sometimes in this way, that the height is reached in the middle of the day, or that the exacerbation takes place in the night, or that two or more considerable elevations, instead of one only, take place in the twenty-four hours. Such occurrences, which have been observed in typhoid fever and in phthisis, can, of course, only be found out by the observations of the temperature being repeated with sufficient frequency. A more frequent application of the thermometer will also be necessary in some cases of ague, where the attacks are not well marked, or occur in the night, in order correctly to judge of the case.

The *decline* of the elevation of temperature, at the termination of a disease, may be gradual, the daily fluctuation, however, taking place as usual; or it may be rapid, by a continuous sinking of the temperature to, or somewhat below, the normal, in the course of from twelve to thirty-six hours, or even in six to eight hours, as in relapsing fever. The latter mode of termination of a fever is called *crisis*, whereas the former is designated *lysis*. A crisis may sometimes be accompanied by symptoms of collapse, and, in some rare instances, by acute delirium, which, however, generally passes off within a day or two, and is not of bad omen provided the general condition of the patient remain good. Symptoms of this kind, as well as a more considerable elevation of the temperature just previously to its fall, or a great irregularity in the course of the temperature preceding it, may be called *perturbatio critica*. It would appear that diseases caused by the action in the system of some foreign substance—as, for instance, some infective agent, its action being of a limited duration—have a tendency to a critical defervescence. Diseases, on the contrary, in which an organ has become materially altered, as by an injury, or by some infection either primarily or, in the course of a chronic disease, by the duration of the morbid action, or by some supervening secondary infection, show a slow decline of the pyrexia, with a tendency to a remittent type. The repair of the damaged structures taking some time, the decline of the pyrexia is slow, and the defervescence by lysis. Examples of the former mode of defervescence are furnished by acute pneumonia, erysipelas, typhus, relapsing fever, and measles when not complicated by more serious inflammation; the latter type is shown by typhoid fever, in which the specific process produces deep alterations in the glandular structures of the intestine, which persist for some time after it has terminated. The ancient physicians believed that a crisis took place on certain days in particular, as, for instance, the seventh day of an illness; but more extended experience, gained by means of the thermometer, has shown that, although a change or a termination of a disease take place at a certain definite period, the latter is not bound to one particular day. *See* CRISIS.

Any *irregularity of the course* of the temperature in a disease in which, as a rule, it runs a very regular and definite course, is indicative of some disturbance or complication, and its early detection is therefore important for diagnosis, no less than for prognosis and treatment.

On *the approach of death* the temperature in many cases gradually sinks; but instances are not of rare occurrence in which, on the contrary, especially in diseases with high fever, a continuous rising takes place towards the fatal termination, reaching sometimes hyperpyretic degrees.

In *convalescence* the temperature is more easily influenced by external causes, as well as by internal changes, and the approach of a relapse or complication being at once indicated by a rise of temperature, the continuance of regular thermometrical observations in the first period of convalescence is of very great importance; the more so, as convalescents are sometimes not sensible to changes, which at first only show themselves in an alteration of the temperature.

TREATMENT.—Abnormal states of temperature ought not, as a rule, to be considered as objects of treatment by themselves, all the concomitant symptoms, in fact the whole state of the patient, having to be taken into consideration, in order properly to treat a case of febrile disease. But there are exceptional cases in which the state of the temperature at once urgently requires a symptomatic treatment. Such are, for instance, cases of *hyperpyrexia* in sunstroke or heat-stroke, in which the most energetic means ought at once to be applied to reduce the temperature. As the experience of American physicians has shown, life may in such cases sometimes be saved by perseveringly rubbing the surface of the body with large pieces of ice, using at the same time stimulants by the rectum or subcutaneously. A rapid abstraction of heat by rubbing with ice, or cold bathing with affusions, may also be the only means of saving a patient in whom, in the course of acute rheumatism, hyperpyrexia has set in; and a case published by the late Dr. Wilson Fox, in which the temperature reached 110° F. in the rectum, is very instructive in showing that external cooling may be successful, when even very large doses of quinine (120 grains had been given in six hours) had been administered without effect. The same plan must be followed in hyperpyrexia occurring in the course of other diseases. Complications, such as pneumonia, do not contra-indicate this treatment, the success of which is, however, dependent upon the possibility of rousing the nervous system, and upon the circulation remaining sufficiently active.

An *abnormally low temperature* requires the external application of heat, which will be materially assisted by warm stimulating drinks or injections, using eventually subcutaneous injections of ether or of tincture of musk, or intravenous or subcutaneous injection of a 0·6 per cent. solution of chloride of sodium in water, to stimulate the action of the heart, and to increase the blood-pressure. *See* SHOCK.

Apart from such exceptional cases, the treatment of the abnormal states of the temperature must be subordinated to the general treatment of the case. In many cases the abnormal temperature being dependent upon some local cause, the removal of the latter will make the abnormal temperature also disappear, or at least reduce it—an experience with which surgeons are quite familiar.

Rise of temperature being, however, the most appreciable and a most important symptom of *pyrexia*, which, by weakening the heart's action, by lowering blood-pressure, and in other ways, may of itself lead to serious consequences, it would appear advisable in many cases of protracted febrile disease, besides the general or special treatment which the case requires, to treat the febrile temperature symptomatically. And an overwhelming experience has actually shown that the course of the specific fevers, such as typhus, typhoid, scarlatina, although it cannot be cut short, can yet materially be influenced, by measures the primary object of which originally was to keep the febrile temperature artificially down, by means of cold baths or wet packing, or by antipyretic medicines. In rehabilitating the cold-water treatment of fevers, which already in the hands of J. Currie had been so successful, E. Brand, Jürgensen, Liebermeister, and their followers started from the idea that the increased blood-heat ought to be combated; and Liebermeister, than whom few physicians have more practical experience in these matters, laid down as the principle to be followed in the antipyretic treatment of fevers, to increase the remissions that normally take place in the daily fluctuation of temperature, and to prolong them as much as possible. Comparative experiments having shown that external cooling by baths, as well as antipyretic medicines, are of greater effect on the temperature at those times of the day and night when it spontaneously has a tendency to decline, these periods were declared the most favourable for the employment of antipyretic measures, necessitating their least frequent repetition. Others have not laid so much weight on the normal daily fluctuations of febrile heat, but have used the bath whenever the temperature rose to a certain point, say 102·2° F. (39·0° C.) or 103° F. (39·5° C.), obtaining in this way equally favourable results, though, perhaps, with more inconvenience to the patients. More extensive experience has, however, shown that lowering the febrile temperature in itself—which at present, by using one or the other of the antipyretic medicines which modern chemistry supplies in such variety and profusion, can be accomplished to a very high degree—does not produce the same good effect on the whole condition of the patient, or so favourably influence mortality as when brought about by cold bathing or other methods of external cooling. It therefore appears very probable that the beneficial action of the cooling treatment by these external means is due not so much to the reduction of the temperature, as to their powerful influence on the circulation and on the tone of the nervous system. So there may, perhaps, after all, be no reason to feel disappointed at the very transient effect which even a very cold bath has in a case of high fever, and which, as far as mere reduction of temperature is concerned, makes its action appear much inferior to that of antipyretic medicines. For troublesome as it may be for the patient, as well as for his attendants, to repeat the external cooling over and over again in the course of a day, it may yet be this very repetition of the bath, with all its effects, which is of essential importance.

The theory from which antipyretic treatment originally started—that pyrexial elevation of temperature is an unmixed evil—is becoming more and more modified as the conviction is gaining ground that a process like the febrile reaction of the system following upon various external influences, which was, no doubt, gradually acquired through evolution, must be of some advantage to its possessor, if it be only this—that by the increased chemical action which goes on at a higher temperature, abnormal and noxious products of tissue-change and of the life-process of infectious germs will be more rapidly destroyed and cast out of the body. But it would certainly be a step in the wrong direction if such considerations were to lead to giving up all antipyretic measures. On the contrary, experience teaches that it is very important not to wait in a case with continuous high temperature until symptoms of failure of the heart's action—a weak pulse, cold extremities, cyanosis and congestion of the lungs, and muttering delirium—show themselves, but to try to prevent these symptoms by at once resorting to external cooling. Patients treated early on this principle will be found much less frequently to pass into that state, to sleep more soundly, and to retain their appetite, bed-sores and other serious complications being of much rarer occurrence; and it has been established that the mortality in specific fevers has by the cold-water treatment been very considerably diminished, and that convalescence also is quicker than in cases treated on a purely expectant plan. If consistently carried through, the good effects of such treatment mostly show themselves in a few days, not only in the whole condition of the patient, but also in the effect of successive baths on the temperature becoming greater and more lasting, so that the number of baths, as required by a certain height of temperature, becomes less every day.

As regards the methods of external cooling, by far the most effective means are cold baths from 60° to 70° F. (15° to 20° C.), and about ten minutes' duration. More agreeable to the patient are baths of about 95° F. (35° C.), gradually cooled down by the addition of cold water to 70° F. (20° C.), or less, as recommended by von Ziemssen, but their duration must be longer to have the same effect as the former. Riess tried prolonged immersions in warm water of 90° F. (32° C.), but, although acting very powerfully on the temperature, the general effect of such permanent baths is inferior to that of repeated short cold baths. Cold wet-packing is less effectual, but may replace baths in special cases, and when they cannot be given. See HYDROTHERAPEUTICS; and COLD, Therapeutics of.

Antipyretic medicines may sparingly be used in order to prolong the effect of a bath on the temperature in cases of very high and persistent fever, but principally with a view to allay some of the troublesome symptoms accompanying pyrexia, especially the headache, the feeling of heat, and uneasiness. For a long time sulphate of quinine had been the only reliable antipyretic drug, but now we possess a great number of chemical preparations, which are much more powerful in reducing a febrile temperature and subduing some of the other symptoms of fever than anything before known. But it ought never to be lost sight of that these preparations, foremost among which stands phenazone, although in individual cases they may be of considerable service, are substances whose effects on the tissues of the body, and especially on the nervous system, are as yet but very imperfectly known, and that a routine treatment of elevated temperature with their aid is much to be deprecated, and cannot compare in innocuity and results with even a routine treatment with cold water, which, it need hardly be said, must also be carefully adapted to the requirements of the case and the individuality of the patient.

C. G. H. Bäumler.

TENDERNESS.—This word, in relation to medical and surgical practice, usually implies that pain, in various degrees and of different kinds, is elicited by pressure, or in some instances by percussion, as distinguished from the sensation which is felt spontaneously by the patient. The term might conveniently be made to include all painful sensations elicited by any physical disturbance of a part, as, for instance, the passive movement of a joint, or the pressure of its surfaces against each other. The like observation applies to any irritation of the mouth or throat, when these parts are the seat of disease accompanied by tenderness; as well as to more internal mucous surfaces, such as the stomach or bladder.

Tenderness is a symptom often of great importance, and it claims the careful attention of the practitioner. It is often present when there is no complaint of pain on the part of the patient; while, on the other hand, it is by no means a necessary accompaniment of spontaneous pain; its very absence is frequently of much consequence in diagnosis. In an investigation for the purpose of eliciting tenderness, much care is required, especially in certain cases; and the examination should be made with gentleness and discretion, so as not to give the patient unnecessary pain, or to produce other effects, which might prove serious in some instances. It may be that only a slight touch can be borne, but pressure may be gradually increased, if necessary, until tenderness is produced; it must be noted what degree of pressure is needed to cause the sensation. The observer must thus endeavour to fix upon the structure in which the tenderness is located, and to determine whether it is superficial or more or less deep, as well as to measure the intensity of the feeling. Its limitation in extent must also be determined. The patient can often give useful information as to the exact character of the sensation produced. Care, however, is necessary to guard against being misled by malingerers, hysterical persons, or those who have imaginary ailments; and also not to mistake tenderness for mere hyperæsthesia of the skin. For this purpose it is of much help, among other points, to watch the patient's expression of countenance whilst pressure is being made. Hysterical patients may seem to suffer acutely when slight pressure is made; but if this be gradually increased, while their attention is diverted by conversation, it is found that the suffering is not real. It must also be remembered that some persons are much more sensitive to physical disturbances than others.

Value in Diagnosis.—Without attempting to treat the subject exhaustively, a few hints may be offered as to the diagnostic indications of tenderness, and the more prominent diseases and conditions in connexion with which the presence and degree of this symptom may give useful information.

1. When pain is complained of, the presence or absence of tenderness, and its degree, may be of signal value in diagnosing the class of painful sensations to which it belongs. For instance, it may be affirmed, as a general rule, that the pain of inflammation is accompanied with tenderness, and especially so if the condition is superficial, has ended in suppuration, or involves definite nerves. On the other hand, a purely neuralgic pain is on the whole free from tenderness, and is not uncommonly relieved by pressure, although there are certain localised 'tender points' in some forms of this complaint, which are also of significance. Hence, when pain is evidently associated with a particular nerve or nerves, pressure may determine whether they are actually involved in some inflammatory mischief, or merely functionally disordered. Actual neuritis gives rise to marked tenderness. Again, the pain of muscular rheumatism, when not inflammatory, is often relieved by pressure; while spasmodic muscular pains are usually thus greatly alleviated, so that patients of their own accord press upon the affected part. In this way a very obvious and decided distinction is frequently afforded between spasmodic and inflammatory conditions involving the abdominal structures. Further, in connexion with tumours and growths, those which are of a malignant nature are often accompanied by pain and tenderness, while those which are benignant may be said to be, as a class, free from such symptoms. Marked tenderness may be an important sign of destructive changes, such as those which occur in some diseases of joints, or as a result of the pressure of an aneurysm or other tumour, where there is at the same time spontaneous pain. Very limited and obvious tenderness may indicate the seat of a foreign body, lodged in the soft parts or irritating them, especially if it should be pointed, as, for instance, a needle. Localised tenderness on percussion is regarded as an important symptom in the diagnosis of cerebral tumour.

2. It must be remembered, in the next place, that tenderness may be a valuable diagnostic sign, when there is no complaint of pain on the part of the patient. For example, it may reveal joint-disease, not previously known to exist. This symptom is not uncommonly of great assistance in recognising the presence and situation of obscure limited disease in the abdomen, such as cancer, ulceration, or suppuration. It may also lead to the dis-

covery of undetected suppuration elsewhere. In the case of children who are too young to complain, but who cry or give other evidence of suffering, an unusual manifestation of pain during their examination must be carefully looked for and attended to, and its locality noted, as useful information may thus be obtained. It may be mentioned that general tenderness is in some instances a striking symptom of commencing rickets in children. In the case of superficial ulcers, in order to determine their condition for purposes of treatment, it is worth while to notice whether they exhibit tenderness, as well as its degree. Some ulcers are indolent, and scarcely at all sensitive; others are extremely irritable, and cannot bear the slightest touch.

3. These illustrations will suffice for the general diagnosis of tenderness, and it now remains but to point out some of the complaints in which this symptom is peculiarly prominent. Amongst these may first be mentioned superficial inflammatory affections, such as acute erythema or erysipelas, and also any condition ending in suppuration. Peritonitis is usually attended with remarkable tenderness, either generally distributed over the abdomen, or localised, according to the seat and extent of the disease. Here, however, it is necessary to guard against being misled by certain hysterical cases, in which there is intense hyperæsthesia of the skin covering the abdomen, but the distinctions already pointed out should prevent any mistake in diagnosis. Gout affecting the joints is generally accompanied by very marked tenderness, much more than in other forms of articular disease, although affections of the joints generally give rise to obvious tenderness. Hysterical patients are again liable to mislead the practitioner in this direction, as they sometimes seem to be intensely tender about a joint, when there is really nothing the matter with it. There is also a peculiar complaint met with in these subjects, called 'spinal irritation,' in which exquisite tenderness is experienced along the spine, or over some of the spinous processes (*see* Spinal Irritation). Amongst other conditions which are attended by peculiar tenderness may be mentioned corns and bunions; chilblains; neuromata; superficial and multiple neuritis; certain stumps after amputation; boils; whitlows; and many affections involving such sensitive structures as the eye, or the matrix of the nails.

Treatment.—In the first place, of course, the disease with which tenderness is associated must be treated apart from this particular symptom, although it may afford useful indications. For example, it may reveal suppuration, when an incision will give vent to the pus, and relieve the tenderness. For the nervous and hysterical conditions in which tenderness is a prominent symptom, general treatment directed to the particular condition present is essential. When a part is really tender, all pressure must be avoided, or even, in some instances, the mere touch of such articles as clothing or bedclothes. For instance, in cases of acute inflammation of joints, or in peritonitis, it is of great service in treatment to raise the bedclothes by means of cradles or in other ways, so that they do not come into contact with the patient. All unnecessary examination of tender structures must be avoided, and such examination should be carried out very gently, if it be required. Hot and cold applications, anodynes, and allied agents may be employed locally with good effect in many conditions for the purpose of diminishing undue sensibility. *See* Hysteria; Pain; and Spinal Irritation.

Frederick T. Roberts.

TENDON-REFLEX.—*See* Spinal Cord, Diseases of.

TENDONS, Diseases of.—Synon.: Fr. *Maladies des Tendons*; Ger. *Krankheiten der Sehnen.*

Although simple in their structure, and performing a purely mechanical function of a passive kind, tendons and tendon-sheaths are liable to a considerable variety of diseases. In some instances these diseases are *primary*, and originate in the fibrous and synovial structure of the parts involved; whilst in other instances they are *secondary* to morbid conditions of the muscles, joints, and fasciæ, with which the tendons are connected. The primary injuries and diseases alone call for notice here.

1. **Injuries.**—Tendons are subject to a variety of injuries as the result of violence, such as partial or complete rupture of the tendons proper; rupture of the sheath; dislocation; incised wounds; and, most common of all, sprain of their fibres.

2. **Inflammation.**—Inflammation of a tendon and its sheath may be traumatic in origin, but it frequently makes its appearance without obvious cause, and then constitutes one form of whitlow (*see* Whitlow). Certain effusions into the synovial sheaths may be regarded as of a [illegible].

3. **Rheumatic affections.**—Of greater frequency and importance are the affections of tendons and tendon-sheaths which occur in acute and chronic rheumatism, in rheumatic arthritis, and in gonorrhœal rheumatism. These will be found fully described in the several articles on these subjects. In acute rheumatism, and in the early stage of gonorrhœal rheumatism, the involvement of the tendon-sheaths may give rise to nothing more serious than pain and stiffness; but in protracted cases of the gonorrhœal affection, and in rheumatic arthritis, permanent changes may result, including contractions, adhesions, calcification, and even complete destruction.

4. **Gout.**—The tendons and their synovial sheaths are by no means an uncommon seat of gouty deposit. This condition is probably best marked in the extensor tendons of the hand, giving rise to a characteristic form of rigidity, or false ankylosis of the finger-joints.

5. **Ganglion.**—Simple ganglion is usually a local dilatation of a tendon-sheath, or a cystic formation in connexion with it. In the experience of the writer it is especially common in rheumatic subjects. *See* GANGLION.

6. **Deformities.**—The most obvious and the most common deformities involving tendons are of the nature of contractions, such as give rise to club-foot and distortions of the fingers. As a rule, these are the result of some of the morbid conditions already referred to, but in other instances they are of more obscure origin. Thus, in the so-called 'Dupuytren's contraction of the palmar fascia,' a highly characteristic deformity of the fingers and palm of the hand results from a kind of stricture of the sheaths of the flexor tendons of the fingers and wrist, due to shortening of the fibres connecting them with the palmar fascia. In several cases of this nature the writer has found marked thickenings of the extensor tendons also, where they are in relation with the interphalangeal joints.

7. **New-growths.**—Various new-growths of a fibrous, cartilaginous, osseous, or malignant nature have been found in connexion with tendons.

SYMPTOMS.—The symptoms of diseases and injuries of tendons are chiefly of an objective and easily recognisable kind. The most obvious of these is impairment of movement of the tendon in its sheath, and of the associated muscles and joints. In its slightest degree, such impairment amounts only to stiffness; but when it is more marked it may take the form of rigidity, or even complete loss of function. Deformities may then very readily arise in connexion with the joints, such as unnatural flexion or extension, or actual dislocation; whether referable to shortening of the tendon, to constriction of its sheath, to prolonged disuse of the joint, or to wasting of the associated muscles with over-action of their opponent groups. Similar results may follow rupture, wounds, or destructive ulceration of tendons.

Traumatic, rheumatic, and gouty effusions into tendon-sheaths give rise to swellings along their course, which are easily recognised if the anatomical relations of the parts be remembered, but which are probably often mistaken for intra-articular disease. Localised swellings on tendons, such as ganglia, nodules, and new-growths, present unmistakable characters.

The chief subjective symptoms connected with the diseases of tendons are pain and a feeling of stiffness. Both these symptoms vary greatly in different instances, and neither is perhaps characteristic of affections of these structures, apart from the associated muscles, bones, and ligaments.

TREATMENT.—The treatment of diseases of tendons, where it is not of a strictly surgical nature, is fully described in the several articles in this work to which reference has been made.

J. MITCHELL BRUCE.

TENESMUS (τείνω, I stretch).—SYNON.: Fr. *Ténesme*; Ger. *Stuhlzwang*.—Tenesmus is a comprehensive term applied to certain morbid sensations referred to the anus and its vicinity. There is a feeling of fulness and weight, with frequent or constant inclination to go to stool, and straining during the act of defæcation, little or nothing being passed, and that often of the nature of slimy mucus or blood, while no sense of relief is experienced afterwards. Tenesmus is a common symptom in cases of dysentery. It may also be associated with local diseases about the lower part of the rectum or anus, such as piles, fistula, or malignant disease. Other morbid sensations are often present at the same time.

TREATMENT.—Any local cause of tenesmus must be removed or cured, if practicable. The sensations are best relieved by local applications of heat or cold, wet pads, or the use of small enemata containing laudanum, or of suppositories of morphine, extract of belladonna, or hydrochlorate of cocaine.

FREDERICK T. ROBERTS.

TEPLITZ - SCHOENAU, in Bohemia. — Simple thermal waters. *See* MINERAL WATERS.

TERMINATIONS OF DISEASE.—*See* DISEASE, Terminations of.

TERMINI IMERESI, in Sicily (*Thermæ Himerenses* of the Romans).—Thermal waters. *See* MINERAL WATERS.

TERTIAN (*tertius*, the third).—A term applied to a form of intermittent fever in which the paroxysms return on the third day, or at an interval of about forty-eight hours. *See* INTERMITTENT FEVER.

TERTIARY (*tertius*, the third).—This word is usually associated with the advanced forms of syphilitic disease. *See* SYPHILIS.

TESTES, Diseases of.—SYNON.: Fr. *Maladies des Testicules*; Ger. *Krankheiten der Hoden*.—The diseases of the testes will be discussed in the following order: (1) Abnormalities of Development; (2) Hypertrophy; (3) Atrophy; (4) Injuries; (5) Acute Inflammation; (6) Chronic Inflammation; (7) Hernia Testis; (8) Cystic Disease; (9) Fibroma; (10) Chondroma; (11) Malignant Disease; (12) Teratoma; and (13) Neuralgia.

1. **Abnormalities of Development.**—(*a*) *Absence.*—There may be complete absence of the testicles. The subjects of this

imperfection, if they attain the age of puberty, present the ordinary characteristics of eunuchs. As the complete gland is formed from two distinct parts, the failure or arrest of development may be limited to either part, separately from the other. Thus cases are described where a well-developed vesicula seminalis and vas deferens have been found, without any trace of a testicle; and others, where a testicle existed with complete or partial absence of the vas deferens.

(*b*) *Excess.*—Supernumerary testicles have been described, and men not infrequently believe themselves to be so gifted. The mistake has arisen from the presence of encysted hydroceles, or of fatty or fibrous tumours of the cord, or of an old epiplocele. There is no well-authenticated case recorded of the presence of more than two testicles.

(*c*) *Malposition.*—The testicles, which are developed in the abdomen, immediately below the kidneys, are at birth, or shortly after, lodged in the scrotum. This change of position is frequently described as 'descent of the testicle,' an obvious misuse of words, if regard be paid to the usual position of the fœtus in the uterus.

The testicle may be retained in the *abdomen*, or in the *inguinal canal*; or may pass through the inguinal canal into the *perinæum*, and be lodged between the bulb of the urethra and the anterior part of the tuber ischii; or over the external pillar of the ring into the subcutaneous tissue of the *upper part of the thigh*; or through the crural canal to the *upper and inner part of the thigh*; or, if it has passed into the scrotum, may be *rotated*, so that the epididymis is in front and the testicle behind. More rarely it has the long axis transverse instead of oblique; or it may be completely inverted, so that the globus major is below, the globus minor above.

Retention in the abdomen or inguinal canal may be the result of adhesions from intra-uterine inflammation, or of disproportion between the gland and the orifices through which it has to pass, or of some constricting band. The passing through the crural canal to the thigh, or through the inguinal canal to the perinæum or thigh, must be the result of some unusual attachment of the lower end of the gubernaculum. Malposition in the scrotum must be caused by some abnormality in the development of the cord.

The consequences will vary with the position. If the testicle is retained in the *abdomen*, the corresponding half of the scrotum remains undeveloped, and the gland is always much smaller than normal. Sometimes there is an arrest of development, or it undergoes fatty or fibrous degeneration, or, if otherwise normal, does not secrete a fertilising fluid. This seems fairly established by numerous observations, both in men and the lower animals, where the testicle has been abnormally retained in the abdomen. One case, however, has been recorded by Hutchinson, where the observer, to whom the retained testicle was submitted for microscopic examination, stated that he found numerous spermatozoa.

When the testicle lies at the internal inguinal ring, the epididymis is frequently found partly in the badly developed scrotum, into which also extends the processus vaginalis. As the communication between this and the peritoneal cavity is usually maintained under such conditions, in case of peritonitis with peritoneal effusion there may be distension of this process, so as to greatly simulate a hernia, and render an exploratory examination necessary.

Retention of the testicle in the *inguinal canal* is more liable to complications than retention in the abdomen. It is often accompanied by inguinal hernia; is more exposed to injury; and when enlarged at puberty, or by inflammation, may cause severe pain from constriction by the surrounding parts.

Inflammation of a testicle retained in the inguinal canal has been mistaken for strangulated bubonocele, or for a bubo. Careful examination of the scrotum should, therefore, be made in doubtful cases.

Retraction can usually be distinguished from retention of the testicle by the state of development of the corresponding half of the scrotum.

The *perinæal* or *femoral* position of the gland is not of necessity attended with any bad results. A testicle, however, so situated, is usually smaller than normal and is more exposed to injury. This is especially the case in the perinæal position.

Treatment.—If retention of the gland in the inguinal canal be attended with any inconvenience, operative interference may succeed in placing it in the scrotum. But if this should fail from shortness of the cord, extirpation would be necessary. When in infants retention of the testicle is complicated by an inguinal hernia, the use of a truss is not to be recommended, as it will prevent the possible descent of the testicle, and the hernia not infrequently spontaneously subsides. If the retention of the gland be permanent and cause inconvenience, it is better to remove it at once. If the gland have passed through the crural canal, nothing can be done to remedy the malposition; but when it has passed through the inguinal canal into the perinæum or the thigh, an attempt may be made to place it in the normal position. In an adult, such a proceeding would be hopeless, from the non-development of the scrotum. In infants, the attempt has been twice made at the London Hospital, by Curling and James Adams. Both cases died; and in the one in which alone a *post-mortem* examination was allowed, acute peritonitis was found, which had extended from the pervious processus vaginalis. With antiseptic precautions, however, better results might be anticipated.

The late Mr. John Wood successfully transplanted in an infant a testicle from the perinæum to the scrotum subcutaneously. When a band of tissue in the perinæum, probably the gubernaculum, had been divided with a tenotomy knife, the gland could be pushed up to the inguinal canal, and from thence into the scrotum, where it was retained by a hairlip-pin passed above it as in acupressure. This method, when practicable, would be unattended with danger. But as sometimes the unaided efforts of nature draw the gland from the perinæum up to the inguinal ring, where it is comparatively safe from injury, and more favourably situated for any attempt at removal to the scrotum, it is advisable always in infants to allow time for such a possible modification, which might moreover be encouraged by electric stimulation of the cord.

Of malpositions in the scrotum, that where the epididymis is in front, and the testicle proper behind, is alone of any practical importance. In any operation for hydrocele or hæmatocele of the tunica vaginalis, the position of the testicle ought first to be ascertained.

(*d*) *Arrest of development.*—This sometimes occurs after the testicles have passed into the scrotum, so that these glands remain permanently in their infantile condition. No general cause has been discovered for this abnormality.

2. **Hypertrophy.**—When only one testicle has been retained in the abdomen, the other sometimes attains an unusually large size. Such cases of, as it were, compensating development are, however, the exception and not the rule.

3. **Atrophy.**—Wasting of the testicle may result from inflammation, from lesions of the spinal cord caused by injury or disease, or subsequently to injuries of the head. It may also be produced by early and excessive venereal excitement; or by deficient blood-supply, due to aneurysm or other causes. It is frequently found associated with varicocele.

4. **Injuries.**—The testes are greatly protected from accidental violence by their mobility, and the laxity of the surrounding structures. Immediate death has resulted from severe contusions of the testicle, probably from reflex inhibition of the action of the heart. Contusion and wounds require appropriate surgical treatment.

5. **Acute Inflammation.**—When acute inflammation attacks the body of the gland solely or chiefly, it is called *orchitis*; when the epididymis, *epididymitis*. For the comparatively rare cases in which the vas deferens, or this duct along with the other structures of the spermatic cord, is affected, without the testicle being implicated, the barbarous hybrids, *deferenitis* and *funiculitis* have been coined.

Ætiology.—Acute inflammation may be caused by direct violence, or by the extension of inflammatory processes from the mucous membrane of the urethra. It may also occur, though rarely, as a sequela in small-pox or in pyæmia. Orchitis is not infrequently a concomitant of parotitis or mumps.

Of these varieties, the most frequent is gonorrhœal epididymitis. This was at one time regarded as an instance of 'sympathetic inflammation.' Careful examination will, however, always prove that the vas deferens is also affected, though sometimes in so slight a degree that its participation in the inflammation might easily escape notice. This form is, therefore, due to direct extension of the inflammation from the urethral mucous membrane. Orchitis associated with mumps has been generally regarded as an instance of 'sympathy,' or 'metastasis.' Kocher, however, considers it to be the result of urethritis. According to this experienced observer, the disease commences as stomatitis, by which the parotid, or sometimes the submaxillary and neighbouring lymphatic glands become infected. The morbid material is carried by the blood to the kidneys, and in its course through the urinary passages sets up cystitis or urethritis, and thus the orchitis results. This explanation is not satisfactory, since in some epidemics of mumps orchitis has occurred prior to, or without any affection of the parotid gland. Orchitis and epididymitis sometimes occur in rheumatic or gouty subjects. Occasionally cases are met with in which no exciting cause can be discovered. It sometimes occurs in very young children, and, in the absence of any constitutional taint or other discoverable cause, probably results from some accidental injury in these cases.

Symptoms.—The symptoms of orchitis are local pain and swelling, with, in cases of orchitis sometimes, and in cases of gonorrhœal epididymitis frequently, redness and tension of the corresponding part of the scrotum. Severe lumbar pain is in some cases felt, especially by labouring men, who apply for relief on account of some supposed sprain or injury, being ignorant of, or attaching no importance to, the affection of the testicle. This is probably due to inflammation of the lumbar lymphatic glands, with which the lymphatics of the testicle freely communicate; but it may possibly be an example of 'referred sensation.'

Prognosis.—The prognosis is good. The inflammation usually subsides speedily, and leaves the gland in a healthy condition. Atrophy sometimes results after inflammation associated with mumps, or caused by severe contusion. Chronic induration of the epididymis may persist; but after some months it usually disappears. Stricture of the epididymis, or of the vas deferens, is very rare. Suppuration does not occur except in pyæmia, or after small-pox, or in strumous and very enfeebled persons.

Treatment.—Rest in the recumbent position, with the scrotum supported by a crutch-pad, and the application of ice locally, are in ordinary cases sufficient. Where rest is impossible, well-adjusted strapping of the part affords considerable relief, and promotes absorption of the products of inflammation so rapidly as not infrequently to necessitate the re-application of the strapping within twenty-four hours. Attention to diet, and avoidance of all violent exercise, will be requisite. In more protracted cases mercury, taken in small doses internally, or applied locally by inunction or on strapping, will be found of benefit. The practice, of late years recommended by some eminent surgeons, of puncture or incision of the ordinarily inflamed gland, is, according to the writer's experience, never necessary. If suppuration, however, occur, a free incision should be made as early as possible.

6. Chronic Inflammation.—Chronic orchitis may sometimes be the result of an acute attack, but is much more frequently induced by *syphilis*, *struma*, or *gout*.

(a) *Syphilitic orchitis.*—This variety may occur in young children who are the subjects of inherited syphilis, in the form of hard nodules in the testicle. In adults it belongs to the tertiary stage of the disease, but is very often symmetrical. It is usually painless, the patient being frequently ignorant of its existence. The gland is enlarged, very hard, insensitive to pressure, and often nodular in form.

Syphilitic orchitis sometimes commences in an acute form. The testicle is large, very tender on pressure, with dull aching pain limited to the gland or radiating to the groin and back. There is usually effusion in the tunica vaginalis, varying in quantity in different cases, and the scrotum is congested and œdematous. Generally only one testicle is affected, but after some weeks the other gland may also present similar symptoms. The condition resembles gonorrhœal epididymitis, but may be distinguished from it by the absence of any existing or precedent urethral discharge, by the body of the gland being solely or chiefly affected, and by the existence of concomitant syphilitic symptoms. It rapidly improves under mercurial treatment, but if left untreated generally passes into the ordinary chronic form.

Treatment.—This form of orchitis is usually very amenable to treatment, but has a tendency to recur. Iodide of potassium combined with mercury in small doses internally, when it can be tolerated, and strapping locally, will in most cases produce rapid disappearance of the disease, for a time at any rate. Atrophy may sometimes result; and in some cases suppuration, with the formation of troublesome sinuses, may occur. In one case under the notice of the writer, which was complicated by an inguinal hernia, the gland had, after very prolonged and unsuccessful treatment, to be removed, as the use of a truss caused great pain, and the non-use of it led to a dangerous descent of the hernia.

(b) *Strumous orchitis.*—In most systematic works on surgery tubercular disease of the testicle is given as a distinct affection, but the descriptions of it are very confused, no two being in perfect agreement. This is partly because at one time the presence of caseous matter was regarded as evidence of tubercle, and partly because in many cases microscopic examination of the gland after its removal can alone determine the nature of the disease. Tizzoni and Gaule have, therefore, proposed to substitute the term 'phthisis' for 'tuberculosis' of the testis, since in this organ, as in the lungs, tubercular and non-tubercular processes, either separately or concurrently, run the same course.

Symptoms.—Tubercular disease of the testis is not rare in young children, and usually commences in the body of the gland. It occurs, however, much more frequently after puberty, and then commences, in the majority of cases, in the epididymis; the body of the gland and the vas deferens becoming subsequently infected in the progress of the disease.

A nodular swelling is found either in the gland or in the epididymis, which is usually only slightly, if at all, painful, and runs an indolent course. After a longer or shorter time, this softens down into an unhealthy pus; adhesion and perforation of the superjacent structures ensue, and a fistula is formed. This condition may continue for a long time, but usually the disease extends to the rest of the glandular apparatus. Sometimes the testicle is very much enlarged. The vas deferens, if affected, may either be uniformly thickened, up to the inguinal ring, or present a number of distinct round or spindle-shaped enlargements. The prostatic portion of the tract, the vesiculæ seminales, bladder and kidneys may be similarly affected. Digital examination, through the rectum, ought therefore always to be made.

Treatment.—The treatment of strumous orchitis consists in careful attention to diet and hygienic conditions; in the use of cod-liver oil and iodide of iron; and in the protection of the part from accidental injury by a suspensory bandage. Abscesses should be opened as early as possible, and any fistula either laid open by incision or dilated by laminaria, and treated with stimulating lotions, such as nitrate of silver of the strength of five grains to the ounce. In favourable cases the disease may be arrested, but usually cases removal of the gland becomes necessary. If the epididymis and the vas deferens are much involved, the gland, by obliteration of its duct, is functionally useless; and as there is always considerable risk of infection of the system generally, early removal of the gland is, in such cases, to be recommended. If the prostate and vesicula seminalis have become affected, this would, of course, be useless.

There is another form of caseous orchitis, not of tubercular origin, in which the intertubular lymphatic spaces of the testis become filled with a new-growth of lymphoid tissue, by which the seminal tubules are ultimately compressed and destroyed. This may become transformed partly into fibrous tissue, but in the greater part usually undergoes fatty degeneration, forming caseous masses, which subsequently break down into curd-like pus. The symptoms are very similar to those of the tubercular disease, but there is not the same danger of general infection of the system.

(*c*) *Gouty orchitis.*—Chronic orchitis from gout can be diagnosed by the history of the patient, and yields readily to the ordinary treatment for gout, but is very apt to recur.

7. Hernia Testis.—This morbid condition was formerly known as 'benign fungus of the testis.'

Description.—It consists of a fungous protrusion from the scrotum, of a red or yellowish-red colour, and varies from the size of a pea to that of a small egg. There are two varieties, which may be distinguished as *superficial* and *deep*. The superficial form springs from the visceral layer of the tunica vaginalis, and is very comparable to the fungous granulations occasionally met with in cases of suppuration, or in wounds of the synovial sheaths of tendons. In this the tunica albuginea is intact, but probably altered in structure. In the deep form the tunica albuginea has been perforated, and the protruded mass consists largely of seminal tubules. It cannot be regarded as an evidence of any special disease of the gland, as it may occur, but by no means necessarily, after any form of orchitis in which there has been suppuration.

Treatment. —The treatment consists in well-adjusted pressure upon the protrusion; with the occasional application of caustics, such as nitrate of silver or red oxide of mercury. Freeing the margins of the opening from adhesions, and bringing the thus liberated integument over the protrusion by means of sutures, is usually very successful. When the precedent inflammation has been due to some specific cause, the appropriate constitutional treatment must also be employed.

8. Cystic Disease.—Cysts are frequently found in the testicle, either separately or associated with other growths.

Description.—In true cystic disease or simple cystoma, the whole or part of the body of the testicle is replaced by a closely aggregated mass of cysts, of very variable size. Some are so minute as only to be visible on microscopic examination, while others may attain to the dimensions of a pigeon's egg. When only part of the gland is so affected, healthy glandular substance is found at the periphery, enveloping the cystic growth. The cysts have no proper wall, and are lined with shallow cylindrical epithelium, which is sometimes ciliated. They are filled with either clear watery, or sometimes very viscid, fluid; or with atheromatous matter, resembling the contents of a sebaceous cyst. Very frequently nodules of cartilage are found interposed between the cysts. The disease usually occurs in adults, but one case has been recorded where the enlargement was first observed at the age of three months. The structure seems to indicate very clearly the origin of the cysts to be from retention within the rete testis.

There is another form of cystic disease, where the cysts are separated by a considerable quantity of gelatinous connective tissue, and often contain polypoid ingrowths, which sometimes completely fill their cavities. The tumour is often as large as a child's head. This form is regarded as cystic adenoma of the gland.

Cysts of the epididymis are described in the article on Hydrocele.

Symptoms.—Cystic disease of the testicle is usually attended with very little pain. The tumour is of an oval form, either with a smooth surface, or with irregular elevations; and does not attain a very considerable size, being generally about as large as a goose's egg. There is an indistinct sense of fluctuation, unequal at different parts.

Diagnosis.—Cystic disease of the testis has sometimes been mistaken for hydrocele or hæmatocele. The form of the tumour, its relatively greater weight, the absence of transparency, and the impossibility of detecting the body of the testicle at any part, distinguish it from hydrocele. The distinction from hæmatocele is in some cases more difficult. If exploratory puncture be considered requisite, a full-sized instrument should be used, as the fluid may be so viscid as not to flow through a small cannula.

Treatment.—Castration is the only remedy for this condition.

9. Fibroma.—Fibrous tissue is found in abnormal quantity in atrophy of the testis, in chronic orchitis, and associated with new-growths. By fibroma of the testicle, however, is meant a new-formation of fibrous tissue to a considerable extent, without any other important change. In structure it resembles fibrous tumours of the uterus. It so rarely occurs, however, as to practically be devoid of clinical importance.

10. Chondroma.—Cartilage, usually of the hyaline, but sometimes of the fibrous variety, is found in association with many new-growths in the testicle. Pure chondroma is comparatively rare.

Description.—This form of tumour of the testis occurs as disseminated nodules, connected by fibrous tissue; or as elongated masses with branching processes. By compression of the seminal tubules, it leads to dilatation of other parts of the tubules; and by invagination of the walls of such dilatations the growth often seems to be in the interior of a tubule. Careful examination, however, will always prove it to be of extratubular origin. It similarly invades the lymphatics, and through them has a great tendency to infect other parts of the system. It is often associated with myxoma; and sometimes, though rarely, it develops into bone. It can only be diagnosed with any certainty when the tumour has attained a large size, and is then characterised by the hardness and slow growth of the mass.

Treatment.—Castration is the only treatment; and in consequence of the tendency of this disease to invade other organs, the rule laid down by the late Mr. Curling is the best—'to recommend an operation without unnecessary delay, in all cases of large sarcocele which do not give any indication of yielding to treatment.'

11. Carcinoma and Sarcoma.—These are classed together, because, though histologically of very different origin, the distinction between them in any individual case is often impossible, except by microscopic examination of the tumour after removal. Even then the distinction is sometimes impossible, if we may judge from the description of recorded cases of mixed sarcoma and carcinoma.

Carcinoma originates in the epithelial structures of the gland, and is almost invariably of the encephaloid variety. Scirrhus is said by all writers to occur sometimes, and so-called specimens are in many museums. According to Mr. Butlin, however, many of these are probably examples of fibrous sarcoma. Encephaloid cancer usually commences in the body of the testis, by the formation of one or more nodules. Sometimes the epididymis is first attacked. Very rarely is there general infiltration of the gland. In an early stage of the disease the testis is hard, from tension of the tunica albuginea, but when this has been destroyed in the progress of the growth, the mass is soft, and there is often distinct fluctuation. This may be unequal at different parts, from the presence of cysts. The growth is usually painless, but in some cases there is acute pain, either locally or in the lumbar region. The chief aids to diagnosis at this period are the rapidity of the growth, the enlargement of the blood-vessels of the cord, and the age of the patient. For while encephaloid cancer has been met with in young children and old people, still the vast majority of recorded cases have occurred between twenty and forty years of age.

If the tumour attain a very large size, the scrotum may slough, and a bleeding fungus protrude. The disease has a great tendency to invade other parts of the system, and especially at an early period the lumbar lymphatic glands. This may lead to œdema of the lower extremities, from pressure on the abdominal veins. The inguinal glands generally escape infection, except in some cases where the scrotum has been involved in the disease. Secondary growths have been found in the mesenteric glands, liver, spleen, and lungs.

Sarcoma originates in the connective tissue of the testicle, and sometimes develops in both glands simultaneously. With microscopic examination two varieties can be distinguished, the round- and the spindle-celled. The latter grows more slowly, and both are often associated with cystic and cartilaginous formations. The symptoms are very similar to those of cancer.

Sarcoma sometimes commences in the tunica vaginalis, and is then usually accompanied with extravasation of blood into the sac. The writer has met with two such cases, where the shape of the tumour, the complete absence of pain, the history of gradual enlargement, and the very distinct fluctuation were suggestive of hæmatocele. Exploratory examination, however, proved them to be cases of sarcoma. Castration was performed, and the testicles were found to be only slightly affected by the disease. Both cases died within a short period after the operations, from secondary affection of other organs, accompanied by similar hæmorrhages.

Melanoma of the testis was formerly regarded as a form of cancer, but is now considered to be sarcomatous. It is extremely rare, and in the few recorded cases of it similar growths were found in many other organs of the body.

Diagnosis.—As a general rule it may be stated that sarcoma occurs most frequently under ten and after forty years of age; and that the epididymis is more frequently the primary seat of the disease, and, when secondarily involved, is attacked at an earlier period than in cancer. The distinction in any individual case must, however, be very uncertain, and is of little importance.

Prognosis and Treatment.—The prognosis is very unfavourable in both, as recurrence of the growth in other organs after the removal of the tumour is the rule to which there are but few exceptions. Castration is the only possible treatment for both diseases.

12. Teratoma.—The testis, like the ovary, may be the seat of cysts containing hair, skin, bones, &c. The cysts are sometimes within, sometimes upon the gland. The more complex cases may be best explained as resulting from the inclusion of a second fertilised germ; while the simpler cases may be due possibly to the accidental grafting of the germs of such tissues on the rudimentary testicle. The history of a congenital tumour will suffice to direct attention to any such case. They are very rarely met with, and castration is the only suitable treatment.

13. **Neuralgia and Irritability.**—The testicle is sometimes the seat of very acute persistent or periodically recurring neuralgia. This must be distinguished from hyperæsthesia or irritability of the gland, which is occasionally associated with varicocele, or may be the result of self-abuse, excessive venery, or even of unsatisfied sexual excitement. Neuralgia may be due to some local cause, to varicocele, to a descending hernia, or to induration of some part of the glandular apparatus from precedent inflammation. It may also be sympathetic, as in renal colic, or where the digestive system is disordered. Occasionally no cause can be discovered, and we have to assume that it is due to some affection of the central nervous system.

Treatment.—When of local origin, the treatment of neuralgia of the testis must be directed to the removal of the cause; and if all other methods fail, and the pain be severe enough to warrant it, castration may be required. When due to affections of other parts of the body, the treatment must be regulated accordingly.

Hyperæsthesia of the gland usually yields in time to tonics, and attention to ordinary hygienic conditions.

Jeremiah McCarthy.

TETANUS.—Synon.: Lock-jaw; Fr. *Tétanos*; Ger. *Starrkrampf.*

Definition.—A disease of the nervous system, with persistent tonic spasms and violent brief exacerbations. The spasms as a rule commence in the muscles of the face and neck, causing closure of the jaws (trismus, lock-jaw), and involve the muscles of the trunk more often than the limbs. The onset is acute, usually due to a wound (traumatic tetanus), at times without an external injury, specially from exposure to cold (idiopathic or rheumatic tetanus). It occurs also in newly born children (tetanus neonatorum), and rarely after childbirth, or abortion (puerperal tetanus).

Ætiology and Pathology.—Tetanus is believed to depend upon a poison, produced in the bodies of persons infected with a specific bacillus which exists in different forms of mould. If earth mixed with this tetanus bacillus is inserted beneath the skin of the lower animals, symptoms of tetanus are produced. Tetanus has also been transmitted from man to the lower animals by the inoculation of materials from wounds, and the injection of blood and of urine containing this bacillus. The bacillus multiplies principally in and about the wound: having probably been introduced into the injured tissues with dirt, it there produces a poison which we suppose causes the symptoms of tetanus. Our knowledge regarding the pathological changes produced by this poison is still vague, neither the nervous centres nor any other part of the body presenting characteristic lesions after death from this disease; but the symptoms which characterise it are referable to an abnormal influence acting on nerve centres which control the voluntary muscles affected. Professor Clifford Allbutt, and other observers, have described the pathological changes in the spinal cord after death from tetanus as consisting of intense congestion of the tissues, with structureless exudations, especially in the grey matter. It is difficult to determine, however, whether these changes are the causes, or simply the effects of the abnormal nerve-action which characterises tetanus.

It is urged, however, that there is much in the phenomena presented by some instances of traumatic tetanus to lead us to think that the violent spasm of the muscles in this disease is due to irritation set up in the peripheral distribution of a nerve; and that this hyper-action, once established, is conveyed along the nerve to the spinal cord, exciting by reflex action the muscles near the injured nerve to a state of spasm. The irritation is supposed to extend to the whole length of the spinal cord, so that a slight impression on the skin is sufficient to produce general tetanic convulsions. In support of this theory a few cases have been recorded in which division of the principal nerve, or in other instances the stretching of a nerve leading from a wound, has completely stopped an attack of tetanus. And in some cases the writer has certainly seen tetanic spasms commence as if by reflex action. For instance, after ligature of a large bleeding pile, the patient, within thirty-six hours of the operation complained of spasms of the sphincter ani muscle; and although the ligature was instantly removed, the disease ran a rapid and fatal course.

On the other hand, the circumstances of tetanus, when considered in all their bearings, point to some influence at work which is different in its nature from that of ordinary reflex action. It is the exception rather than the rule for the muscles in the neighbourhood of the wounded part to be first involved in the disease, as they probably would be if it arose from a purely reflex action; it matters not where the seat of the injury may be, in by far the greater number of cases the muscles of the face are affected before those of any other part of the body. In most instances of tetanus, for twenty-four or forty-eight hours before spasms of the muscles have set in, the patient's face presents a pinched appearance, which is characteristic of the disease and depends on rigidity of the muscles of expression. Various groups of muscles are subsequently involved, in the following order—those of mastication, the neck and back, the muscles of respiration, and, lastly, those of the extremities. So generally is this the order in which the muscles are implicated, that it appears as if the poison causing the disease affects, first, the medulla oblongata, and afterwards extends to the spinal cord.

We must, however, admit, that cases of tetanus are met with among patients in whom it is impossible to discover any wound or abrasion of the skin of the body,[1] or mucous membranes, and in instances of this description, it is difficult to understand how the disease can depend either on reflex action or from a poison produced by a bacillus.

It seems certain that local conditions and meteorological changes greatly influence the development of tetanus. In the tropics, the disease is far more frequently met with than in other parts of the world. It is seldom absent from the Calcutta Hospitals, and in some seasons appears to prevail as an epidemic. It is, in fact, a matter of common observation in Bengal, that after sudden changes of temperature cases of tetanus appear among surgical patients; so that, while admitting that in many instances of tetanus, wounds or injuries are the first step in the disease, we cannot overlook the fact that a chill is frequently its immediate antecedent. The disease attacks persons of all ages; it occurs occasionally among infants immediately after birth, but more commonly commences a few days after the remains of the umbilical cord have separated from the child's body. Men are more subject to tetanus than women. In the tropics tetanus is by no means uncommonly met with among horses, especially after they have undergone the operation of castration.

Symptoms.—In cases of traumatic tetanus the symptoms usually commence from the fifth to the fourteenth day after the infliction of the wound. The symptoms begin in man, or in the lower animals, whether of traumatic origin or otherwise, in rigidity of the muscles of expression. In the course of a few hours the muscles of mastication, and of the head, neck, and back become involved, so that the patient experiences difficulty in opening his mouth, or in moving his head from side to side; deglutition is impeded by spasmodic contraction of the muscles of the pharynx. The rigidity of one or more of the groups of muscles above referred to, is constant throughout the whole course of the disease; but in addition to this, from time to time these muscles are thrown into the most frightful spasms; in this way the patient's body is sometimes bent like a bow, the whole weight of the trunk being supported on the back of his head and heels. The abdominal and thoracic muscles are also implicated, and hence the patient's belly is tense and hard, and the walls of his chest expand imperfectly in breathing. The muscles of the arms and legs are often extremely rigid, and convulsed in a violent manner; they are the seat of terrible pain. The interval between the paroxysms of spasm of the affected muscles is uncertain; sometimes the cramps last only for a few seconds, at other times for five, and even ten minutes. The most dangerous cases of tetanus are evidently those in which the muscles of respiration are principally involved, for death is generally caused in this disease by the interference with the respiratory process, the chest being, as it were, compressed in a vice (Watson). In consequence of the spasm of the muscles of the neck and thorax, the sick person is unable to speak, but his intellect generally remains clear up to the last, nor are the other functions of his body materially deranged. The patient suffers much from hunger and thirst, which he is unable to alleviate; and, above all, he longs for sleep, which is frequently denied him in consequence of the recurring spasms. The surface of the skin is bedewed with perspiration; and the pulse rises and falls with the intensity of the spasms, and the duration of the disease. The temperature will be described presently.

Puerperal tetanus is most frequently met with in tropical countries; of fifty cases which occurred in a temperate climate, eighteen came on after abortion, from the second to the fourth month of pregnancy. In most cases the disease has made its appearance after plugging the vagina; in cases of adhesion of the placenta; or after operations have been performed for the delivery of a fœtus. The symptoms are the same as those above described. This form of the disease is very fatal.

Tetanus neonatorum generally commences from the second to the third week of life; seldom later. It is rarely met with in this country, except in St. Kilda. Occasionally it is seen in tropical countries.

Course and Duration.—Tetanus is one of those maladies which run a definite course, although its duration is not so precisely defined as that of some other diseases. It may kill the person affected in the course of a few hours; but in the greater number of instances patients die of tetanus from the seventh to the eleventh day after the commencement of the disease. If the patient survive the twelfth day, the malady generally subsides. He may usually be pronounced cured in twenty-five days from the commencement of the attack; but the patient often suffers for many weeks subsequently from rigidity of the muscles which have been involved in the tetanic spasms.

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[1] In the surgical wards of the Mayo Hospital, Calcutta, within a period of [illegible] years, [illegible] cases of tetanus were treated. Of these, 44 cases were traumatic, and 24 died. Of the remaining [illegible] idiopathic cases, 10 died.

Prognosis.—Tetanus is a very fatal disease. The writer has relied much on the thermometer, not only as a means of forming a prognosis, but as indicating to some extent the treatment to be followed in tetanus. Doubtless in some of the worst instances of this disease the thermometer fails us; for if the muscles of respiration are much affected, as they are in the most severe cases, the process of combustion within the body is so much interfered with, that its temperature is not kept up to the degree we might expect, in proportion to the violence of the muscular action. Nevertheless, as a general rule, in instances of tetanus, so long as the thermometer indicates that the temperature of the patient's body is under 101° F., it is probable the patient will recover. If it rises beyond 101°, there is impending danger; and if it reaches 103°, the case is one to cause the greatest anxiety. After death from this disease the temperature of the body not infrequently rises as high as 107°.

Treatment.—One of the most remarkable facts connected with tetanus, is the almost incredible amount of Indian hemp and opium which persons suffering from it may be given, without these drugs producing their poisonous effects on the system. The writer has prescribed them in large doses, but has failed to satisfy himself that they influence for good the progress of the malady. He has also given the Calabar bean a fair trial in tetanus; but unless it be pushed to the extent of rendering the patient collapsed, the temperature of his body falling perhaps to 94° or 95°, and the pulse being hardly perceptible at the wrist, he has found that this medicine hardly affects the spasms of tetanus in severe cases, whilst in the milder forms of the disease there is no necessity for resorting to such a dangerous means of relief. In fact, we know of no treatment which will cut short the progress of a case of tetanus; we must therefore employ our efforts to keep the sick person alive during the illness through which he is passing. As a means to this end, we must feed him, and, if possible, secure him at least some six hours' sleep during the day. With respect to food, the patient must be ordered about four ounces of milk every four hours; one egg, or half an ounce of the juice of raw meat, being mixed with his milk, morning, noon, and evening. If the pulse indicates great exhaustion, beef-tea and brandy may be given as an enema, in addition to the abovementioned food. In cases of tetanus the teeth are often so firmly locked together that it is necessary to insert one's fingers between the closed jaws and the cheeks, and pour the milk into the cavity thus formed; the liquid will trickle between and behind the patient's teeth, and pass down his throat. Some of it may occasionally run into the trachea, and cause considerable spasm, but no serious result follows from this. In these cases food may be administered not only by the rectum, but also by a nasal tube. If the patient can swallow with comparative ease, arrowroot may be mixed with the milk.

With reference to drugs, no medicine probably procures sleep so well as the hydrate of chloral in cases of tetanus. It should be administered in 40-grain doses (to an adult) at bedtime; and in severe cases of the disease (the temperature of the patient's body rising to upwards of 101°) an additional 30 grains of chloral should be given at midday. However serious the case may seem to be, we should rigidly adhere to this plan of treatment, the urgency of the symptoms not causing us to deviate from our attempts to administer to the patient a sufficiency of food, and enough hydrate of chloral to make him sleep some six hours in the twenty-four. It is much better to give a full dose of chloral once, or even twice, a day than to administer small doses more frequently.

N. C. Macnamara.

TETANY.—Synon.: *Tetanilla*; Idiopathic Muscular Spasm; Fr. *Tétanos Intermittent*; Ger. *Tetanie.*

Tetany is a neurosis described originally by Dance in 1831, and more or less fully since under many names, especially in France. It is probably much more common in that country than in England, where it is very rarely met with. It is mostly a comparatively trivial and temporary malady.

Ætiology.—Tetany is associated with no recognised organic changes in any part of the nervous system; and much uncertainty prevails in regard to its causation. It occurs mostly between the ages of fifteen and thirty years, though it may show itself in older people, as well as in young children and even in infants. It occurs in either sex, but is more common among females. Persons of a neurotic temperament, or those whose constitutions have been disturbed or weakened from many causes, are specially liable. Teething, the establishment of menstruation, chronic diarrhœa, lactation, the state of convalescence from many acute diseases, are all conditions which predispose to this affection; whilst exposure to cold and emotional disturbance seem to act as the most common exciting causes.

Symptoms.—The morbid manifestations of tetany consist, in the main, of tonic spasms, frequently recurring for brief periods in one or other part of the body, painful in character, and unaccompanied by loss of consciousness. The attacks in different individuals vary widely, the spasms being sometimes quite local, sometimes involving many different regions of the body.

In the *slighter kinds* of attack, a numbness and tingling is felt in the fingers and toes, which speedily become fixed in tonic spasm. As the spasms strengthen, they may extend to higher parts of the limb and become painful. The fingers are drawn together and slightly flexed, the thumb is bent into the palm, and the wrist slightly flexed. The toes also are drawn together and towards the sole, the big toe being drawn under them. The dorsum of the foot is arched, and the heel pulled up, whilst the leg and thigh are more or less rigidly extended. One or more of the limbs may be affected in this way; or if all are implicated, it may be simultaneously or successively. This condition of things lasts for a few minutes, or even for an hour or two, accompanied often by severe pain along the nerve-trunks, and by some diminution of sensibility in the parts affected. When the attack is about to terminate formication sets in, as at the commencement of the spasm. After variable intervals the attacks are renewed, it may be in an hour or two, or only after several days. Such paroxysms may be frequent during several months; and, according to Trousseau, so long as a tendency to recurrence of the spasms exists, they may always be excited anew by simply 'compressing the affected parts, either in the direction of their principal nerve-trunks, or over their blood-vessels, so as to impede the venous or arterial circulation.' On the other hand, the application of cold to the parts affected frequently arrests the spasms for a time.

In the *more severe forms* of tetany, the attacks may begin in the manner above indicated in the upper extremities, next in the lower extremities, and then, whilst diminishing in the parts first affected, the spasms may extend more or less generally to the muscles of the trunk. The contractions are invariably more or less painful. The spasms may even spread to the facial muscles, so that the jaws may be firmly clenched, and speech greatly embarrassed. If the muscles of the larynx are involved, as well as those of the chest and abdomen, extreme dyspnœa may be induced. Still there is no loss of consciousness. These attacks may be of brief duration; or they may be extreme in degree, long-continued, and frequently repeated. In these latter severe cases there is slight elevation of temperature, with greatly quickened pulse, and a furred tongue. After some weeks or months the paroxysms usually become less severe and less frequent, and finally cease altogether.

DIAGNOSIS.—The diagnosis must be based upon the progressive character of the attacks; upon the fact that they begin in the upper and lower extremities, and after a time completely intermit; upon the absence of all loss of consciousness during the attack; and upon the fact of the possibility of reinducing the paroxysms by pressure upon the nerves or vessels of the parts affected. These characters will suffice to distinguish the affection from tetanus, epilepsy, and hysteria.

PROGNOSIS.—The prognosis is usually favourable, the complaint gradually subsiding after a few months. Still, in very exceptional cases, the patient may die asphyxiated during one of the extremely severe attacks.

TREATMENT.—The treatment of tetany should in the main be directed to the improvement of the patient's general health, and the diminution of all debilitating conditions or causes of irritation. At the same time, we must endeavour to lessen the general mobility of the nervous system, by seeing that the patient obtains regular and sound sleep, as well as by the administration of one or other of the bromides in suitable doses, in combination with valerian, musk, conium, or other antispasmodic remedies.

H. CHARLTON BASTIAN.

THALAMUS OPTICUS, Lesions of.—SYNON.: Fr. *Maladies des Couches Optiques*; Ger. *Krankheiten der Sehhügel.*

INTRODUCTION. — Diseases of the optic thalamus vary in their symptomatology, according as the lesion is strictly limited to the ganglion itself, or implicates also neighbouring structures.

In the former case it is apparently well established by numerous recorded cases that lesions, such as apoplectic cysts or areas of softening, may exist without producing any discoverable symptoms, in the domain of either motility or sensibility, general or special. This is more particularly the case when the lesions occupy the convexity or ventricular aspect of the optic thalamus.

But more frequently diseases affecting the optic thalamus implicate also, directly or indirectly, the corpus striatum, internal capsule, crus cerebri, or corpora quadrigemina. Owing to the community of vascular supply between the corpus striatum and optic thalamus through the opto-striate arteries of Duret, embolism or rupture of these vessels leads to conjoint destruction, more or less extensive, of both ganglia, as well as rupture of, or pressure on the fibres of the internal capsule. A hæmorrhage or embolism in this region produces hemiplegia of the opposite side of the body. But that the hemiplegia cannot be due to the lesion of the optic thalamus is clear from the fact that such lesions may exist without any motor paralysis whatever. It is, therefore, more logical to attribute motor paralysis, when it does occur in connexion with lesions of the optic thalamus, to implication, direct or indirect, of the corpus striatum or the motor fibres of the internal capsule.

LOCALISING PHENOMENA.—It is a [illegible] whether, apart from considerations as to causation, there are any symptoms specially characteristic of hæmorrhages in the region of the optic thalamus.

Among other symptoms noted are clonic or tonic spasms of the paralysed limbs in a considerable number of the cases. Although these, according to Dr. Bastian, occur in about three-fourths of the cases, they cannot be regarded as pathognomonic, for similar spasms may occur from lesions elsewhere, as in the cortex, centrum ovale, and pons.

Nor is it true that lesions of the optic thalamus specially cause paralysis of the upper extremity, as has been contended by Saucerotte and others. The leg may suffer quite as much; and indeed, when the motor paralysis is associated with anæsthesia, the affection of the leg is frequently much more pronounced than that of the arm or face.

The occurrence of anæsthesia on the paralysed side is more constant and more enduring when the lesion invades the optic thalamus and its neighbourhood than when it is confined to the ganglia of the corpus striatum. This is owing to the fact that the posterior fibres of the internal capsule are directly injured, and not merely pressed on, as in the latter case. The anæsthesia may involve the special senses as well as common sensibility, but more frequently the tactile sensibility only is distinctly impaired. The reflex cutaneous excitability is also greatly diminished, as has been shown by Crichton Browne (*West-Riding Asylum Reports*, vol. v.). The paralysed limbs are frequently also affected with unsteadiness, tremors, or choreic-like spasms, intensified on volitional efforts. This affection, termed *post-hemiplegic chorea* (Weir-Mitchell, Charcot), is generally, if not invariably, associated with a greater or less degree of impairment of sensibility in the affected limbs. It is doubtful how much, if anything, can be assigned to the lesion of the optic thalamus itself in the causation of these symptoms But for regional diagnostic purposes they may be regarded as significant of lesion of the optic thalamus and its immediate neighbourhood. When the lesion involves only the posterior fibres of the internal capsule, lying external to the optic thalamus, the result is hemianæsthesia, general and special, of the opposite side of the body. The power of movement may not be apparently affected. If it be, the leg is, in general, relatively more affected than the arm. But, though the motility is retained, the muscular sense is lost, so that the patient is unaware of the state of contraction of the muscles or the position of the limb, and requires the aid of vision in guiding its movements.

Cases have been recorded by Dr. Hughlings Jackson and others, which render it in the highest degree probable that lesions of the posterior aspect of the optic thalamus, and region of the corpora geniculata, cause hemiopia towards the side opposite the lesion, from paralysis of both retinæ on the corresponding side. A similar result ensues from direct lesion of the optic tract, however, and also from severance of the medullary fibres of the occipito-angular region. Hence hemiopia alone, without other symptoms, cannot be taken as absolutely diagnostic of lesion of the posterior aspect of the optic thalamus. Conjoined with affection of the other forms of sensibility, however, it points to lesion in this region.

Tumours of the optic thalamus, in addition to the general symptoms of intracranial growths (though sometimes these even seem to have been wanting), produce either no special symptoms, or such a variety as to render the regional diagnosis very uncertain or altogether impossible. The symptoms may be those indicative of lesion of the internal capsule, both its motor and sensory strands; or they may be such as have been observed in connexion with lesions of the corpora quadrigemina.

It will thus be seen that, in respect to the regional diagnosis of diseases of the optic thalamus, we are obliged to rely on a combination of symptoms, not one of which can be regarded as absolutely depending on the optic thalamus itself, and that our localisation is at best only approximate.

D. Ferrier

THANET, Isle of, in Kent.—A dry, bright, bracing, marine climate. Principal resorts: Margate, Ramsgate, and Broadstairs. *See* Climate, Treatment of Disease by.

THERAPEUTICS (*θεραπεύω*, I attend). Synon.: Fr. *Thérapeutique*; Ger. *Therapie*.

Definition.—The science and art of healing.

Introduction.—Therapeutics is the most essential part of medicine, for although other parts of medical science are interesting to the practitioner, it is the cure of disease at which he should aim, and it is that which the patient seeks. Therapeutics may be divided into two classes—the therapeutics of fancy, and the therapeutics of fact. In order to cure disease with certainty, the practitioner must know what the nature of the disease is, and what the action of his remedies will be. When these are positively known, therapeutics becomes a science, but when either is uncertain it is simply an art. Its principles may hereafter become a science, but its practice must always remain more or less an art, and be dependent for success upon the skill of individuals. For the symptoms which ought to indicate to the practitioner the nature of the disease may be wrongly interpreted by him, or, as it is usually termed, he may form a wrong diagnosis, and thus be led to apply wrong remedies. The idea in the practitioner's mind may correspond more or less exactly with the condition of the patient, or may not have the slightest resemblance to it; and it is only by careful comparison and experiment that their agreement can be ascertained. An absurd fancy of the practitioner will lead to absurd treatment, and the therapeutic results will not be satisfactory.

History.—In all ages of the world's history we have had the therapeutics of fancy and the therapeutics of fact running side by side, and in proportion as the latter has predominated has treatment been improved. In primitive times the imagination of physicians was busy with fancies regarding the nature, the causes, and the cure of disease. The nature of the disease was sometimes supposed to consist in the possession of the body by an evil spirit, which caused the morbid symptoms, and the cure consisted of various incantations and exorcisms. At other times the disease was supposed to consist in alterations of the fluids or of the solids of the body, or of the formative principle which pervaded them. It was supposed that in disease the juices left their proper places in the body, or became disproportioned in quantity, or that the atoms and pores of the solids became altered, so as no longer to allow of free atomic motion. At other times, again, morbid conditions were attributed to fermentation, with production of alkalis or acids in the body; and later on, when the contractile power of muscular fibre was recognised, diseases were supposed to be due to spasm or to atony. Many fanciful qualities were attributed to medicines, some being reckoned hot, some cold, some astringent, some opening and some closing the pores, some contracting and some relaxing the muscular fibres, and some being supposed to cure disease because there was some external resemblance between them and the organ of the body affected.

Principles.—The unsatisfactory results of such fanciful therapeutics have led some, in all ages of medicine, to a more or less *experimental* therapeutics. Physicians saw men suffering and dying all around them, and could not wait for exact knowledge. They therefore applied themselves to tentative therapeutics, giving first one thing and then another in the hope of doing good, and collecting the results of these experiments on their patients, for the guidance of themselves and others in subsequent cases. The results thus obtained, showing that a certain drug was useful in a certain disease without the reason of this utility being known, constituted *empirical* therapeutics. In order to obtain a broader basis than that afforded by the observation of any single man, some have collected numbers of cases from various observers, and have analysed and tabulated them. The results of this method constitute *statistical* therapeutics. But it is liable to great fallacies, inasmuch as cases which are very different are tabulated, for convenience sake, under the same name, and the results are, therefore, rendered untrustworthy.

The problem placed before the practitioner in the treatment of any one case is rendered exceedingly difficult, not only by reason of the complexity of the bodily mechanism itself, but by the manifold alterations to which it is subject in disease, and the variations produced in the action of a drug by alterations in dose, by differences in the original constitution of the patient, and further differences superinduced by the disease. So complex, indeed, is the problem, that it is impossible to unravel it by any number of observations in disease, and it can only be solved by making ourselves acquainted with a few of the conditions at a time. This can only be done by experiment upon animals, for human life is too valuable to justify the necessary sacrifice. By experimental physiology, the functions of the various parts of the body and their relations to each other are being gradually ascertained; in experimental pathology diseases are induced artificially, in order that we may discover the alterations produced by them in the functions; and in experimental pharmacology, drugs are administered in order to determine the part of the body which they affect, and the nature of the alterations which they produce in its function. The problem being thus simplified, the practitioner may hope to recognise, from the symptoms of the patient, the organ affected by disease, and the nature of the disturbance in its function, and to apply with some degree of success a remedy which will counteract such disturbance. This constitutes *rational* therapeutics. Great advances have of late years been made in this direction, but it will be a long time yet before we can hope to attain such exact knowledge as we desire, and at present our therapeutics must be to a certain extent empirical. When directed towards the removal of the cause of the disease, it has been called *pathogenetic* therapeutics. When this cannot be recognised, or cannot be removed, the treatment is directed to those parts of the organism on which the cause of disease acts, so as to lessen or remove the symptoms which it would otherwise produce. This is *symptomatic* therapeutics. And when we can neither remove the cause nor relieve the symptoms, but are forced to trust to the *vis medicatrix naturæ*, and try to maintain the patient's strength by food and nursing, we have *expectant* treatment. This might perhaps also be called expectant therapeutics, for although in its narrowest sense we understand by 'therapeutics' cure by means of medicines in its wider acceptation the term includes nursing, domestic sanitation, climate, and other measures of treatment, such as regulated exercise, regulated gymnastics, friction, massage, and the application of heat, or of cold water.

T. Lauder Brunton.

THERMOMETER, Clinical (θέρμη, heat; and μέτρον, a measure).—Synon.: Fr. *Thermomètre*; Ger. *Thermometer.*

Definition.—An instrument for measuring different degrees of heat or cold of the human body.

Description.—The thermometer was invented by Galilei, about 1603, but it was Sanctorius (1561-1636) who first formed the idea of investigating the temperature of the human body in health and disease. The substances made use of in the construction of thermometers are mercury, first used by Fahrenheit; a coloured fluid—such as alcohol; or air. Any of these substances, enclosed in a fine exhausted glass tube, expanding at one end into a globular or cylindrical bulb, represents a thermometer. On applying heat or cold to the bulb the contents expand and rise, or contract and descend in the tube respectively. The extent of the rise or fall can be expressed in numbers on a scale, which is engraved on the stem or on a separate piece of white glass, or on a strip of paper fixed to the stem, and enclosed with it in a wider glass tube.

The thermometers used in this country and in the United States are graduated with *Fahrenheit's* scale, whereas on the Continent of Europe the *Centigrade* or *Celsius* scale is now everywhere used for medical and scientific purposes, the *Réaumur* scale falling more and more out of use. The difference between these three scales is this, that in the Centigrade and Réaumur scales the melting-point of ice is marked zero, and the boiling-point of water (or rather the heat of the steam of water boiling at an atmospheric pressure equal to 29·92 inches of mercury) marked 100° and 80° respectively; whilst Fahrenheit marked the former by 32° and the latter by 212°. Therefore 180 degrees of the Fahrenheit scale are equal to 100 degrees centigrade and 80 degrees Réaumur; and the relation of the three scales to each other is as follows:—

$$\begin{array}{ccccc} \text{F.} & & \text{C.} & & \text{R.} \\ 9 & : & 5 & : & 4 \end{array}$$

One degree of F. = $\frac{5}{9}$ C. or $\frac{4}{9}$ R.; one degree C. = $\frac{9}{5}$ F.

In converting degrees of the Fahrenheit scale into centigrade degrees, it must, however, be borne in mind that zero of the C. scale corresponds to 32 of the F. scale; 32 must therefore be deducted in converting a certain degree of the F. scale into the corresponding degree of the C. scale, and 32 must be added when C. degrees are to be expressed by the corresponding degrees of F. The formulæ for these conversions are, therefore:—

$$x \text{ deg. F.} = (x - 32) \times \tfrac{5}{9} \text{ deg. C.}$$
$$x \text{ deg. C.} = (x \times \tfrac{9}{5}) + 32 \text{ deg. F.}$$

For instance:—

$$99{\cdot}5 \text{ F.} = (99{\cdot}5 - 32) \times \tfrac{5}{9} = 67{\cdot}5 \times \tfrac{5}{9} = 37{\cdot}5 \text{ C.}$$
$$39 \text{ C.} = (39 \times \tfrac{9}{5}) + 32 = 70{\cdot}2 + 32 = 102{\cdot}2 \text{ F.}$$

It will be convenient, for quick reference, to give the corresponding degrees of the Fahrenheit and Centigrade scales in that range with which human physiology and pathology are concerned, side by side:—

F.	C.	F.	C.
95·0	35·0	104·0	40·0
96·0	35·55	104·9	40·5
96·8	36·0	105·0	40·55
97·0	36·11	105·8	41·0
98·0	36·66	106·0	41·11
98·6	37·0	106·7	41·5
99·0	37·22	107·0	41·66
99·5	37·5	107·6	42·0
100·0	37·77	108·0	42·22
100·4	38·0	108·5	42·5
101·0	38·33	109·0	42·77
101·3	38·5	109·4	43·0
102·0	38·88	110·0	43·33
102·2	39·0	111·2	44·0
103·0	39·44	112·1	44·5
103·1	39·5	113·0	45·0

In thermometers for clinical use the degrees on the scale ought to be divided into fifths. Thermometers ought to be carefully compared from time to time with a standard instrument, as they are liable, after a certain time, to give abnormally high indications owing to the bulb gradually contracting a little. Great improvements in the manufacture of glass for thermometers have, however, recently been introduced by Abbé and Schott (Tenaër Normalglas), whereby this drawback has been reduced to a minimum. In England thermometers may be sent for comparison with a standard instrument to the Kew Observatory; in Germany to the Imperial Physico-Technical Institute, Sect. II., at Charlottenburg, near Berlin.

Of great convenience for clinical use has been the introduction of self-registering mercurial maximum thermometers. It is not without interest to notice that a self-registering thermometer, by a small piece of iron being introduced into the tube, had been used by Currie at the end of the last century; but just as Currie and de Haën's work with the thermometer had been entirely forgotten for half a century, so were self-registering thermometers only used again in medicine some time after the ordinary thermometer had been re-introduced into clinical practice by Baerensprung, Traube, and Wunderlich. Casella was the first maker who constructed a registering clinical thermometer, by introducing a small quantity of air into the tube, and thereby separating a small part of the mercurial column from the rest. Instruments are now made in which the index—that is, the small separated part of the mercurial column—is prevented from falling back into the bulb, or in which an index is only formed each time the mercury rises out of the bulb. In using an instrument of this kind, the index, it need hardly be said, must be carefully shaken down below 95° or 96° before the thermometer is applied to the patient.

Another principle has been followed in the construction of very sensitive instruments for special researches on temperature, namely, that of the thermo-electric apparatus. The electric current that is produced in a circuit composed of two different metals when their point of contact assumes a different temperature from that of the other ends, or again, as first observed by Svanberg, the changes that a galvanic current shows when the resistance of a part of the circuit is altered by a change of temperature acting on it, can be measured by a galvanometer enclosed in the circuit. Gavarret, Heidenhain, and other physiologists have used the thermo-electric pile in physiological investigations in animals. J. S. Lombard, Hankel, Kunkel, and others, have applied it to observations in man. More recently a convenient form of thermo-electric apparatus for clinical purposes has been devised by Rédard. The apparatus, constructed on the last-mentioned principle by C. W. Siemens, for measuring deep-sea temperatures, might also easily be adapted for clinical purposes.

A self-registering apparatus for continuous observations, on the principle of an air-thermometer, has been constructed by Marey; and an instrument automatically registering the changes of temperature on the surface of the body during a certain time was devised by Mr. W. D. Bowkett (*Lancet*, July 1881). A very neat little metal thermometer in the shape of a small watch, showing the movements of a 'Bourdon tube,' which are caused by variations of temperature by the hand moving on the watch-face, has been constructed by Immisch. This can be placed in the axilla or between any folds of the skin, on the surface of the body or inside the mouth, and will correctly indicate the temperature. By a special arrangement the hand can be fixed before removing the instrument, which then acts as a maximum thermometer. But, although convenient for isolated observations and under special circumstances, it cannot for general clinical purposes compare with the ordinary glass thermometer, which, it need hardly be said, it surpasses in solidity.

For measuring surface-temperatures, mercurial thermometers of special shape, namely, a long cylindrical bulb coiled up in one plane at a right angle to the stem, have also been constructed. A thermo-electrical apparatus, or Bowkett's or Immisch's instruments, are, however, more sensitive and more convenient for that purpose.

Applications of the Thermometer.—The object we generally have in view with clinical thermometry being to examine as nearly as possible the temperature in the interior of the body, or the blood-heat, which is less variable than that of the surface (*see* TEMPERATURE), the localities most suitable for applying the thermometer would be the natural cavities, or the openings by which a thermometer might be introduced to a certain depth into the interior of the body. In the rectum, vagina, or bladder, the temperature is not subject to the ordinary changes acting from without, and the time required for taking an observation with the thermometer in any of these localities would be only such as is necessary for raising the temperature of the mercury to that of the surrounding mucous membrane. This time might be materially shortened by previously heating the thermometer to a degree a little below or above that to be expected in the body. With this preliminary measure an observation of the temperature in the rectum or vagina will not take more than half a minute.

The case is very different if we take the temperature in a cavity of the body which is not always closed, such as the mouth; or in the axilla, which can be formed into a closed cavity only by placing the arm closely against the chest. Here, quite independently of the sensitiveness of the thermometer, the time required for an observation is much longer, because the temperature of the mucous membrane of the mouth, or of the skin of the axilla, begins itself slowly to rise after the closing of these cavities, until it is raised to that of the deeper tissues which are not exposed to the loss of heat from without. Whereas nine to eleven minutes on an average are required for an observation of the temperature in the mouth, ten to twenty-four may be necessary for the mercury to become stationary in the axilla. The time varies also according to the state of the general circulation. It will be found much longer in persons with a weak circulation, for instance, in a case of heart-disease, than in the case of a vigorous patient with a good circulation and with febrile heat. It is evident that, as was first pointed out by Liebermeister, the time for an observation in the mouth or axilla can be materially shortened, not so much by previously heating the thermometer, as by, previously to the introduction of the latter, keeping the mouth or axilla closed for ten to fifteen minutes. These cavities will then have assumed a steady temperature, and the time required for the observation will only be that necessary for raising the temperature of the mercury and the glass to the temperature of the surrounding parts. It is, therefore, a good plan, if the patient had been lying on one side, to turn him over to the other, or to make him lie on one side for a time before the thermometer is introduced, and then to place the thermometer in that axilla which had been closed by the position of the patient. If the skin of the axilla be very wet with perspiration, it ought to be wiped dry before applying the thermometer.

For practical purposes the rule generally recommended in observations being taken in the axilla, to leave the thermometer until the mercury has remained stationary for five minutes—a rule which naturally applies to self-registering no less than to ordinary thermometers—secures sufficient accuracy; and this rule should be given to nurses and attendants to whom the observations are left. Especially in obscure cases, in which much depends upon the discovery of even a trifling elevation of the temperature above the normal standard, which may be of great importance for diagnosis, this precaution ought never to be omitted; and for observations requiring scientific accuracy, as, for instance, when the effect of some drug on the temperature of the body is being studied, the observations ought to be made by the physician himself.

For various reasons the axilla is the locality most suitable, and therefore generally used, for thermometrical observations. In very young or restless children, however, as well as in very emaciated adults, axillary observations would become untrustworthy. In such cases, or where patients are in an insensible state, or under special circumstances—for instance, when a great divergence exists between the axillary and the internal temperature, or when doubts arise as to the correctness of an axillary observation—the rectum, or eventually the vagina, may be used for applying the thermometer, and with a self-registering thermometer this can be done without unnecessarily uncovering the patient. In using the rectum, great care must be taken not to let a small instrument slip into it, and in restless children to prevent the instrument from being broken. This is best prevented by placing the patient on his side, and while the thermometer is kept *in situ* with one hand, letting the other one rest on the hip of the patient, in order to be able at once to arrest any turning movement which he might happen to make. The thermometer ought to be introduced about two inches deep into the rectum; and may, before being taken out, be gently pushed forward a little more, in order to bring the bulb in contact with a fresh part of the mucous membrane, which has not been cooled by the thermometer. When large masses of fæces fill the rectum, the thermometer passing into them may indicate a somewhat lower temperature than when in contact with the mucous membrane.

Other places of application, such as the inguinal fold, or the fold of skin between the thumb and the second metacarpus, may be used for special, but are quite unsuitable for general, clinical purposes. The clinical thermometer ought always to be carefully washed after being used.

Thermometrical Records.—It is extremely useful to register on a chart the thermometrical observations in a case of disease, and to connect the marks by lines; the curves which are thus formed being quite typical in many diseases. On the same chart may be entered, also by marks and lines, or otherwise, the numbers of the pulse and respirations, as well as remarks concerning other symptoms, or the treatment. For observations made with the thermometer, *see* TEMPERATURE.

The use of the thermometer for estimating the temperature of rooms, and especially of wards, is fully described in other appropriate articles. *See* NURSING THE SICK; and PERSONAL HEALTH. C. G. H. BÄUMLER.

THIRD NERVE, Diseases of.—INTRODUCTION.—The third nerve is purely motor in function. It supplies the levator palpebræ superioris; the superior, inferior, and internal recti; the inferior oblique; and the ciliary muscle and the sphincter of the iris. It arises from the surface of the crus cerebri by a series of fasciculi, proceeding from a nucleus of grey matter which lies beneath the hinder part of the floor of the third ventricle and the aqueduct of Sylvius, and is continuous behind with the nucleus for the 'fourth' nerve. From the experiments of Hensen and Voelcker, and some limited facts observed in man, there seems to be a serial representation of the several functions of the two nerves in this tract of grey matter. The anterior portion innervates the ciliary muscle subserving accommodation; next is the centre for the sphincter of the iris, through which contraction of the pupil is produced. Behind these centres for the internal muscles are, successively: those for the levator palpebræ; the rectus superior; while that for the internal rectus is probably by the side of the latter; farther back are centres for the inferior rectus and inferior oblique, while behind the former is the centre for the superior oblique (fourth nerve), associated in function with the inferior rectus. It is probable that the series of separate roots of the third nerve corresponds to this series of centres and of functions. We do not yet know whether the associated actions in convergence, and those of the lateral movements of the two eyeballs, are arranged in this nucleus or in adjacent centres. The fibres for the internal rectus seem to pass up to the nucleus of the third nerve from that of the sixth—those fibres for the internal rectus that are concerned in the conjoined lateral movement.

Description.—Morbid states of the third nerve are revealed by (1) Spasm, or (2) Paralysis in the muscles supplied by it, that is, those of the eyeball and the upper eyelid; in the iris; and in the ciliary muscle.

1. **Spasm.**—Spasm is never met with at the same time in all the muscles supplied by the third nerve. It involves isolated ocular muscles, especially in the internal rectus, in conditions of irritation of the trunk and nucleus of the nerve, as in meningitis, in hysteria, also in hypermetropia, and in paralysis of the antagonist muscle. When extreme, the eyeball is turned inwards, and cannot be moved out. Clonic spasm of the muscles occurs in 'nystagmus,' which may be present only during voluntary effort, or may be spontaneous. The elevator of the upper eyelid is occasionally spasmodically contracted, so that the eye cannot be shut, but remains widely or partly open (*lagophthalmos*). Some degree of this elevation is common in exophthalmic goitre, and may occur alone, as a partial manifestation of a similar state. Slight contraction of this muscle occurs also in cases of long-continued paralysis of the orbicularis palpebrarum. Spasm of the levator may also be due, in rare cases, to peripheral irritation in the region of the fifth nerve.

Contraction of the sphincter of the iris produces diminution of the pupil (*myosis*), sometimes to very small dimensions. It may result from irritation of the trunk of the third nerve; or from stimulation, central or reflex, of the nucleus; or it may be secondary to paralysis of the dilator fibres supplied by the sympathetic. It may result from excessive (associated) efforts at accommodation. It is, however, most frequently met with in locomotor ataxy, and is associated with loss of reflex action. The condition is described more fully in the next section. Spasm of the ciliary muscle may result from the other causes of irritation of the nerve-trunk, or from excessive efforts at accommodation in hypermetropia. Its effect is to produce a fixed accommodation for near objects.

Treatment.—The treatment of the central causes of overaction of the third nerve commonly resolves itself into that of the primary condition. Rest is important, and attempts to converge and accommodate should be, as far as possible, avoided. If no exciting cause can be discovered, the overaction should be reduced by sedatives, of which bromide of potassium is the safest. Sometimes belladonna may be added with advantage, but its effect should be watched. It is needless to say that distinct errors of refraction should be corrected by glasses. When a peripheral source of reflex excitation can be ascertained, its influence may be lessened by injections of morphine or cocaine. Functional overaction is often the expression of weakness, and needs nervine tonics in addition to the other measures. Counter-irritation, in the region of the related sensory nerve, is frequently of great service in this as in most other forms of functional spasm. Persistent convergence in hysteria can generally be removed by a small blister to each temple. Atropine will overcome spasm of the sphincter pupillæ or of the ciliary muscle. The cold douche to the eyeball is useful in spasmodic lagophthalmos, but many cases of this affection are extremely obstinate. The treatment of the retarded descent of the lid occurring in exophthalmic goitre, and now and then met with as an isolated symptom (or combined only with a quick pulse), is that of this disease as a whole.

2. **Paralysis.**—Ætiology.—The commonest cause of paralysis of the third nerve is some affection of its trunk as it passes through the membranes at the base of the brain, through the orbital fissure, or along the orbit; due either to rheumatic inflammation of the nerve-sheath, to syphilitic inflammation of the nerve or membranes, or very frequently to injuries of various kinds. Less frequent causes are acute lesions—hæmorrhage, softening, inflammation—in the nucleus of the nerve, or at the inner part of the crus cerebri through which the fibres pass and from which they emerge; compression of this part by an aneurysm or a growth in the interpeduncular space; basilar meningitis; and aneurysm of the termination of the internal carotid. A syphilitic growth, on the nerve or near it, may compress the fibres. Paralysis is also met with as a result of diphtheria, and in association with disease of the spinal cord, especially locomotor ataxy. It occurs also, in rare cases, as part of multiple neuritis after other acute specific diseases besides diphtheria, and from some toxic substances. Sudden palsy of a branch, occurring during effort, is probably due to an extravasation in the sheath of the nerve.

Two peculiar causal varieties deserve mention. In *relapsing palsy* the nerve on one side becomes paralysed subacutely, the whole, or more commonly some, of its branches suffering; it recovers imperfectly; and then the other nerve becomes similarly affected. Afterwards the palsy of the first returns, and some permanent affection of both nerves remains. This form is met with in the subjects of old syphilis. *Periodical* or *recurring palsy* is a peculiar variety, perhaps allied to migraine, in which transient palsy of the third nerve occurs at intervals during many years, sometimes even from childhood up to adult life.

Occasionally all the muscles supplied by the third nerve become paralysed, together with the other orbital muscles—'ophthalmoplegia externa'—from degeneration of the [illegible] of the nuclei of these nerves; and hence it is also termed 'chronic nuclear palsy.' This is usually due to alterations in the grey matter similar to those which, in the spinal cord, gives rise to progressive muscular atrophy. It is perhaps in some instances due to peripheral degeneration of the nerves. It is met with in association with tabes, and also alone; and in both cases is most common in the subjects of syphilis, being met with in both the acquired and inherited forms.

Symptoms.—Paralysis may affect some or all of the fibres of the third nerve. When complete, the upper eyelid is dropped and cannot be raised, and the eye can be moved only outwards, and a little outwards and downwards; after a short time it is always turned outwards. The pupil is in a mid-state between contraction and dilatation, and cannot be made to contract by light; power of accommodation in the eye is lost, owing to paralysis of the ciliary muscle. Each muscle supplied by the nerve may be paralysed separately, by an affection of its special branch of the nerve after it leaves the main trunk.

When the levator palpebræ superioris is affected, *ptosis*, or dropping of the eyelid, alone results. It is seldom an isolated symptom of disease of the third nerve, since the branch to the levator is seldom alone affected; but it occurs, with palsy of the associated superior rectus, from limited disease of the nucleus. It is met with in partial disease of the nerve from all the causes of this. It is also congenital. A form of 'morning ptosis' sometimes occurs, owing to a difficulty in raising the lids on first waking. In hysteria, ptosis may be simulated by contraction of the orbicularis, a mechanism which becomes distinct if contraction of the corresponding half of the occipito-frontalis is induced by making the patient look up.

Paralysis of one of the three straight muscles supplied by the third nerve is indicated by symptoms which occur chiefly during movements in which the paralysed muscle is needed; they are the series of symptoms that result from paralysis of any ocular muscle, and which are elsewhere described in detail—limitation of movement, primary deviation, strabismus, secondary deviation of the unaffected eye, diplopia, erroneous projection of the field of vision, and often vertigo as the result of the last. In diplopia the distance between the two images increases as the object is moved in the direction of action of the affected muscle. When the internal rectus is paralysed, slight power of movement inwards still remains from the superior and inferior recti. There is divergent strabismus and crossed diplopia, when looking upwards and inwards the images approach at the top, when looking downwards and inwards they approach at the bottom. The patient carries his head turned towards the side of the affected muscle, to avoid the double vision. When the superior rectus alone is paralysed, the movement upwards of the affected eye is diminished, and the eye deviates a little outwards; there is crossed diplopia in the upper half of the visual field, the image formed by the affected eye being higher than the other, the two diverging above, the difference in height being greater in looking outwards and upwards, while the difference in obliquity is greater on looking inwards and upwards. When the inferior rectus only is affected there is defective movement, with crossed diplopia, on looking downwards. The second image is below that of the healthy eye, the distance between them being greatest on looking downwards and a little inwards. The images are not parallel, but diverge at the bottom, and the difference in obliquity increases on looking inwards and downwards. The inferior oblique is very rarely affected alone.

In paralysis of the sphincter iridis, the elasticity of the structure maintains the pupil at middle size, and it can be further dilated by atropine, but all power of contraction beyond that degree is lost. When the ciliary muscle is paralysed, the power of accommodation is lost: the far point of vision remains the same, but the near point is rendered much more distant.

The remarkable loss of reflex action of the iris, which occurs in association with locomotor ataxy, is often accompanied by myosis. Then, the pupil does not dilate on stimulation of the skin (Erb). When the pupil is not small, this reflex dilatation is usually preserved. In loss of the light-reflex the contraction on accommodation and convergence is often preserved (Argyll-Robertson). Sometimes this is also lost, the ciliary muscle being paralysed—the 'ophthalmoplegia interna' of Hutchinson. Power of accommodation may be lost although the pupil still contracts on an effort at accommodation. These symptoms also occur in cases of old syphilis, apart from spinal disease. They probably then depend on limited degeneration in the nuclei of the third nerve, the result of the action of some poison left by the organised virus of syphilis.

Diagnosis.—Paralysis of the third nerve is generally obvious; only the slighter palsy of separate branches supplying the ocular muscles is sometimes not easy to recognise; and for this purpose, a careful examination of the double images is often necessary. The diagnosis of the cause is less easy. Rheumatic paralysis succeeds exposure to cold, and is often attended by much pain; in syphilis other cranial nerves are often affected independently; in meningeal and spinal disease there are the respective distinctive symptoms; in disease of the crus there is hemiplegia of the opposite side, coincident in onset with the affection of the third nerve; in interpeduncular disease the affection of the third nerve may precede the hemiplegia, and both third nerves commonly suffer. After diphtheria the ciliary muscle is usually alone affected. In the pseudo-ptosis of hysteria, the contraction of the orbicularis can be rendered evident by making the patient try to look up; the contraction of the levator has to be counteracted by conspicuous contraction of the orbicularis.

Prognosis.—When due to cold or to recent syphilitic mischief, or occurring after diphtheria, the prognosis of paralysis of the third nerve is good if proper treatment can be secured. In cases of organic cerebral disease it is less favourable, and is subordinated to that of its cause. In association with spinal disease the ultimate prognosis is unfavourable, for, although the early attacks are usually recovered from, the affection often recurs, and each recurrence leaves some residual effect. As a general rule, however, the prognosis must be guided by the nature of the morbid process on which the palsy depends, the extent to which this can be influenced by treatment, and the duration of the changes in the nerve-elements on which the symptoms directly depend.

Treatment.—In rheumatic paralysis of the third nerve from cold, hot fomentations, counter-irritation by blisters to the temple, with an alkaline diuretic or salicylates, should be employed in the early stage. In all forms of acute or subacute inflammation it is wise to give small repeated doses of mercury. Subsequently small doses of iodide of potassium and tonics are the most useful. When it is of syphilitic origin, large doses of iodide of potassium usually suffice to effect a cure. If associated with spinal mischief, strychnine, iron, and arsenic are occasionally of some service. In intracranial disease—tumour, aneurysm, or meningitis—the treatment is that of its cause. After diphtheria tonics are alone necessary; it is indeed a merely subordinate symptom in most cases. In paralysis of the sphincter pupillæ and ciliary muscle, occasional instillation of a small quantity of solution of eserine does good, by stimulating locally the paralysed fibres, and this has been said to be beneficial in affections of other branches of the nerve. In the paralysis of the ocular muscles electricity has been recommended, applied through the eyelid to the affected muscle, a small electrode being used, and the eye so turned as to bring the muscle as much as possible within reach, the other electrode being placed on the temple. A direct application to the conjunctiva is too painful. But whether faradism or voltaism is used, the evidence of benefit, when the facts are rigidly scrutinised, is practically *nil*. The only 'satisfactory' results have been in syphilitic cases in which iodide of potassium was also given. The application of the continuous current in the neighbourhood of the orbit sometimes produces slight temporary increase of power, when there is only weakness, but the effect is produced merely by the stimulation of the sensory nerves, and is never enduring.

W. R. Gowers.

THIRST.—Synon.: Fr. *Soif*; Ger. *Durst*. Thirst is a sensation indicating a necessity on the part of the system for an increased supply of water, as appetite shows there is a need for the introduction of food. Although the sensation is referred to the back of the throat, it is not a purely local feeling, as is proved by the fact, well known to physiologists, that it cannot be allayed by the swallowing of water, unless the fluid reach the stomach and be absorbed. It is always present in febrile disorders, an increased supply of liquid being required both to reduce the heat, by promoting the evaporation of moisture from the skin and lungs, and also to wash away the products of the increased tissue-changes that accompany these complaints. In like manner it is always present when much fluid has been abstracted from the system; thus, it shows itself after all surgical operations attended by hæmorrhage. It is a prominent symptom in cholera and diarrhœa, in which diseases large quantities of serum are rapidly removed from the gastro-intestinal circulation, and equally so in diabetes mellitus, where fluid is largely excreted along with sugar by the urinary organs. A craving for cold and acid drinks presents itself in acute gastritis, the intensity of the thirst being perhaps due to the incessant vomiting, which prevents fluids remaining long enough in the stomach to be absorbed. In chronic gastritis thirst is usually present, and is chiefly complained of towards evening. It forms a useful diagnostic sign between this disease and mere atonic dyspepsia.

Treatment.—Thirst is relieved by the agents usually recognised as refrigerants, such as water, barley water, toast and water, and similar drinks; sucking small pieces of ice; effervescing drinks; freely diluted acid drinks, especially those made with vegetable acids or phosphoric acid, alone or combined with a little aromatic bitter; the juices of fruits, or these made into drinks. Care has often to be exercised in the employment of these apparently harmless agents, and their consumption has to be checked, otherwise patients will take them to excess, and may thus do themselves considerable injury.

Samuel Fenwick.

THORACENTESIS: THORACOCENTESIS (more correctly), (θώραξ, the chest; and κεντέω, I pierce). Synonym for paracentesis thoracis, or tapping of the chest. *See* Paracentesis; and Pleura, Diseases of.

THORACIC ANEURYSM.—Under this head are included aneurysms of (A) the Intra-Thoracic Aorta; (B) the Arteria Innominata; (C) the Pulmonary Artery; (D) the Coronary Arteries; and (E) the Heart. The last two forms have been fully treated of under their respective articles, and will not be further referred to here. *See* CORONARY ARTERIES, Diseases of; and HEART, Aneurysm of.

A. **Aneurysm of the Intra-Thoracic Aorta.**—This may be most conveniently discussed in its clinical aspects under two heads, namely, (1) *aneurysm of the arch*, and (2) *aneurysm of the descending thoracic aorta*; whilst the former may be subdivided into aneurysm of (*a*) the *ascending*, (*b*) the *transverse*, and (*c*) the *descending* portion.

Relative frequency.—Of seventy-six cases analysed by the late Dr. Hayden, including fourteen treated by him, the seat of aneurysm, single or multiple, stated in the order of relative frequency, was as follows: *Single*: ascending portion of arch, thirty; transverse portion, seventeen; descending thoracic aorta, ten; ascending and transverse portions of arch, nine; transverse and descending portions, two; entire arch, two; descending portion, one; thoracico-abdominal aorta, one. *Multiple*: ascending portion of arch and descending thoracic aorta, two; ascending portion of arch and abdominal aorta, two.

1. **Aneurysm of the Arch.** — The different parts of the arch of the aorta must be considered separately.

(*a*) *Ascending portion.*—ANATOMICAL CHARACTERS.—Aneurysms arising from one of the sinuses of Valsalva, within the range of the valves, rarely attain a size larger than that of a billiard-ball. They are saccular and not infrequently pedunculated, communicating with the aorta by a small orifice. They further exhibit a remarkable tendency to *descend* in the progress of growth, involving in their course the heart or the root of the pulmonary artery. By their position they are sheltered from direct influx from the ventricle, whilst they are exposed to the maximum force of reflux from the aorta. When, however, the orifice is partially or entirely above the level of the valves, the main pressure sustained by the sac is that of efflux from the ventricle; hence the direction of growth is upwards. Aneurysm of the portion of the vessel immediately above the level of the valves is especially prone to advance towards the right side, forming a tumour visibly projecting, or detectable by palpation and percussion, in the vicinity of the right nipple. It may be fusiform or saccular, true or false; it usually attains a large size; and, when fusiform, not infrequently extends over a great portion or even the whole of the arch. The direction of growth may, however, be backwards or to either side; the aneurysm in its progress implicating the œsophagus, the pulmonary artery or one of its branches, the superior vena cava, or either auricle; it is in such cases usually saccular, and of comparatively small size. Aneurysms of the extra-pericardial portion of the ascending aorta usually tend forwards and upwards in the line of main blood-pressure, projecting at the right margin of the sternum above the fourth costal cartilage, and occasionally likewise into the root of the neck, involving the arteria innominata. They may, however, grow backwards and to the right, implicating the right bronchus or lung, or the superior cava; directly backwards, pressing upon the œsophagus or the bifurcation of the trachea; or, projecting mainly towards the left side, they may involve the left branch of the pulmonary artery, and the left bronchus or lung.

SYMPTOMS AND SIGNS.—Aneurysm of the sinuses is rarely attended with very definite symptoms; indeed, only when it presents at the anterior wall of the chest.

Owing to its position within the pericardium, and its close proximity to the heart, the symptoms produced by aneurysm in this situation may be readily confounded with structural or valvular disease of the heart itself. The acoustic signs are, for the purposes of diagnosis, no less indefinite; because, from the position of the aneurysm close to the orifice of the aorta, a murmur produced by it, whether of influx or of efflux, may be easily mistaken for one of the same rhythm caused by obstruction at the aortic orifice or inadequacy of the valves. The difficulty of diagnosis is further increased by the usual co-existence of atheroma with dilatation of the first portion of the aorta, relative incompetency of the valves, and eccentric hypertrophy of the left ventricle. The ordinary symptoms are those of palpitation and derangement of the rhythm of the heart, from affection of the cardiac plexus. But the diseases just mentioned may, in the absence of aneurysm, give rise to similar phenomena. The existence of venous stasis and congestion of the upper half of the body, viewed in conjunction with tumultuous and irregular action of the heart, and in the absence of discoverable cause of venous obstruction at a higher point in the chest, would, however, warrant the *presumptive* diagnosis of aneurysm at the root of the aorta, implicating the right auricle or the termination of the superior cava; and if with these symptoms were associated systolic murmur at the base, not transmitted in the course of the aorta, or a double murmur, a positive diagnosis to the above effect might be made. Were the diastolic murmur preceded by a distinct second sound, valvular inadequacy from dilatation of the aorta, without valvular disease, would be thereby indicated, and the diagnosis of aneurysm *pro tanto* sustained. Symptoms of obstruction of both cavæ, namely, general venous congestion and engorgement of the liver, would in the foregoing connexion justify the special diagnosis of pressure upon the sinus of the right auricle. The symptoms of pressure upon the other chambers of the heart are those only of deranged rhythm and circulation, such as may be due to various causes inherent in the heart. Systolic murmur in the pulmonary artery may result from the pressure of an aneurysm on the root of that vessel. Communication of an aneurysm with one of the chambers of the heart is usually effected by an aperture not more than two to three lines in diameter. It is the result of progressive absorption, and the symptoms are scarcely to be distinguished from those of antecedent pressure. The physical signs are more characteristic; they consist in a loud murmur, systolic or diastolic, of a 'booming' or 'splashing' character, accompanied by thrill, traceable from the root of the aorta in the direction of abnormal influx, and not transmitted in any of the ordinary lines of valvular murmur. If two murmurs exist, they are fused or converted into a continuous rumble. Sudden transfer of the seat of greatest intensity of such a murmur, from the aortic area to some other point of the præcordia, would be conclusive, not only as to the irruption of an aneurysm into one of the chambers of the heart, but likewise as to the date of its occurrence. The sac of an aneurysm in the situation of the aortic sinuses does not attain any considerable size, as it usually bursts into the pericardium, thus causing sudden death.

Aneurysm of the ascending aorta, external to the pericardium, is occasionally latent, but ordinarily it is characterised by very definite symptoms and signs. A large fusiform aneurysm of this portion of the vessel, or one engaging the entire arch, equally expanded, not in contact with the anterior thoracic wall or pressing inconveniently upon any of the adjacent organs, may be virtually latent; exhibiting no symptoms of aneurysm except vague neuralgic pains darting over the chest, shoulders, arms, and back, and no sign but exaggerated double sound. Pointing externally, or in persistent contact with the chest-wall, an aneurysm may be readily identified by the circumstance that it presents a second centre of pulsation and intensified sounds. The ordinary pulsation is systolic, expansile, and diffused (though not always equally) over the entire surface; but a second and minor impulse of diastolic rhythm may likewise exist. The former is in many cases accompanied by tactile thrill. The acoustic signs consist either in two sharply accentuated sounds, nearly alike in character, and corresponding in rhythm to those of the heart; or in a single or double murmur of blowing or 'booming' quality. There is likewise absolute dulness, with suppression of respiratory sounds and of vocal fremitus, to the extent of the tumour.

Pressure upon the superior vena cava is characterised by venous congestion, limited to the upper half of the body: whilst actual communication with that vessel is evinced by cyanosis to the same extent; extreme engorgement with pulsation of the jugular veins; a buzzing systolic murmur; and intense thrill, at the seat of communication and transmitted into the veins of the neck. According to the late Dr. Mahomed, in cases of arterio-venous aneurysm *inspiration* alters the characters of a sphygmogram, by diminishing the volume of blood in the artery. Pressure upon the main bronchus is indicated by diminished or suppressed respiration, with normal percussion-sound, in the corresponding lung; and occasionally by 'whiffing' or 'jerking' inspiratory sound. Diminished respiration throughout either lung, with inequality as between its upper and lower portions, would indicate pressure, but unequal in degree, upon the primary bronchus and its superior secondary branch; whilst partial or complete suppression confined to the upper lobe would show that the superior lobular branch was alone implicated. Pneumonia from occlusion of the pulmonary vessels, or from pressure upon the pneumogastric or pulmonary plexuses, is a frequent result of the pressure of an aneurysm. The consolidation of lung-substance so produced is due to implication of the laryngeal and pharyngeal nerves. Bronchitis may likewise arise from mechanical irritation; and where present may, in greater or less degree, mask the physical signs of aneurysm. The sudden irruption of an aneurysm into one of the bronchi is indicated by copious discharge of florid blood from the mouth and nostrils, and is instantly fatal by syncope or asphyxia. An opening established into the pulmonary substance is followed by 'leakage' of blood, or repeated but limited hæmoptysis. Pressure upon the pulmonary artery is necessarily attended with engorgement of the right chambers of the heart, and general venous congestion; and the establishment of an opening into that vessel, with sudden and urgent dyspnœa without spasm or stridor, extreme congestion of the lung, and hæmoptysis. Death is rapid in such cases; but should an opportunity for physical exploration be afforded, a 'buzzing' systolic hum might be detected in the second and third left intercostal spaces, close to the sternum. Pressure upon the œsophagus is indicated by dysphagia, referred by the patient to a corresponding point of the chest. Dysphagia due to the pressure of an aneurysm is remittent, and varies in some degree with posture—traits by which it is distinguished from that produced by cancer. Dysphagia from volvulus of the œsophagus may, however, exhibit similar variations.

(*b*) *Transverse portion.*—Anatomical Characters.—Aneurysms of this portion of the aorta are usually fusiform: they involve mainly its anterior and superior wall, pushing forward the upper end of the sternum, projecting into the neck, compressing the left innominate vein, and modifying, in many cases, the circulation in the primary arteries and their branches. They likewise frequently press backwards upon the œsophagus and trachea, the pneumogastric or sympathetic of either side, or the left recurrent nerve. Owing to the backward course of the left extremity of the arch, aneurysms arising from this portion of the vessel rarely appear in front. They project above the left clavicle, involving the innominate vein, the pneumogastric, sympathetic, or recurrent nerve of the left side, and occasionally all three; or posteriorly in the left scapular region.

Symptoms and Signs.—Pressure upon the left innominate vein is accompanied by visible engorgement of the thyroid, left jugular, subclavian, brachial, and superficial thoracic veins and their tributaries, with œdema of the left arm. The circulation in the carotid or subclavian artery of one side is often diminished or suppressed by the lateral pressure of an aneurysm, or by clot formation in the sac. Pressure upon the trachea is indicated by clanging or metallic cough, and stridor 'from below,' that is, loudest at the upper part of the sternum, and distinctly audible over the lower cervical and upper dorsal vertebræ. The symptoms of aneurysmal pressure upon the sympathetic, pneumogastric, and recurrent nerves are most frequently exhibited on the left side only. Those due to implication of the sympathetic or its cilio-motor roots are manifested in the pupil on the affected side. They consist in dilatation or contraction of the pupil according to the degree of pressure; the former from irritation, and the latter, which is the more usual phenomenon, from paresis of the nerve. Laryngeal stridor, huskiness or loss of voice, and harsh metallic cough, in the absence of local disease of the larynx, are eminently diagnostic of pressure upon either recurrent nerve. By means of the laryngoscope the vocal cord on the side of disease, and in rare cases the cords on both sides, are seen to be fixed during breathing and vocalisation, from unilateral or bilateral paralysis of the abductor muscles of the larynx. Sir George Johnson holds that unilateral paralysis is distinguished by slight huskiness of voice, with stridor on full inspiration; and bilateral paralysis, by permanent dyspnœa and stridor. Paroxysmal dyspnœa or fatal asphyxia may result from collapse of the arytænoid cartilages in such cases. Pressure upon either pneumogastric is especially characterised by paroxysms of remittent spasm of the glottis, which may be suddenly fatal; but, where the recurrent nerve is not likewise implicated, persistent stridulous breathing, aphonia, and metallic cough are not exhibited. A marked difference in the volume of the pulse at the wrists is frequently noted in aneurysm involving the innominate or subclavian arteries.

The physical signs are identical with those already described in connexion with aneurysm of the ascending portion of the vessel.

(*c*) *Descending portion.*—Anatomical Characters.—Aneurysm of the left curvature and descending portion of the arch involves the left recurrent nerve in nearly every instance. In the progress of growth it passes into the root of the neck; backwards towards the left scapula; or backwards and outwards into the substance of the lung.

Symptoms and Signs. — These include symptoms of pressure upon the recurrent or pneumogastric nerve, as well as the subclavian or internal jugular vein; a pulsating tumour in the left interscapular space, which may attain very large proportions; and signs of congestion and consolidation of the upper and back part of the left lung. In the last case the aneurysm, being involved in the pulmonary structure, may afford no specific evidence of its existence.

The physical signs differ in no respect from those which characterise aneurysm of the other portions of the arch.

2. **Descending Thoracic Aorta.** — Anatomical Characters.—Aneurysms of the upper portion of this division of the vessel rarely attain a large size. They may pass upwards and to the right side, implicating the trachea and œsophagus; or directly to the right, stretching the œsophagus or thoracic duct, and ultimately opening into one of them, or into the right pleura. In a case which came under Dr. Hayden's notice, the trachea and the œsophagus were simultaneously perforated, and death occurred by hæmorrhage into both. The aneurysm may advance to the left, and ultimately prove fatal by rupture into the left pleural cavity; it may erode the vertebræ and ribs, opening into the spinal canal, causing paraplegia; it may point in the left infrascapular region; or it may advance towards the anterior wall of the chest, displacing the heart, and involving itself in the substance of the left lung. Aneurysm of the lower part of the vessel usually extends into the abdomen, constituting the thoracico-abdominal form of the disease. It may displace the heart forwards, and the liver downwards; it may likewise extend backwards, eroding the vertebræ, and pointing in the lower dorsal or the lumbar region on the left side. Finally, an aneurysm in this situation may prove fatal by simultaneous hæmorrhage into the left pleural cavity and left retroperitoneal space, or into the vertebral canal.

SYMPTOMS AND SIGNS. To what has been already stated on this subject it is only necessary to add, that progressive absorption of the vertebræ is indicated by fixed and boring pain referred to a particular point of the vertebral column, which is tender to pressure, or not infrequently radiating or 'nipping' pains extend round the chest from implication of the intercostal nerves. Forward displacement of the heart by an aneurysm would be characterised by violent impulse, simulating that of cardiac hypertrophy (the distinction would rest upon the presence of the special symptoms and signs of aneurysm); a remarkable derangement of cardiac impulse, constituting the 'double jog' of Hope; with absence of the positive signs of hypertrophy. Pressure upon the thoracic duct is very rare; it would be indicated by the symptoms of mal-assimilation, wasting, and inanition—symptoms which are foreign to aneurysm under its ordinary forms.

The physical signs of aneurysm of the descending thoracic aorta are ordinarily limited to a sharp sound, single or double, audible over the dorsal vertebræ and somewhat to the left; and, more rarely, perceptible impulse. The existence of murmur is exceptional; when present, murmur is all but invariably single and post-systolic, and is inaudible in the erect posture.

DURATION AND TERMINATIONS. The duration of aneurysm of the intra-thoracic aorta may vary from a few days to several years. Death is most frequently caused by rupture of the sac into various parts; or by gradual exhaustion from insomnia and inanition. Of seventy-one cases of aneurysm in this situation tabulated by Dr. Hayden, including twelve observed by him, twenty-six were fatal by rupture of the sac; namely, into the pericardium ten—all being aneurysms of the ascending aorta; into the left lung or pleura five—four being of the transverse, and one of the descending thoracic aorta; into the trachea four—three of the transverse, and one of the ascending aorta; into the right lung or pleura three—two of the ascending, and one of the descending thoracic aorta; into the left bronchus or œsophagus three—two of the descending thoracic, and one of the transverse aorta (in one of these an opening existed both into the left bronchus and the œsophagus); externally one—the aneurysm having arisen from the transverse aorta. Death may also result from asphyxia, from intercurrent inflammation of the lungs or pleura, or from coma.

B. Aneurysm of the Arteria Innominata.—Aneurysm involving the innominate artery may be mistaken for aneurysm of the aorta, at or near the first curve of the arch.

SYMPTOMS AND SIGNS.—Those which are most distinctive of innominate aneurysm are the early appearance of pulsating tumour above the right clavicle, accompanied by arterial obstruction on the right side; displacement of the trachea and larynx to the left; and pulsation with accentuated sound, localised at the right sternoclavicular joint and immediately above it. Diminished circulation in the right carotid and subclavian arteries at an early period of the disease, and the reduction or arrest of pulsation in the sac by digital pressure upon these vessels, afford the most constant and least equivocal evidence of innominate aneurysm. The early occurrence of neuralgic pains in the right side of the neck, the right shoulder, and ear, followed by œdema and partial paralysis of the right arm, is likewise suggestive of innominate, as distinguished from aortic aneurysm. The symptoms of nerve-pressure on the right side, as exhibited in the larynx and pupil, are usually well-pronounced in this disease. The physical signs are in no respect different from those of aneurysm of the arch. Concurrent implication of the aorta is ordinarily determined with the greatest difficulty, and occasionally a positive diagnosis in this respect cannot be made. If pulsation and sound of maximal intensity exist at the level of the second costal cartilage, or an inch and a-half below the sternal end of the clavicle, whilst the pulse-tracing of the right radial artery exhibits imperfect aneurysmal characters, the aorta may be considered as involved in the disease.

C. Aneurysm of the Pulmonary Artery.—Aneurysm of the main trunk or primary branches of the pulmonary artery is unknown; but aneurysm and ectasia of the secondary and subsequent branches have been repeatedly found in connexion with cavities in the lungs, and are recognised as the ordinary source of fatal hæmoptysis in the third stage of phthisis. Cavities confined to one lung with walls condensed by fibroid growth, and either stationary or in process of secondary ulceration, are those which are most favourable to the formation of pulmonary aneurysm or ectasia. In the walls or trabeculæ of such cavities the branches of the pulmonary artery remain pervious; their coats, already thickened by chronic inflammation, and weakened by degenerative changes, expand under vascular pressure, where least supported, and form an aneurysm, globular, fusiform, or semi-fusiform, according to the extent and degree of their structural change and denudation, or a simple ectasia. These ultimately give way by rupture or erosion, and severe hæmorrhage into the cavity and connected bronchi is the immediate result. Active ulceration of an existing cavity is usually attended with partial thrombosis of adjacent vessels. Hence, in such cases, hæmoptysis is seldom copious, and death results from exhaustion produced by repeated small hæmorrhages. In the process of primary and active excavation of lung-tissue the vessels are completely blocked, and hæmoptysis, even to a small amount, is exceptional. *See* Hæmoptysis.

Symptoms and Signs.—Of a special kind there are absolutely none. Copious hæmoptysis in connexion with cavity would be eminently suggestive of pulmonary aneurysm. Of twelve cases of fatal hæmoptysis in the third stage of phthisis, tabulated by Dr. Douglas Powell, a ruptured aneurysm or ectasia of a pulmonary branch was found to be the source of hæmorrhage in no less than eleven instances.

Treatment.—The treatment of aneurysm will be found described in the articles Abdominal Aneurysm; and Aorta, Diseases of. The *curative* treatment of aortic or innominate aneurysm should be directed to the single object of effecting consolidation of the contents of the sac. With this object in view, three methods have been pursued, either separately or conjointly, namely, the *postural* and *dietetic*; the *medicinal*; and the *operative*. As complemental of the first plan of treatment of thoracic aneurysm, an occasional blood-letting by venesection, to the amount of eight to ten ounces, for the purpose of reducing arterial tension or venous engorgement, may be demanded. With a view to causing or promoting deposition of fibrin in the sac, several agents have been used, namely, acetate of lead, in doses of four to eight grains; iodide of potassium, ten to thirty grains; and aconite, five minims of the tincture thrice daily. Ergotin has been used hypodermically by Langenbeck. Each of these agents has been credited with success in the treatment of aneurysm. But, as spontaneous cure has been occasionally witnessed under favourable circumstances as to diet and rest, where no medicine had been given, a more than promotive influence, by retarding the circulation and reducing vascular pressure, can scarcely be assigned to the medicine used, where rest and restricted diet have been observed. Galvano-puncture of the sac has been practised with success. Deligation of the common carotid artery, or of that vessel and the subclavian, may be followed by the most favourable result, in cases where pressure upon these vessels has been found to control pulsation in the sac. For details of the operative treatment of aneurysm the reader is referred to works on surgery and to the article on Aneurysm.

The *palliative* treatment of thoracic aneurysm is discussed in the article Aorta, Diseases of. A few leeches applied from time to time in the vicinity of the sac, or a hypodermic injection of morphine or hydrochlorate of cocaine, will relieve the pain and allay the inflammation caused by excentric pressure.

Thomas Hayden. C. J. Nixon.

THORACIC DUCT, Diseases of.—Synon.: Fr. *Maladies du Canal Thoracique*; Ger. *Krankheiten des Ductus Thoracicus.*—The thoracic duct is the main trunk belonging to the absorbent system, by means of which the chyle from the lacteals, and the lymph from the lymphatics (except that from the right side of the chest, neck and head, and the right arm), are conveyed into the circulatory system, so that these fluids may be mixed with the blood. It starts from the receptaculum chyli, deep in the upper part of the abdominal cavity; passes through the aortic opening of the diaphragm, on the right of the aorta; accompanies this vessel along the thoracic cavity; passes beneath its arch and the left subclavian artery; then along the left side of the œsophagus; and, finally, comes forward in the neck from behind the left carotid artery, arching over the subclavian artery, and crossing the phrenic nerve and anterior scalenus muscle, to open usually into the left subclavian vein, near its junction with the internal jugular. These facts enable us to understand how the chief morbid conditions of the thoracic duct are produced.

The diseases of the thoracic duct resemble in kind those of the absorbent vessels generally (*see* Lymphatic System, Diseases of); and it will suffice to indicate here the following practical points: (1) The passage of fluid along the duct, and its escape into the subclavian vein may be impeded by any condition which interferes seriously with the venous circulation, and distends the veins considerably, such as certain cardiac diseases. (2) Local obstruction of the thoracic duct may arise at any point, from direct pressure upon it, especially by an aortic aneurysm, and it may become thus permanently occluded; or from intrinsic tubercular disease, which is of special importance (*see* Memoir by Stilling, Virchow's *Archiv*, and *Lancet*, vol. i. 1882). (3) As a consequence, dilatation of the portion of the tube behind the seat of obstruction will probably supervene in various degrees, and it may become considerably enlarged and thickened. The portion beyond tends to become contracted and atrophied. (4) Perforation of the thoracic duct occurs in exceptional instances, owing to the destructive effects of an aneurysm or other morbid condition, or as the result of injury.

It is, as a rule, quite impossible to determine during life that the thoracic duct is diseased. This might be suspected if, along with some known cause which might lead to obstruction of the tube, the patient became extremely emaciated, anæmic, and weak, without other obvious reasons to account for these symptoms. No treatment directed immediately to the thoracic duct can be practicable under any circumstances.

Frederick T. Roberts.

THORACIC TUMOUR.—A tumour within the chest. *See* BRONCHIAL GLANDS, Diseases of; LUNGS, Malignant Disease of; MEDIASTINUM, Diseases of; and THORACIC ANEURYSM.

THORAX, Diseases of.—*See* CHEST, Diseases of; CHEST-WALLS, Diseases of; and CHEST, Deformities of.

THORAX, Examination of.—*See* PHYSICAL EXAMINATION.

THREAD-WORM.—*See* ENTOZOA.

THROAT, Diseases of. — SYNON.: Fr. *Maladies de la Gorge*; Ger. *Rachenkrankheiten*.

The throat is a comprehensive term, its diseases including those of the pharynx, tonsils, palate, and uvula, and in popular language even those of the larynx and trachea. The principal affections of these different structures are described in their appropriate articles, to which the reader is referred, and here it will only be necessary to offer a few general remarks on throat-diseases. In many instances all the parts are more or less involved in the morbid conditions present, but in other cases one structure is mainly or exclusively involved. Moreover, the throat may be interfered with by neighbouring diseases, such as retropharyngeal abscess, and some affections of the neck.

SUMMARY OF DISEASES.—The affections of the throat may be thus grouped in a general way: (1) There may be no actual disease, but the patient merely complains of various sensations referred to the region, these being of a nervous character. (2) The throat is liable to injury by substances swallowed. (3) This part is obviously affected in certain general diseases, especially some of the acute specific diseases. Thus it is particularly involved in scarlatina and diphtheria, and to a less degree in measles, Rötheln, influenza, and general catarrh. Syphilis also implicates the throat in its various stages. This region is sometimes attacked by erysipelas, small-pox, herpes, or thrush. (4) Acute congestion and various forms of acute inflammation, affecting different structures of the throat, are of common occurrence, resulting from causes acting either locally or generally. The cases present much diversity in their severity, depending upon the extent, seat, and terminations of the inflammation. (5) Chronic congestion and inflammation are also not uncommon, of various degrees, and producing different effects in different cases. (6) Ulcerations of the throat are of frequent occurrence, being usually dependent on some general condition, such as syphilis, scarlatina, or diphtheria; but sometimes purely local in their origin. They may become sloughy or gangrenous, causing much destruction of the tissues, or even opening up vessels, and thus proving fatal by hæmorrhage. The after-effects of ulceration may be evident in the way of cicatrices or bands, contraction, adhesions, and permanent loss of parts. (7) The structures in the throat are very liable to become relaxed, and thus to produce symptoms, especially the uvula. (8) The throat may be occupied by some enlargement or morbid growth. Here may be mentioned chronic enlargement or so-called hypertrophy of the tonsils, which, however, is usually the result of chronic inflammation, congestion, or, it is said, albuminoid disease. Post-pharyngeal adenoid growths are now believed to be a common cause of trouble in this locality. Cancer and polypi are the more definite tumours usually met with, though very exceptionally, and cancer may proceed to ulceration. (9) Malformations are not uncommonly of importance in connexion with the throat. The size of the pharyngeal cavity varies much in different persons, but its unusual smallness may be of more or less consequence. Deformities of the palate are of much importance, being either congenital or the result of disease. (10) Sensory or motor paralysis involving the throat is sometimes a serious affection. The condition is especially met with after diphtheria, or in cases of labio-glosso-laryngeal paralysis.

CLINICAL SIGNS.—The symptoms in throat-affections are very variable, as regards their severity, exact nature, and combinations, but they are more or less of the following nature: (1) Painful or other abnormal sensations are usually complained of. Pain may range from mere 'sore-throat' to marked suffering; and in some instances it is attended with throbbing, or shoots towards the ear. Tenderness is also very common, when anything passes over the surface, or even when the parts are moved in the act of swallowing, and the painful feeling may be only experienced at this time. Talking or coughing is sometimes painful. Tenderness may also be felt when pressure is made over the tonsils from without. Amongst other sensations often complained of are a sense of dryness, irritation, fulness or tightness, heat or burning, obstruction, or the feeling of a foreign body. (2) Not only may the act of deglutition be painful, but in throat-diseases it is often attended with difficulty in various ways, and may be quite impracticable (*see* DEGLUTITION, Disorders of). (3) Articulation is affected in certain conditions, the voice being characteristically altered, and becoming of a thick, guttural, or nasal quality. In other cases it is slightly rough or husky; and, of course, it is likely to be more or less hoarse if the larynx is involved. When the palate is destroyed, the speech is permanently affected. (4) In some forms of throat-disease the breathing is obstructed owing to swollen structures, deposits, or growths filling up more or less the passage of the pharynx. This is especially felt in the recumbent posture; and patients suffering in this way often breathe with the mouth wide open, and snore loudly. The breath may have an unpleasant or even fœtid smell, as the result of morbid states of the throat. (5) Throat-affections frequently excite the acts of hawking or coughing, and various materials are thus expelled in many cases. It may also be mentioned here that some irritation in the pharynx is capable of causing reflex vomiting. (6) Morbid conditions in this part may give rise to hæmorrhage, and this occasionally proves of a serious or even fatal character, as the result of certain destructive lesions. (7) Physical examination of the throat is of essential importance in revealing its morbid conditions. Inspection is usually sufficient, with the aid of a good light, and it is in most cases necessary to depress the tongue by means of the finger, the handle of a spoon, or a tongue-depressor. In some instances it is requisite or more convenient to feel the parts in the throat with the finger. External examination should also be made beneath the angles of the lower jaw. The objective conditions determined by physical examination will depend on the nature of the disease.

Treatment.—For the treatment of the different throat-affections the reader must refer to the articles in which they are respectively discussed. The writer only mentions the subject in order to draw attention to two points, namely: first, the great importance of *general* treatment in a large proportion of cases of affections of the throat; secondly, the necessity of using *local* measures *efficiently*, when these are required; while at the same time it is often most desirable that the parts affected should be kept as much at rest as possible.

Frederick T. Roberts.

THROMBOSIS (θρόμβος, a clot).—Synon.: Fr. *Thrombose*; Ger. *Thrombose.*

Definition.—The coagulation of fibrin in the heart, blood-vessels, or lymphatics during life.

Description.—Thrombosis may take place in the heart, the arteries, the capillaries, the veins, and also in the lymphatics. The coagulum consists of fibrin, entangling in its meshes a larger or smaller number of blood-globules, which, in rapidly formed thrombi, consist of both red and white varieties, and hence the thrombus is at first dark-coloured. In slowly formed thrombi, and in those due to projections from the coats of the vessels, the red cells may be absent, and the thrombus is colourless or yellowish-white. In most thrombi the white cells are present in much larger proportion than in normal blood.

When a thrombus occupies the place where coagulation began, it is called a *primitive* thrombus; when it gradually extends from this point along the vessel, an *extension* or *produced* thrombus. This extension usually proceeds along the vessel to its junction with a large branch, into which the thrombus may often be seen to project with a rounded extremity, and this, by obstructing the blood-current, may again form the starting-point for a fresh extension.

Structurally, thrombi may be distinguished as *laminated*, and *non-laminated* or *uniform*. The former result from a process of continuous, the latter from one of intermitting coagulation. In laminated thrombi there is often a layer of white blood-cells between the laminæ, due to the tendency which these bodies have to wander out of the clot.

Thrombi may further be distinguished into *parietal*, or those which adhere to some part of the wall of the vessel; and *obliterating*, or those which completely fill the vessel. Parietal thrombi are generally nearly colourless, and are due to some roughness or other change in the lining membrane. Obliterating thrombi, which are at first coloured, are produced by the sudden coagulation of the blood; the thrombus thus formed shrinks, and leaves a space which again fills with blood; this again coagulates, and so complete obstruction of the vessel is effected. A *post-mortem* coagulum never completely fills the vessel, as, after the shrinking process has taken place, there is no further supply of blood to coagulate. Other points of distinction between *post-mortem* coagula and thrombi are these—the former are never laminated; they are looser in texture, and moister; they do not adhere so closely to the wall of the vessel; and though they may be either coloured or colourless, they never present the appearances due to the subsequent changes which take place in thrombi.

Changes in Thrombi.—The first change observed after the thrombus has shrunken and become denser is *decolorisation.* The colouring-matter dissolves out of the blood-globules, becomes diffused, and is transformed. The thrombus accordingly changes from dark red to tawny, and finally to a yellowish-white; and at the same time it loses its soft elastic texture, and becomes tougher, denser, or even somewhat friable.

The subsequent changes vary. First, a process of *shrinking* and drying up may occur, by which the thrombus gets converted into a tough leathery substance, which may even become calcified, and in this way are formed the concretions in veins known as *phleboliths.*

Secondly, *softening* may take place; this may be due either to a process of molecular disintegration, or more rarely to suppuration. In the former case the thrombus liquefies into a milky fluid, consisting of an oily and granular detritus, the process beginning in the centre. In the heart this change often occurs in the layers of fibrin entangled among the trabeculæ, or in the globular masses which sometimes project from them into the cavities, thus giving rise to the formation of cysts.

Suppuration is occasionally seen in the thrombi of veins surrounded by, or leading from, inflamed parts; a multiplication of leucocytes takes place in the thrombus, either by proliferation or immigration, and the whole softens down into a purulent fluid. In these cases the wall of the vein itself is always inflamed. These softened and broken-down thrombi are a common cause of embolisms.

Lastly, the thrombus may become *organised*. Organisation has been chiefly studied in wounds and ligatures of arteries and veins, and the appearances have been very differently interpreted by different observers. According to one opinion, the thrombus itself becomes organised; the white blood-cells contained in it, or immigrant leucocytes from the vasa vasorum, as proved by including a portion of vein between two ligatures and impregnating the blood with vermilion (Bubnoff), become converted into stellate connective-tissue corpuscles, with interlacing processes; new vessels permeate the clot along the line of the stellate processes from the unobstructed portion of the artery or vein, and form anastomoses with offshoots from the vasa vasorum perforating the tunica intima, which disappears; and thus a vascular reticulated connective tissue is formed, in the meshes of which lie the remains of the red blood-globules and fibrin of the clot. The progressive dilatation of the newly formed vessels gradually renders the thrombus cavernous; and finally, by their coalescence, it entirely disappears, and the vessel again becomes pervious. Cornil and Ranvier dispute the correctness of these observations, and assert that the appearances are really due to the outgrowth, from the tunica intima, of vascular granulations penetrating the thrombus, which gradually disappears without taking any part in the formation of the reticulated connective tissue which is found occupying its place.

Pathology.—According to the views of coagulation now entertained, the formation of fibrin is due to the interaction of two substances present in the blood-plasma: fibrinogen and a ferment (*see* Blood, Morbid Conditions of). The ferment is believed to be contained in the white blood-cells, and is, in all probability, partly derived from these bodies, for in all spontaneously coagulable fluids white blood-cells are present, and where they are absent coagulation does not take place. Even in the blood, when coagulation is retarded, as by keeping horse's blood in a tube formed of the excised jugular vein, it is found that the upper layers, from which the white cells have subsided, coagulate very imperfectly, while a firm clot forms in the lower layers, where the corpuscles are numerous. The white blood-cells also are often seen to form the starting-point from which the threads of fibrin form.

The nature of the process of coagulation is still very obscure. It does not appear to resemble a chemical precipitate.

As the two factors of coagulation, fibrinogen and the ferment, are always present in the healthy blood-plasma, it is evident that there must be some restraining influence which prevents coagulation; and the cause of thrombosis must be looked for in the removal or weakening of this influence. According to Brücke, contact with the healthy lining membrane of the vessels prevents the blood from coagulating; consequently any structural change in this membrane is liable to cause thrombosis. The presence of a foreign body produces the same effect, and a thrombus itself acts as a foreign body. Retardation or arrest of the blood-current is also a common cause of thrombosis. Loss of motion in itself tends to retard coagulation, but free circulation is necessary for the maintenance of the nutrition and integrity both of the vessels and the white blood-cells; hence stagnation tends to cause thrombosis by removing the restraining influence of the healthy vascular wall, and also by setting free the ferment from the white corpuscles; moreover, the motion of the blood maintains the contact between each particle and the lining membrane of the vessels, and so prevents coagulation.

According to many modern observers, an important part in the coagulation of the blood is taken by the bodies, whose exact nature is still undetermined, called blood-*plates* or *plaques*. Eberth and Schimmelbusch find that if the inner coat of a vessel be injured, and at the same time the circulation be retarded, the blood-plates adhere to the injured spot in layers, often entangling among them leucocytes. The blood-plates then become granular, and fuse together into a colourless thrombus, which may block the vessel. To this process they give the name of conglutination, and to this ordinary coagulation may be added. Bizzozero considers that coagulation is produced by the disintegration of the blood-plates, and denies the influence of the white cells; but this is very doubtful.

The principal causes, therefore, of thrombosis are alterations in the lining membrane of the vessels, and retardation or arrest of the circulation; to these may be added the presence of foreign bodies, and probably also the microzymes of septic processes.

Hyperinosis, or increase in the constituents of the fibrin, and diminished fluidity, as in cholera, can only be regarded as predisposing causes requiring retardation of the circulation to take effect.

Retardation of the circulation being one of the most important causes of thrombosis, we find, as might be expected, that its most frequent seat is the veins, where the circulation is naturally feeble.

VARIETIES. — 1. *Venous.*—The principal causes of venous thrombosis are two. The first of these is wounds and injuries of veins, where the formation of thrombi is the natural way of arresting hæmorrhage. The thrombus may extend along the vein from its primitive seat, and thus cause blocking of venous trunks at a distance from the site of the injury. This is often seen after parturition, when thrombosis of the uterine sinuses may extend to the iliac and femoral veins. Secondly, inflammation of the coats of the vein, by altering the condition of the lining membrane, may cause thrombosis; but in many cases of phlebitis the thrombosis is the primary change, and the inflammation of the coats is set up by it. Other causes of venous thrombosis are pressure on the veins; dilatation; and arrest of the circulation in the capillary territory of the vein, as from embolism or inflammatory stasis. Hence we occasionally find the veins leading from inflamed organs thrombosed. Lastly, thrombosis of the veins is not infrequently due to retardation of the circulation, owing to failure of the propelling power of the heart, in cases of marasmus and exhausting diseases. These thrombi are most frequently met with in the veins of the lower extremities and pelvis, next in the sinuses of the dura mater.

According to Köhler and Hanan many of these marantic thrombi are to be ascribed to an increased formation of ferment, a 'ferment intoxication;' and the local retardation of the circulation only determines the seat of the thrombosis.

2. *Arterial.*—Apart from wounds and injuries, thrombosis of the arteries is most frequently caused by degeneration of the lining membrane, giving rise to rough surfaces to which the coagula attach themselves, and to aneurysms in which the coagulation is due to stagnation; aneurysmal thrombi are commonly laminated. Arrest of the circulation from any cause, as embolism, will also cause thrombosis.

Thrombosis of the larger arteries, without alteration of the lining membrane, is most probably always the result of embolism, the embolus being usually derived in the systemic arteries from thrombi of the heart, the result of asystole. Of this nature are the cases of thrombosis and gangrene of the extremities which sometimes occur in fevers and wasting diseases. Thrombosis of the pulmonary artery may be produced in a similar manner, or the embolus may be derived from a thrombus in the veins.

3. *Cardiac.*—Thrombosis of the heart may be caused by endocarditis, the thrombi then usually forming caps to the inflammatory outgrowths or vegetations. Large thrombi are most commonly caused by imperfect emptying of the cavities and consequent stagnation, due either to stenosis of the orifices, or to want of tone in the muscular walls. Thrombi may also extend into the right auricle from the venæ cavæ.

4. *Capillary.*—Capillary thrombosis may be due to extension from the veins and arteries, or it may be primary. In the latter case the conditions which cause it are imperfectly known; aggregations of white blood-globules will often block the capillaries and small vessels in the manner of thrombi, but this condition is usually transient, and not attended by true coagulation. The inhibitory influence of the lining membrane of the blood-vessels is so powerful in the capillaries that, as long as their structure remains intact, coagulation rarely takes place. Thus inflammatory stasis, or obstruction of the afferent artery by embolism, may exist for a considerable time without the blood in the capillaries coagulating.

5. *Lymphatic.*—Thrombosis of the lymphatics has been chiefly observed in the puerperal condition, in the lymphatics of the uterus and their continuations to the lumbar glands, and in rare instances in the thoracic duct. It is probably due to alteration in the constitution of the lymph, normal lymph having very slightly coagulable properties.

SYMPTOMS.—The symptoms of thrombosis are those of arrest of the circulation, and they differ according to the vessel affected. In the veins, if a main trunk be obstructed, so that a sufficient collateral circulation cannot be rapidly established, the effects produced are passive hyperæmia, venous dilatation, transudation of serum, and sometimes hæmorrhage in the territory of the blocked vein, with enlargement of the collateral channels. In extreme cases moist gangrene may result. Thus, according to the vein affected, we may have anasarca of an extremity, ascites, or hydrothorax; hæmorrhage from the stomach, intestine, or kidney; œdema and cyanosis of the face and neck; and so on. The symptoms of arterial thrombosis are in the main those which are elsewhere described as occurring when the artery is blocked by embolism (*see* EMBOLISM). Coagulation of blood in the cavities of the heart is described in a separate article. *See* HEART, Thrombosis of.

TREATMENT.—The treatment of thrombosis varies according to the seat of the process. *See* AORTA, Diseases of; BRAIN, Vessels of, Diseases of; HEART, Thrombosis of; and VEINS, Diseases of.

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THRUSH.—A parasitic stomatitis. *See* MOUTH, Diseases of.

THYMUS GLAND, Diseases of.—SYNON.: Fr. *Maladies du Thymus*; Ger. *Krankheiten der Thymusdrüse.*

In consequence of the atrophy of this organ in early life, little notice has been taken of it, either in its healthy state or when affected by disease.

According to the researches of Sir John Simon, the thymus gland reaches maturity in the child at the age of two years; it remains more or less perfect up to eight to twelve years; then it rapidly decreases in size, the glandular substance becoming converted into fat; and at the age of twenty years there is no trace of the organ left. At birth its weight is in proportion to the weight of the child. Taking 22 grs. to the lb. to be the usual proportion, 100 to 200 grains will be the weight of the gland at birth. From investigations made on young and hybernating animals, it appears that the greater the ratio of respiratory and muscular activity, the speedier is the decline of the gland. Consequently Sir John Simon thinks 'the thymus fulfils its use as a sinking fund of movement in the service of respiration.'

Summary of Diseases.—Instances both of excessive growth and of prolonged existence of the thymus have been reported. A list of such cases was published by the late Mr. Alexander Bruce. In a healthy boy, aged fourteen, killed by an accident, the gland was found to weigh 620 grains; in a lunatic, aged twenty-one years, 300 grains; in a woman, aged twenty-nine years, 57 grains; in another woman, aged forty years, 30 grains. Krause mentions three cases, aged twenty-five, twenty-five, and twenty years, wherein the glands weighed respectively 292, 380, and 356 grains.

The actual diseases of the thymus gland which have been recorded are: (1) Inflammation, followed by suppuration. In one such instance the abscess burst into the trachea. Syphilis has been stated to be a cause of inflammation of the embryonic gland. (2) Fatty degeneration of the gland. (3) Tubercular deposit in the gland. (4) Malignant disease. (5) Enlargement of the gland in leucocythæmia; and in (6) lymphadenoma. (7) Calculi have been found embedded in the gland-substance.

Cases have been reported of children dying from suffocation, with no other cause assigned for their death than pressure on the trachea of an enlarged thymus gland. Considering its position, between the sternum and the windpipe, and the small power of resistance possessed by the rings of the trachea during infantile life, an enlarged thymus may be a possible cause of suffocation.

In connexion with enlargement of the gland, a respiratory affection called 'thymic asthma' has been recognised. It is also named after two physicians, 'Kopp's,' or 'Millar's' asthma; but the majority of writers on diseases of children deny the existence of such a malady.

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THYROID GLAND, Diseases of.—Synon.: Fr. *Maladies de la Glande Thyroïde*; Ger. *Krankheiten der Schilddrüse.*

Goitre is the most common affection of the thyroid; and associated with it, but as a less prevalent disease, is exophthalmic goitre. *See* Goître; and Exophthalmic Goître.

The causes of goitre, such as iron in the drinking-water, the practice of carrying weights upon the head, the habitual exertion of mountain exercise, all point to the fact that the thyroid gland is closely connected with the circulatory system.

The diseases of the thyroid gland other than goitre are rare. They comprise: (1) Acute Inflammation; (2) Hydatid Cysts; (3) Calcareous Deposit in the Gland; (4) Cancer; (5) Sarcoma; (6) Recurrent Thyroid Tumour. Fatty degeneration of the thyroid is of doubtful occurrence. Enlargement of the gland occasionally occurs in leucocythæmia, and in lymphadenoma. The gland is sometimes absent, or an accessory lobe may be present. It may degenerate in old people. The morbid states of the thyroid gland in cretinism and myxœdema are separately described. *See* Cretinism; and Myxœdema. The following affections alone require brief notice.

1. **Acute Inflammation.** — Synon.: Thyroiditis.—This disease occurs in three forms: (*a*) *idiopathic*; (*b*) *metastatic*; and (*c*) *traumatic.*

(*a*) *Idiopathic* thyroiditis is the rarest of these forms of inflammation. It chiefly attacks young people, and is generally due to sudden changes of temperature.

(*b*) *Metastatic* thyroiditis is rarely observed as a complication of acute infectious diseases, especially typhus, puerperal fever, and pyæmia. It has also been met with in pneumonia and bronchitis; and in connexion with orchitis.

(*c*) *Traumatic* thyroiditis usually results in suppuration. Sphacelus of the gland is a possible result of active suppuration—a result not necessarily followed by any further mischief.

Symptoms.—All three forms of thyroiditis commonly produce, amongst other symptoms which do not call for special description here, dyspnœa and dysphagia.

Treatment.—The treatment of inflammation of the thyroid gland consists in applying leeches and ice, and in using other antiphlogistic remedies. Deep-seated suppuration should be relieved by an early incision, otherwise the pus may find its way into the trachea or beneath the fascia. The best plan for opening the abscess is by means of the trocar and cannula.

2. **Hydatid Cysts.**—Echinococci have, in a few cases, produced an enlargement of the thyroid gland. These hydatid cysts are difficult to diagnose from goitrous cysts until

the fluid contents have been examined microscopically.

3. **Calculi.** — These bodies have been found embedded in the substance of the thyroid. The writer has met with a specimen in which the calculus was the size of a walnut, and almost entirely took the place of the gland-substance of one lobe.

4. **Cancer.**—Primary cancer of the gland is a rare disease. It is met with in two forms—encephaloid and scirrhus. Cancer is not, it would appear, so commonly developed in a healthy gland as in one already affected by goitrous degeneration. Secondary cancer of the thyroid may also occur.

Symptoms and Diagnosis. — The special symptoms caused by malignant disease of the thyroid are dyspnœa and dysphagia. The trachea and œsophagus may be involved in the disease. Very commonly one or both recurrent laryngeal nerves are included in an extension of the growth, and sometimes also the large vessels and nerves of the neck. Cancerous disease of the thyroid is probably present when there is a rapid enlargement of the gland, followed in an early stage by duskiness of the skin over the most prominent parts of the swelling. Superficial ulceration at a later date, often accompanied by hæmorrhage, and the general condition of the patient, will render the diagnosis clearer.

Treatment. — The only available treatment is entire removal of the gland, and this, to be of service, must be carried out at an early stage of the disease.

5. **Sarcoma.**—Sarcoma may be developed in the substance of a healthy thyroid gland, or in one already affected by goitrous disease. Thyroid sarcoma is, according to Lücke of Strasburg, rapid in its growth, not exceeding a year in duration. It requires removal of the entire gland.

6. **Recurrent Thyroid Tumour.**—An exceedingly interesting class of cases has been recognised within the last few years, in which tumours, growing simultaneously in various bones, such as the skull, vertebræ, and femur, and in the lungs and glands, have appeared, on examination, to be secondary to a simple adenomatous enlargement of the thyroid gland, and have presented microscopic characters precisely similar to that disease. *See* Tumours.

Therapeutic Action and Uses of Thyroid Gland.—The thyroid gland is now employed as a valuable therapeutic agent, especially in the treatment of cretinism and myxœdema. *See* Myxœdema; also Cretinism in Appendix.

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TIC-DOULOUREUX

TIC-DOULOUREUX (Fr.).—Synon.: Facial Neuralgia; Prosopalgia.

Definition.—Neuralgia of the trigeminal, trifacial, or fifth nerve.

One alone, more often two, but rarely all three divisions of the fifth nerve of one side may be coincidently the seat of neuralgia. It is less common for the third division to suffer than the first and second. Tic has often been preceded or followed by neuralgia in other districts, especially in the occipital nerve.

Ætiology.—Trigeminal neuralgia is rare in young children, but may occasionally occur in them, associated with delayed or irregular eruption of the permanent teeth. In these circumstances, it is sometimes accompanied by epileptic convulsions. In its megrim shape, it almost always attacks the sufferer at some time during the period of bodily development. According to the late Dr. Anstie, the middle period of life is not fruitful in *first attacks* of trigeminal neuralgia, but, given a declared neuralgic tendency, the wear and tear of this stage tend much to recall it. In women utero-gestation, the exhaustion from hæmorrhage at parturition, menorrhagia, or over-suckling, as well as the sexual changes in middle life, are especially prone to reproduce facial neuralgia. It is, however, in the period of degeneration that the worst and most intractable instances occur.

The term 'brow ague' is still frequently applied to a neuralgia of the first division of the trigeminal, which cannot always be referred to a malarious origin. Formerly, when malarious fevers were rife in this country, such an affection was, doubtless, of common occurrence; but at the present day, owing to drainage and cultivation, it is rare for this cause to be in operation. Cases do, however, occur, and these may usually be recognised by regular periodicity in the attacks of pain, a semi-algide condition of the system, and the rapid and effectual influence of quinine. Cold wind, especially with a moist atmosphere, has an undoubted influence in starting neuralgia of the fifth nerve, the unprotected condition of the face explaining probably its peculiar liability to be so attacked. There appears reason to think, however, that when damp with cold excites an attack of neuralgia, there must be at the same time a peculiar condition of the system, or neuralgia of the fifth would be much more common in this climate than it is. Such a condition is probably of a rheumatic or gouty nature, and the cold seems to start a subacute inflammation in the sheath of the nerve. As regards other general conditions predisposing to the affection, they are those common to neuralgia. *See* Neuralgia.

Injury of the nerve; foreign bodies, irritating either this or some other nerve; morbid growths of bone, especially such as cause contraction of bony canals traversed by branches of the nerve; and syphilitic periostitis, may act as exciting causes of tic-douloureux. Or the immediate cause may be in the floor of the cranium, in the form of tumours or disease of bone or of membranes, aneurysm, or abscess.

SYMPTOMS.—Some obscure feeling of discomfort may precede the outburst of actual pain, or this may occur suddenly and without warning in some part of the district supplied by the fifth nerve. There will be one or more foci from which the pain will seem to emanate in swift flashes, a dull aching remaining in the intervals, of a very wearying character. Generally short-lived at first, the paroxysms of darting, burning, boring pain gradually increase in severity and duration. The patient sometimes cringes under the violence of the agony. When fairly pronounced, there is a great tendency to the excitement of a paroxysm by the influence of such slight irritants as a current of air, a sudden noise, or the muscular movements concerned in speaking, laughing, chewing, blowing the nose, or coughing. The attack of tic may vary to any extent in degree and duration, from a short-lived paroxysm which never returns, to a disease of the most obstinate character, embittering, with more or less constantly repeated attacks, the whole of a long life. In such cases it has a tendency to remit during the course of severe intercurrent diseases.

When the *ophthalmic division* of the nerve is affected, it sometimes happens that the first notice of the attack is an exceeding soreness of some spot on the scalp, recognised only on brushing the hair, and this is followed some hours afterwards by pains in the branch of nerve distributed to this point. The pains are most marked, and tenderness on pressure can generally be noted, in one or more of the following places: the supra-orbital notch, at a point a little above the parietal eminence, in the upper eyelid, at the junction of the nasal bone with its cartilage, within the eyeball, or at the inner angle of the orbit. There is often lacrymation, with redness of the conjunctiva, and sometimes intolerance of light. There is sometimes so much tenderness that the patient cannot wear a hat, or even wash his forehead. Or he may be unable to blow his nose. If one or two hairs be drawn over this hyperæsthetic surface, it will be found that the tactile discrimination is diminished, as compared with the corresponding region of the opposite side. The pain is sometimes described as shooting in the upper eyelid, or going between the eyeball and the cavity of the orbit, extending thence over the brow, as though the forehead were being slit open. Pressure upon the parietal eminence will send a sort of heavy dull shock into the eye. To neuralgia of this division, in consequence of the pain being limited to one-half of the anterior aspect of the head, the term *hemicrania* has been applied, whence the *migraine* of the French, and the vernacular 'megrim.' The neuralgic affection constitutes, however, only a portion of the complex group of phenomena to which the term 'migraine' is properly applicable, and which may include, besides, subjective sensations of dazzling lights or colours, often of a zig-zag shape, transient hemiopia, vertigo, unilateral numbness and tingling of extremities, impairment of speech, nausea, and vomiting. See MEGRIM.

When the *superior maxillary division* is in fault, violent pain is experienced in the cheek-bone or jaw, or in both, points of tenderness being found at the site of emergence of the infra-orbital nerve, over the malar bone, or on the gum of the upper jaw. The attacks of pain are sometimes accompanied by profuse watery secretion from the nasal and buccal mucous membranes. There may be swelling and acute sensitiveness of the lip and nostril, the slightest contact with which causes pain to shoot widely in various directions, sometimes appearing to affect distant parts of the body. Acute pain may also occur in the parotid gland, accompanied by a great flow of saliva; and also in the teeth.

When the *third division* is attacked, points of intensity may be found on the temple, a little in front of the ear, at the place of exit of the inferior dental nerve, at the side of the tip of the tongue, or more rarely in the lower lip. The writer has met with cases in which neuralgia of this division, attacking both sides of the lower jaw and the under-surface of both borders of the tongue, occurred in plunges of agony which caused the patient to utter a kind of shrieking groan, and the head was jerked convulsively. Such attacks may be brought on by chewing, swallowing, and even by speaking. In other cases the pain may be entirely localised in one side of the tongue-tip, but here at times it is so intense that the patient rolls on the floor in agony. To cases of this kind, marked by lightning-like seizures of exquisite character, and accompanied by spasmodic movements of the facial muscles, the term *epileptiform neuralgia* is sometimes applied. Hereditary tendency to insanity sometimes accompanies this form. The lingual branch of the fifth is happily not so often affected as the other portions, for there is probably no form of neuralgia involving more exquisite suffering. When the auriculo-temporal division is affected, pain is situated in the outer auditory meatus and temple. Many cases of so-called earache are doubtless examples of neuralgia affecting this nerve.

There is a variety of trigeminal neuralgia which is known as *clavus hystericus*, and which occurs chiefly, but by no means solely, in females, and affects the period of bodily development. It is characterised by intense pain, limited to one or two small points (the parietal, or supra-orbital), and resembling the driving of a nail into the skull. It occurs most often in the anæmic, and has frequently been mistaken, with unfortunate results, for some inflammatory affection demanding depletory measures.

In severe tic-doulóureux the facial muscles, those of the tongue, and even sometimes those rotating the head, may be spasmodically contracted by reflex action (*see* FIFTH NERVE, Diseases of). With supra-orbital neuralgia there may be blepharospasm or strabismus. The writer once saw a patient liable to neuralgia of the supra-orbital division for a period of twenty years, in whom, one year before, the attack began to be attended with complete ptosis and external strabismus, from paralysis of the third nerve. A certain amount of weakness continued between the attacks, but it was as an immediate sequel of the pain that the loss of power was most strongly marked. Two days after the cessation of the pain the eyelid could be raised fairly well and the eyeball moved, though never quite freely. Some degree of vaso-motor paralysis was shown by the reddening and heightened temperature of the face and swelling of the veins, which occurred unilaterally during the paroxysms of pain, as well as by the soreness of skin, indicating probably a temporary congestion which remained behind. To the same cause must be referred the extreme redness of the conjunctivæ and mucous membrane of the nostrils, with increased lacrymation and flow of nasal and buccal secretion, often observed in this form of neuralgia. The hair is very liable to be changed in colour about the seat of pain. There may be a permanent blanching, as of the greater part of an eyebrow or a small tuft upon the head, or the change may be a fluctuating one, the colour returning during the intermissions of the disease. Individual hairs in the district of the affected nerve may be hypertrophied, or the converse may happen; and during the persistence of attacks the hair may become brittle and fall out, to return, however, when the neuralgia subsides. The late Dr. Anstie described a state of thickening, the result of subacute inflammation, in the periosteum of bone and in fibrous fasciæ in the neighbourhood of the painful points of neuralgic nerves. Pressure on these swellings may not merely excite pains in the affected branches, but send a powerful reflex influence through the cord to distant organs, causing vomiting, or affecting the action of the heart. The skin is apt to grow coarse; and patches of pigment to occur in the painful situations. In neuralgia of the second and third divisions the corresponding half of the tongue is sometimes seen to be covered with fur from overgrowth of epithelium, and this even when the process of mastication has taken place equally on each side; or there may be salivation severe enough to cause a suspicion of mercurial action, but which may be distinguished by its being unilateral. Acute inflammation of the skin, in the form of herpes or of erysipelas, not infrequently attends neuralgia of the fifth, especially its first division; and the eyeball itself may become in similar circumstances the seat of serious inflammatory action in one or other of its tissues. There may be a profuse and extensive eruption of herpes, leaving cicatrices which suggest confluent small-pox. In such a case neuralgic pains may cease during the eruption, to recur with great violence whilst this is scabbing. Acute glaucoma is attended by symptoms which appear to refer it to trophic changes consequent on neuralgia of the ophthalmic division of the fifth. There appears reason to think that recurrent iritis may sometimes be related to neuralgia or some kindred affection of the same division. Common sensation is frequently blunted during and after paroxysms of tic; but occasionally there will be so much and such persistent hyperæsthesia of the skin, that the patient cannot bear the face to be washed. In epileptiform tic the sufferer will often be observed to rub violently with a handkerchief the part of the face affected; but, on the other hand, there are cases in which not even the touch of a light bonnet can be borne, so exquisitely sensitive is a portion of the scalp. A touch with the finger upon this locality will sometimes cause the patient to fall to the ground.

DIAGNOSIS.—The paroxysmal character of the pains, coupled with the tenderness on pressing various points, sufficiently indicates tic-douloureux. The only condition with which it is at all easily confounded is the painful anæsthesia which is apt to be an early symptom of the encroachment of a tumour upon, or some other destructive lesion of the trunk of the nerve within the cranium (*see* FIFTH NERVE, Diseases of). The presence of the pain will distinguish the spasmodic contractions of the facial muscles secondary to neuralgia from mimetic spasm proper. There is no doubt that neuralgia about the forehead is often mistaken for some inflammatory intracranial mischief, and this is peculiarly liable to happen where either ptosis or strabismus forms part of the symptoms. Careful examination, bearing in mind the points of diagnosis described, ought to obviate error. Still more important is it to avoid the error of ascribing to this form of neuralgia the pain occasioned by the growth of intracranial tumour (*see* BRAIN, Tumours and New-Growths of). It must be remembered that pus in the antrum may occasion neuralgic symptoms; and that a fruitful source of trigeminal neuralgia is caries of the teeth.

DURATION AND PROGNOSIS.—Tic-douloureux occurring in youth and apparently as an accident of exposure, or as a result of faulty teeth, may never recur. It is perhaps more common, however, for repetitions of the attack to take place, alternating, it may be, with neuralgia in other quarters. Tic is not infrequently liable to recur, especially under circumstances of depression, through a whole lifetime, but it may never have the character of extreme severity. In certain few cases, however, it is not only obstinate, but of terrible violence, the patient being incapacitated through many years by the constantly recurring affection. The pain has been in some cases violent enough to destroy life. As a rule, however, the disease, however severe the agony entailed by it, does not seem of itself to shorten the duration of the life which it fills with suffering.

Treatment. As in neuralgia generally, the treatment of tic is partly constitutional, and partly local and palliative of suffering (*see* Neuralgia). The first care in a case should be to have the state of the teeth accurately investigated, and faulty teeth removed or otherwise treated. It may happen that a tooth betraying no outward signs of decay is carious internally, and may thus easily escape recognition.

The hypodermic injection of morphine holds the first place as a means of relief. It is well to begin with a small dose, say $\frac{1}{10}$th grain, and repeat it in the course of twelve hours if necessary. If the doses employed can be kept at a moderate amount, there will not be much fear of opium-hunger being created, and they can be discontinued without difficulty as the disorder subsides. The injection is quite as efficacious when made in the arm as in the face. Blisters are often of great service. A small one should be applied over the branches of the cervico-occipital nerve at the nape of the neck, and repeated if necessary. The constant voltaic current is sometimes useful. A sufficient number of cells (from four to eight or ten) should be employed to give such a current as causes the negative pole to impart a very distinct burning sensation. The circuit should never be abruptly opened by the removal of the rheophore; a gradual heightening and lowering of the strength, respectively, should take place, both on applying and when leaving off, to avoid a shock. The rheophores should be fitted with sponges well moistened with salt and water, or with carbons plunged for a minute or two in hot water. The application may be continued for five or ten minutes at a time, and be repeated several times daily. In some cases of tic a combination of 20 or 30 grains of chloride of ammonium with 5 drops of liquid extract of opium, taken two or three times a day, is singularly efficacious.

Butyl chloral hydrate—2 to 4 grains in a pill taken every two hours for a few times—may be sometimes employed with advantage. So, also, the tincture of gelsemium sempervirens, given in doses of 15 to 20 minims every two hours, till relief is obtained. Phenazone, in doses from 5 grains every half-hour, or from 10 to 20 grains every four or five hours, for a few times, is sometimes particularly useful. The hydrate of chloral in a dose of 20 grains will occasionally be of great service, if the pain is not very severe, in procuring a natural kind of sleep from which the patient wakes relieved. If, however, the pain be severe, chloral hydrate is useless. It is important not to confound the epithelial overgrowth of the tongue, which so commonly occurs in tic, with the ordinary furring from digestive difficulties which is supposed to indicate a necessity for purgatives. It will be observed that it only affects a lateral half.

In two cases of epileptiform tic of from seven to ten years' duration, which had resisted all treatment, and incapacitated the sufferers from earning their livelihood, the writer had two out of the three divisions of the trigeminal stretched, with most satisfactory results. In one case five months, in the other about twelve months, have elapsed since the operation, without return of pain. It appears to be essential that not only the central end of the nerve should be pulled upon with considerable force, but also the peripheral portion. A considerable amount of cutaneous anæsthesia ought to follow the operation, though it usually does not last more than a few days. In cases of still more obstinate tic-douloureux, operations have been performed on the nerve and its ganglion at the base of the skull. *See* Nerves, Diseases of.

T. Buzzard.

TIN, Poisoning by. — Synon.: Fr. *Empoisonnement par l'Étain*; Ger. *Zinnvergiftung.*

The importance of tin as a toxic agent has only comparatively recently been recognised; for although attention was drawn nearly a century ago to the possible danger attending the use of tinned vessels for culinary purposes, the danger was supposed to be due simply to the contamination of the metal with arsenic. Subsequently alarm was excited in consequence of the employment of alloys of tin for the storage of tinned preserved articles of food, such as meat, vegetables, and fruits; but here again the danger has been assigned to the lead with which the tin is alloyed, a lead-tin alloy being used for the construction of the capsules employed. Recently, attention has been directed to the tin with which tinned foods and fruits are almost invariably contaminated, as itself presenting a source of danger to the consumer. It is known that the soluble salts of tin, met with in commerce as *Dyer's salt*, *pink salt*, &c., are poisonous; and experiments on animals show that even the insoluble hydrated oxides of tin are fatally poisonous, the oxides being no doubt dissolved in the alimentary fluids, tin having been detected after death in such cases in the liver and other solid viscera. Certain kinds of sugar recently brought into commerce are prepared by a process which introduces tin to the extent of from one-fourth to one-third of a grain per lb. of sugar into the manufactured article; and it is at present a moot point whether these sugars are innocuous or deleterious.

Anatomical Characters. — The *post-mortem* appearances in fatal poisoning by tin are those of the mineral irritants. The cases observed have been too rare to be spoken of otherwise than generally. *See* Poisons.

Symptoms.—Of these but little is known. Concentrated solutions of stannous chloride and of stannic chloride—the lower and higher chlorides respectively of the metal—are known to act as irritant poisons. Neurotic symptoms are also manifested, so that tin-salts do not appear to act simply as irritants. In large doses the chlorides produce fatal results. Probably the toxic results are heightened by the free hydrochloric acid invariably present in the commercial solutions of stannous and stannic chlorides.

Treatment.—The treatment to be employed is that for mineral acids. *See* Poisons.

Thomas Stevenson.

TINEA (*tinea*, a moth-worm). — *See* Epiphytic Skin-Diseases; Tinea Imbricata; Tinea Trichophytina; and Tinea Versicolor.

TINEA IMBRICATA.—Synon.: Solomon Island or Tokelau Ringworm; *Herpes Desquamans* (Turner).

Definition. — An epiphytic skin-disease, produced by a fungus resembling the trichophyton, and characterised by an imbricated, scaly desquamation.

Geographical Distribution.—As far as is known, this disease is at present confined to the islands and countries included in the area within 175° W. and 95° E. longitude, and the north and south tropics; but, as it spreads with great rapidity when introduced into districts with a favourable climate (Turner, *Samoa Med. Mis. Reports*), it is not improbable that, as communication extends, it will in time become endemic in all tropical countries possessing a damp atmosphere and a temperature ranging between 70° and 90° F. In certain places within the endemic area it is exceedingly prevalent; Florida Islands, for example, where one-half, and the Treasury Islands, where four-fifths, of the inhabitants are affected (Guppy). Throughout the Malay country it is common, and cases have frequently been noted on the China seaboard as far north as Foochow. It attacks foreigners as well as natives.

Symptoms.—Usually the disease occupies a large area. In old-standing cases the entire integument, with the exception, perhaps, of the palms of the hands and the soles of the feet and part of the hairy scalp, is covered with the characteristic thin, tissue-paper-like scales arranged in concentric parallel lines. These scales vary in size, according to their situation and the amount of friction they have been subjected to, from one-sixteenth to half an inch in breadth, by a quarter of an inch to one inch or more in length. They are firmly attached to and continuous with the healthy epidermis at the periphery or advancing edge of the circle they belong to, and free and ragged at the other edge. At, and just beyond the line of their attachment the skin is darkened from aggregation of the fungus, which, in its advance, is raising and throwing off the epidermis. The parallel lines of scales may be from an eighth to half an inch apart.

The pattern, so to speak, of the disease is readily understood from an inoculation experiment. By rubbing scales from a case into abraded healthy skin the fungus is easily implanted. In about ten days thereafter it has so multiplied that it forms a brown layer underneath the epidermis. As this layer extends, the epidermis over its centre breaks down, and a scaly ring is formed. Gradually the ring so formed enlarges, and a second brown spot forms in the common centre. This, in its turn, extends, its centre also breaking down. Then a third ring forms in the same way, and a fourth, and so on in never-ending series—like the waves made by a stone thrown into a pond.

Where two or more rings impinge, a gyrated or scalloped pattern is produced.

Itching is sometimes complained of, but there is never any sign of inflammation of the skin, as in common ringworm.

The fungus is readily demonstrated by placing a scale moistened with liquor potassæ under the microscope. It closely resembles the trichophyton, but may be distinguished from it by its prodigious profusion, its position just under the epidermis, and, perhaps, by the presence in the interior of the conidia and mycelium of many brown particles. Unlike trichophyton, it has no special predilection for the hair or hair-follicles; in fact, it seems to thrive best on the non-hairy parts of the body.

Diagnosis. — Tinea imbricata is distinguishable from ordinary ringworm by the size of the scales, by the numerous, closely approximated, concentric parallel rings, by the absence of inflammatory redness, and by the extreme profusion of the fungus. From psoriasis and ichthyosis it is diagnosed by the presence of the fungus, the concentric rings, and by the attachment of the scales being at one edge only.

Treatment.—Painting the affected parts —taking a limb or part of the body at a time—with iodine liniment is at once effective. All clothes must be boiled or destroyed; and relapses at once treated. In the labour-ships of the South Pacific sulphur ointment inunction is the treatment adopted, and with success.

Patrick Manson.

TINEA TRICHOPHYTINA. — SYNON.: Common Ringworm; *Tinea Tonsurans*; Fr. *Trichophytie* (Hardy); Ger. *Scheerende Flechte.*

DEFINITION.— A contagious disease of the skin of man and some animals; caused by the growth in the skin of the trichophyton fungus (Gruby and Malmsten, 1842-5); and characterised for the most part by inflammation of the skin, and disintegration of the hairs.

ÆTIOLOGY. — The trichophyton fungus grows in the horny epidermis of man, cattle, the dog, cat, horse, guinea-pig, and rabbit; and we know nothing of its existence elsewhere. The affection is intercommunicable between these animals, and frequently inoculated from them to man. Ringworm is, however, mostly passed by simple contact from person to person, or through the medium of hairdressers, or brushes, towels, caps, and so on. Isolated cases occur; or it is endemic—on the body in hot climates, and on the head in England, France, Italy, and other countries; occasionally it is epidemic in a community. We know little about the soil preferred by the fungus; like favus, it particularly affects the young. A comparatively high temperature with moisture favours it; hence its frequency and severity in the tropics, and in the rainy and hot seasons. Some think it especially attacks the delicate, but the explanation probably is that it grows in the finer skins and hairs with more ease.

The *fungus* attacks the hairs with more avidity than does the achorion, and is more easily inoculated. The mycelium (·0018 to ·0026 mm. in diameter) consists of very long, fairly straight and regular threads, but little ramified, and in these respects is distinguishable from the achorion. The rounded, uncoloured, strongly refractile spores vary from ·0021 to ·0035 mm. in diameter, and are more uniform in size and shape than achorion. They may be seen isolated or in moniliform chains, joined to the mycelium or massed together. The spores become more numerous as time goes on, and are especially abundant in the structures of the hair and nail. The fungus is distinguishable in cultures. *See* EPIPHYTIC SKIN-DISEASES.

After an extended series of researches by means of the microscope, cultivations, and inoculations, Sabouraud has distinguished at least three species of trichophyton affecting man. These he identifies with those described by Gruby in 1842-44. They are probably often saprophytic, and this is especially likely to be the case with the first to be mentioned. *See* MICRO-ORGANISMS.

1. *Trichophyton megalosporon ectothrix.* This trichophyton is characterised by *large* spores and mycelium, situated between the hair and its follicular sheath, and always derivable from animals, especially the horse. The so-called kerion, *T. barbæ*, and the rarer *Perifolliculitis agminata* are caused by it

2. *Trichophyton megalosporon endothrix.* This trichophyton is also characterised by *large* spores (7-8μ diameter), which invade the hair-structure itself. It is the cause of *T. circinata*, and of about 35 per cent. of the cases of *T. tonsurans.*

3. *Trichophyton microsporon Audouini.* A trichophyton characterised by small spores (2-3μ diameter), and without appreciable mycelium was originally named by Gruby in honour of a distinguished investigator of the muscardine of silkworms. Gruby described this species as occurring in a variety of ringworm-patch which he called *Porrigo decalvans*, the name applied by Thomas Bateman to what is now known as *Alopecia areata.* This unfortunate error has given rise to endless confusion. This small-spored form permeates the hair and forms a sheath around it, and has a special preference for the scalp of children. Most of the rebellious cases are due to this cause.

DESCRIPTION.—The objective symptoms of tinea vary widely, according to the site attacked, especially with reference to the hairiness of the region, the suitability of the nutrient medium, the conditions of heat and moisture, the state of nutrition of the tissues, and their susceptibility to respond to the varying degrees of irritation provoked by different specimens of the fungus. Thus four phases of disease may be usefully distinguished, namely, (1) *Tinea trichophytina tonsurans*, or the tonsure-making ringworm of the scalp; (2) *T. t. circinata*, or ringworm of comparatively glabrous parts; (3) *T. t. barbæ*, or *T. sycosis*, affecting the hairy portion of the face and neck; and (4) *T. t. unguium*, or ringworm of the nails. These phases frequently co-exist.

1. *Tinea t. tonsurans.*—Ringworm of the scalp is excessively frequent in this country, especially in London. It is a standing nuisance in our elementary and some other schools, and not infrequently leads to a child's temporary exclusion, and may interfere seriously with his life prospect. It may spread unnoticed for weeks and even months. The typical patch is seen as a rounded desquamating area, in size from a threepenny-piece to a four-shilling piece, over which the hairs, issuing from erected follicles, lie in a disorderly manner, and are reduced to lustreless, opaque, brittle, swollen, and distorted stumps, and look as if they had been nibbled off. Under the microscope mycelium will be found amongst the scales, and in and around the hairs some mycelium and quantities of spores. The fungus enters the follicle and proliferates there freely, passing into the hair, and spreading almost to the bulb and sometimes a long way up the shaft. In this way, the cuticle and the fibres of the hair are completely disintegrated. If the hair is [illegible]

diseased, it can be extracted with its root-sheath. When the disease has lasted some time, cutting the hair will reveal patches in all stages. Some are just beginning as small rounded scaly spots, over which the hair is not yet altered; others, of larger size, have a few hairs affected; and so on. Thus, as the satellites grow which arise around the larger patches, and are absorbed to form gyrate or irregular areas, and as fresh spots are inoculated, the greater portion of the scalp may be eventually involved. T. circinata, of adjoining portions of the face, neck, and shoulders, is frequently associated. The scurf consists of epithelium and sebum, the product of inflammation involving the skin-surface as well as the follicles; but redness of the surface is not often seen in the scalp, nor a margined circle as on the body.

Endless variations of this typical condition are met with. Firstly, the crusting of sebum may be very free, and encase each hair in an asbestos-like sheath, and cake all together in a crusted mass. Various degrees of this seborrhœa may exist. Secondly, the case may be complicated by eczema, and the crusts hide the characteristic stumps. Thirdly, the degree of inflammation induced may be severe, so that no typical areas are seen; but directly a follicle is involved a solid lump, perhaps the size of a pea, is formed, which may suppurate. Occasionally a large area is thus involved; and as an abscess is simulated, it is cut into, but no pus found. A variety of this phase, where the patulous mouths of follicles exude a viscous fluid, is called *kerion*; but this term is often applied loosely to any ringworm which is much inflamed.

Ringworm of the scalp is very chronic. It affects both sexes, and especially the young; infrequently tender infants; rarely adults.

2. *Tinea t. circinata.*—Ringworm of glabrous parts has usually two characteristics. The fungus grows out equally in all directions, so that the patches tend to be circinate (hence the name) and marginate like the 'fairy rings' of downs, but are sometimes atypical and irregular in shape. Secondly, an inflammatory eruption is caused; and the inflammation may be of all degrees. It is commonly erythematous, but may be papular, vesicular (hence the old term Herpes circinatus) or pustular, or, rarely, bullous. Usually these objective symptoms appear on the spreading border. Hence we get a tiny red scaly spot, enlarging peripherally by slow degrees, and often studded with papules, or perhaps crusted over, whilst the extending edge may be papular, vesicular or pustular, or simply uniformly raised. Sometimes two or more concentric rings develop. On so-called glabrous parts the diseased hairs are not nearly such a prominent feature as on the scalp; and the areas do not spread indefinitely, but often tend to die down spontaneously after a time, or only extend by coalescence. In hot countries, where ringworm of the general surface and beneath the loin-cloth is very common, and more rarely in temperate climates, the disease is most extensively developed in the hot and rainy seasons, and the body becomes more or less widely covered with figured coalescent patches. Curiously enough, ringworm of the scalp in these countries seems to be less frequent than with us. There is still another well-known and not uncommon phase to note. We occasionally observe isolated cases or small family epidemics, in which a margined ringworm forms on the inguino-cruro-scrotal or axillary regions, perhaps bilaterally. This was at one time thought to be an eczema and not parasitic, and is often still called *Eczema marginatum.*

3. *Tinea t. barbæ.*—Ringworm of the hairy parts of the face, or more especially the beard, is not at all uncommon in this country, and assumes such peculiar features that it must be specially described. It is a penalty paid for the luxury of being shaved. The early stages usually consist in the formation of the ordinary T. circinata patches, which presently become indistinct; and so great are the irritation and the infiltration produced in this region, that soon considerable nodules and even tumours are formed along the jaw. If these swellings are carefully examined, they will often be found studded with stumps of hairs characteristically diseased, but these hairs may fall out. At other times pustules form and simulate the pustular folliculitis known as sycosis. Indeed, this phase of ringworm is sometimes called *T. sycosis*, or *parasitic sycosis.*

4. *Tinea t. unguium.*—Ringworm of the nails, or Trichophytic onychomycosis, occasionally comes under notice, and the observer may never suspect the nature of the malady, especially when any pre-existent ringworm elsewhere has disappeared. It is naturally very chronic; and one or more or, rarely, all the nails of the hands and feet may be affected. The change in the nail commences by whitish points on the lateral parts, seen through the unaltered upper layers. Longitudinal striæ form; and the nail gradually becomes greatly thickened, brittle, exfoliating, discoloured, disorganised, and distorted.

Diagnosis.—Typical patches of *ringworm of the scalp* are easily recognisable from simple seborrhœa, psoriasis, or other diseases, by the characters already given; but many atypical phases, and conditions altered by treatment and complications, such as seborrhœa, eczema, and impetigo, come before us. We have already referred to the occurrence of pustules, small phlegmons, and more considerable swellings, such as kerion. It is useless to rely on the observance of ringed patches, but it may be said that whenever desquamating patches occur on the heads of the young, the ringworm fungus should be carefully sought for. It is essential for a correct diagnosis that the observer should be thoroughly skilled in the detection of the characteristic hairs and fungus, for without this no amount of detailed description will save him from failure. As a case is getting well, only a few isolated stumps or withered brittle hairs may be scattered about the scalp. *Alopecia areata* is distinguished by the bald, smooth, wasted patches, quite free from signs of inflammation. Stumps occur round the margins of some cases of alopecia areata, but they are club-shaped or like 'notes of interrogation,' free from fungus, and not brittle and swollen. Ringworm patches, after long rubbing or under other conditions, occasionally, however, closely simulate alopecia areata.

Ringworm of glabrous regions makes its nature suspected by its centrifugal spread and margined border; but it is proper, and indeed sometimes necessary, to display the fungus to make a sure diagnosis. The fungus, however, may be difficult to find. This affection has to be distinguished from all other forms of ringed eruption—*e.g.* seborrhœa (eczema seborrhœicum), psoriasis, pityriasis rosea, vesicating erythema multiforme (herpes iris), and macular leprosy; also from circumscribed eczemas and intertrigo. Ringworm contracted from horses and cattle may set up severe inflammation. On the hands and feet the patches are often atypical.

Ringworm of the beard may generally be detected by the characteristic stumps and fungus. Careful search must be made in all cases of scaly patches, pustular folliculitis, and phlegmons occurring in this region.

Trichophytic onychomycosis is often very difficult to diagnose, and to separate by naked-eye appearances from other disintegrating and hypertrophic affections of the nails. The fungus must be sought for.

Treatment.—There is no method of dieting or internal medication which will so alter the soil as to perceptibly retard or prevent the growth of the fungus of tinea, or which directly kills the parasite. Obviously, however, it will be proper to try and restore defective nutrition, and correct any departure from the standard of health presented by the patient.

Prophylaxis is most necessary, and every child with ringworm should be excluded from school, and isolated as far as possible from other children, who should be carefully examined from time to time. Separate toilet requisites should be provided, and kept disinfected. Light paper, linen, or silk head coverings, which can be easily disinfected or destroyed, should be always worn, either as a separate article, or as a lining to the ordinary head gear. The source of contagion should be investigated.

The principles only which should govern the *local treatment* can be here discussed, as it would be quite impracticable to attempt to give in detail all the remedies and methods so strongly recommended from time to time. Laboratory experiments would lead us to suppose that nothing could be easier than to eradicate the fungus by the exclusion of oxygen, or application of some parasiticide or acid medium; but practically it is most difficult in those cases where the fungus has once established itself in the lower parts of the hair and its envelopes. This is chiefly due to the mechanical difficulty in getting the parasiticide in contact with the fungus, and partly to other obscure causes. We have then to recognise the fact that the mere application of parasiticides, however energetic, or acids (such as acetic acid) which are inimical to the growth of achorion and trichophyton, is only useful up to a certain point, and only masters the disease situated in deeper parts after a long time. We can do very much by removing the fungus mechanically, that is, by promoting free desquamation, and the removal of the diseased hairs.

Tinea t. tonsurans.—(1) In the first place it is advisable to cut the hair quite short, if possible over the whole head, or at any rate around the diseased areas, and, moreover, to keep it so. This displays the distribution of the disease, and promotes cleanliness and more efficient application of the remedies. Shaving the patches under antiseptic precautions every ten days or so is strongly to be recommended, as it removes a quantity of fungus above the surface of the skin. (2) All crusting should be cleared away. (3) The head should be systematically scrubbed each day with soft, tar, sulphur, carbolic, or other suitably medicated soap. This proceeding is cleanly, prevents the lodgment of fungus, and helps to clear out the mouths of the follicles. (4) There is an endless number of parasiticide applications to select from, such as the bichloride, biniodide, and oleate of mercury, citrine and other mercurial ointments; the acetate, sulphate, and oleate of copper; nitrate of silver; sulphur, iodide of sulphur, sulphurous acid, hyposulphite of sodium; iodine preparations; carbolic, salicylic, chrysophanic, and acetic acids; resorcin, naphthol, creasote, thymol, turpentine, oil of cade, and similar remedies. These can be used in various combinations and alternations, in the form of powder, liquid, ointment, plaster, and so on. To make them more penetrating, they may be conveyed to the part in fats, lanolin, glycerine, ether, or chloroform; or a variety of collodion varnishes may be used to exclude the air and prevent dissemination. The choice of the remedy, and the strength of the application, must depend on the object to be attained, the extent over which it is used, and other circumstances. If the parasiticide action alone is sought, the production of a weeping dermatitis is usually avoided, but the treatment under these conditions is a long one. We can greatly assist the cure by mechanical means, as by causing free desquamation, by blistering, by removing the epidermis and diseased hairs by the curette and thus exposing the gaping follicles, or by exciting a pustular or phlegmonous dermatitis over *small* areas. By mopping in a solution of iodine in creasote or like applications a crust is formed; and, when set, this is dragged off, bearing the entangled hairs. Phlegmonous inflammation is difficult to produce to order, but when brought about the hairs fall out with the happiest results. (5) Epilation of the hairs is of the greatest value, and is systematically carried out in France, not only over the diseased areas, but by forming a protective zone around. Some practice and skill are necessary. It seems useless to try and epilate much-diseased hairs, as they only break off, and the razor will do as well; but when the hairs become less brittle, or are loosened by surrounding inflammation, their extraction is much more satisfactory.

By the stereotyped forms of treatment, which consist in rubbing in parasiticides, the duration of the affair is always long—generally months, or even years if the disease is deep-seated and extensive.

T. t. barbæ or *T. sycosis* must be treated on the same principles. If the phlegmonous folliculitis is very severe, fomentations of boric acid or weak sublimate or hyposulphite of sodium will be necessary, as for kerion of the scalp.

T. t. corporis, when recent, can be easily cured by the application of tincture of iodine, or the persistent rubbing in of parasiticides in ointment, glycerole, or other preparation. Fresh undiluted sulphurous acid is a good remedy, and can usually be borne. Inveterate or widespread cases should be treated like psoriasis. Goa powder, moistened with acetic acid or lemon juice, is a favourite remedy in hot countries.

T. t. unguium requires that the nail should be softened in strong potash solution preparatory to scraping or cutting away. When sufficient is removed, parasiticides may be rubbed in, or the part kept soaked in them. T. Colcott Fox.

TINEA VERSICOLOR. — Synon.: Willan, Fr., and Ger. *Pityriasis Versicolor*; *Phytosis Versicolor.*

Definition.—An affection of the epidermis, characterised by an extensive discoloration, sometimes fawn, sometimes olive. The irregularly shaped patches and blotches give the integument a variegated or mottled appearance.

Ætiology. — Tinea versicolor indicates lowered nutritive action of the skin, associated in many instances with general debility, but in others the health is unaffected. It is frequent in proportion to warmth of climate, and to warmth of each part of the individual's body. A mould, the *microsporon furfur*, discovered by Eichstedt, can be always found in the epidermis.

Description.—The most common site of tinea versicolor is the trunk, where it may assume a symmetrical distribution, spreading down the sides from the armpits, or occupying the middle line or even the whole surface of the abdomen. Thence it may descend to the thighs like an apron. It is likewise met with between the scapulæ, in the mammary furrow of women, on the neck, upper arms, and flexures of the elbows. The uncovered and habitually washed parts of the skin are exempt, as light and air and cleanliness check the growth of the epiphyte. *See* Epiphytic Skin-Diseases.

If closely examined, the discoloured skin appears punctated by the follicles, which are deeper tinted than the rest of the surface. This inspection satisfies us that the perspiratory ducts mainly harbour the cryptogam, while the hair-follicles are not invaded. The patches are slightly elevated, and they present evidence of some hyperæmia; further, we discover that by the nail the coloured epidermis can be readily crumbled and separated, and that it also takes on a branny exfoliation—hence the synonym of *pityriasis.* The distinctive characters, therefore, are the colour, which is fawn in blondes, brown in brunettes; the patchy distribution; the exfoliation; and the itchiness, especially marked when exercise heats the body. Such features, however, vary considerably in degree; in some instances the colour is so pronounced as to suggest a pigmentary affection simply; in others, the exfoliation is remarkable; while, again, the itching may be either almost absent or insufferable. In the coloured races the patches are grey.

The malady is mainly inconvenient from its appearance; but as the sites are rarely exposed, it is often borne for years without the person seeking advice. Disease of the liver is now and then dreaded by the patients, owing to their yellow hue. It is discovered very often in the phthisical and others who sweat profusely, especially if they wear flannels without frequent change.

Contagiousness is not strong, as the affection may exist for years upon a husband or a wife without spreading to the other; it seems that a special soil is more distinctly needed than in the case of any other of the dermatological flora. It is a disease of the adult, unlike the other tineæ, which are, moreover, unattended by pigmentation. It rarely gets well without persevering treatment, and is very apt to relapse.

Diagnosis.—A thin fragment of the exfoliated epidermis, treated with a solution of caustic potash, exhibits under the microscope with a quarter-inch object-glass, numerous clusters of cells about the size of red blood-corpuscles; these are the conidia of the well-defined *microsporon furfur*. Threads, the mycelia, interlace between the cells. The diseases with which this well-defined malady has been confounded are the abnormal pigmentations, melasma and chloasma, macular syphilide, and pityriasis. The slight elevation, peculiar exfoliation, and the flecked appearance, as well as considerable symmetry, contrast with the smooth subcuticular stains of the first; co-existent signs denote the second; and the absence of inflammation and of abundant desquamation mark it from the last-named. Erythrasma is distinguished by the narrower localisation, the redder colour of the patch, and the greater minuteness of the fungus. *See* ERYTHRASMA.

TREATMENT.—If there be a low condition of health, tonics and a nourishing regimen are called for; but local measures usually suffice. The skin should be scrubbed in a soft soap or other alkaline bath; and when dried it should be carefully treated with the sulphide of potassium ointment, any of the mercurial ointments diluted, or a lotion of bichloride of mercury, or of one part of hyposulphite of sodium to eight of water. Previous sponging of the surface with vinegar increases the efficacy of this last parasiticide, which is the most convenient. Friction with strong alcohol or ether will often cure a small patch instantaneously. Daily use of sulphur soap gently stimulates the skin and checks the growth of the mould. The inner clothing, especially the flannels, must be disinfected or destroyed.

ERASMUS WILSON. E. D. MAPOTHER.

TINKLING, METALLIC.—A sound of a peculiar quality, which the name sufficiently defines, occasionally heard on auscultation in connexion with cavities in the lungs, or when air and fluid are present in the pleura. *See* PHYSICAL EXAMINATION.

TINNITUS (Lat.).—SYNON.: Fr. *Bourdonnement d'Oreilles*; Ger. *Summen*; *Klingen*.—Tinnitus, a term which is commonly used when speaking of noises in the ears, is a frequent symptom in many diseases of the external, middle, and inner ear. It is usually present in all those conditions where there is undue pressure on the labyrinth; for instance, when there is pressure on the tympanic membrane from cerumen, imperfect entrance of air into the tympanum, due to obstruction of the Eustachian tubes, or effusion within the tympanic cavity. It accompanies most inflammatory diseases of the external or middle ear; follows injuries to the tympanic membrane, and blows on the head or ear; may occur in aneurysm at the base of the skull; and is a prominent symptom in all nervous affections of the auditory apparatus, as well as in many states of disordered health when the ear is healthy. So infinite are the degrees and variations in this symptom, that there is probably no known sound to which it has not been compared by patients. When tinnitus is due to some curable local cause, the symptom rapidly disappears with its removal. When, however, it accompanies the deafness in nervous affections, it is often the more troublesome symptom of the two, and the less amenable to treatment. Strychnine is the most useful tonic in ear-affections, and quinine the least suitable, as this drug exercises a distinctly injurious effect, if taken in large doses. *See* EAR, Diseases of; HEARING, Disorders of; and VERTIGO.

W. B. DALBY.

TITUBATION (*titubo*, I stagger).—A term for staggering or stumbling gait. *See* CEREBELLUM, Diseases of; and VERTIGO.

TOBACCO, Poisoning by.—SYNON.: Fr. *Empoisonnement par le Tabac*; Ger. *Tabakvergiftung*.—The minor effects of tobacco-poisoning—nausea, depression, vomiting, vertigo—are well known to the incipient smoker. Fatal poisoning by tobacco rarely occurs, except through its ignorant administration by mouth or rectum. Cases of nicotine-poisoning are still more rare, this, the volatile active alkaloid of tobacco, not being readily procurable.

ANATOMICAL CHARACTERS. — After death from tobacco-poisoning the organs and tissues have a tobacco-like odour, and the odour of nicotine becomes more pronounced on treating them with liquor potassæ. Turgescence of the brain has been described; but, beyond the odour, there is nothing diagnostic in the appearances.

SYMPTOMS.—When a strong decoction of tobacco or snuff is administered, either by mouth or rectum, very speedily—usually in about five minutes—the patient is seized with vertigo, acute abdominal pain, nausea, and vomiting. The skin is pallid and bathed in perspiration. Stupor supervenes, with partial or general convulsions, and stertorous respiration; and death may result in fifteen or twenty minutes, preceded by dilatation and insensibility of the pupils. When the alkaloid, nicotine, is swallowed, insensibility supervenes almost immediately; the pupils are widely dilated; respiration is speedily suspended; and the patient dies in three or four minutes.

The toxic effect on vision of the *continued* use of tobacco is described in the article EYE, AND ITS APPENDAGES, Diseases of.

DIAGNOSIS.—The *odour*, coupled with the above described symptoms, would leave no doubt as to the nature of the case. Usually there is a history of administration

Prognosis.—The prognosis is in all cases unfavourable. *Fatal dose.*—Thirty grains of tobacco are said to have proved fatal. A drop or two of nicotine would doubtless prove fatal.

Treatment.—The treatment of poisoning by tobacco consists in the exhibition of emetics, followed by tannic acid freely in any form, to render the alkaloid insoluble. Strong tea, coffee, and stimulants should also be administered. Iodine, dissolved with iodide of potassium, has been recommended; but is probably of little efficacy, and is undoubtedly irritating to the stomach. Twenty to thirty minims of tincture of nux vomica may be given, and repeated at intervals; or, better, a hypodermic injection of $\frac{1}{25}$ grain of the nitrate or other soluble salt of strychnine may be administered.

Thomas Stevenson.

TOKELAU RINGWORM. — *See* Tinea Imbricata.

TONE, Want of.—This expression, although commonly employed in a somewhat loose and unscientific manner, is sufficiently understood in the main. To appreciate its meaning, it is first necessary to inquire what tone is. In the widest sense of the term, a person may be described as being *in tone* when his organs individually discharge their functions in a perfect manner, and act harmoniously as a whole, just as a violin is said to be *in tune* when melody can be educed by striking its individual strings. More correctly, tone is applied to a condition of the muscular system, as signifying that state of tension in which voluntary muscular efforts can be produced and continued with a healthy and pleasurable feeling; and also to muscular organs, to indicate a certain degree or power of contraction of their walls.

Ætiology and Pathology.—Various factors combine to produce and maintain muscular tone. First, this state is dependent on a proper supply of *nervous energy*; secondly, *nourishment* and *oxygen* must be furnished in abundance; thirdly, the *products of waste* must be thoroughly removed from the system; and fourthly, the *work* required of the muscular tissue must not be excessive, that is, a certain amount of rest must be afforded to it.

Want of muscular tone results, then, from failure of any of these conditions.

1. *Nervous failure.*—Whatever view may be taken of the nature of nervous and muscular force, modern research has shown that they are intimately connected with each other. If the nerve-supply be cut off, muscles waste; and *vice versâ*, if the muscles remain unemployed, their nerve-centres suffer. The effect of nervous disease or disorder in producing loss of muscular tone is illustrated by such neuroses as hysteria and epilepsy, by some forms of mental disease, and by the large but indefinite class of cases known as 'nervous debility,' of which mental strain, anxiety, sexual excess, or masturbation and alcoholism are frequently the exciting causes.

2. *Failure of nutrition.*—Deficiency of the blood-supply immediately lowers muscular activity, in consequence of interference both with the nutrient and the oxygenating processes. It is on this account that want of tone is found in anæmia, in convalescence from acute diseases, and to a certain extent even in chronic dyspepsia. Want of oxygen and impurity of the atmosphere lead as distinctly to lassitude; and, if long continued, to lowering of muscular energy and loss of tone, as amongst the inhabitants of large towns, and in persons employed in close, ill-ventilated rooms.

3. *Retention of waste products.*—When muscles are called into action certain compounds are formed within them, which must be eliminated by being passed back into the circulation and excreted. The lungs, skin, kidneys, liver, and bowels must, therefore, discharge their functions properly to keep the muscular system in tone. We have here the explanation of a very common class of cases of want of tone. Many persons, either from choice or from necessity, habitually take an amount of active bodily exercise insufficient for the removal of the waste products from the muscular and other systems. In the former case this is the result of indulgence in abundant rich food, combined with lazy habits, confinement to warm 'relaxing' rooms, and the avoidance of 'bracing' exercise. In the latter case, the metabolic inactivity is referable to enforced confinement in sedentary employments, often of an exhausting kind, carried on perhaps in an impure atmosphere, or throwing a continuous strain upon one set of muscles, such as those involved in standing or sitting. Both these classes of cases also are met with chiefly in large towns, and they constitute a considerable proportion of the persons who 'require tonics.'

4. *Muscular exhaustion.*—Excessive muscular exercise leads to loss of tone: first, by interfering with nutrition, which is most active during rest; secondly, by wear and tear; and thirdly, in the case of hollow muscular organs, such as the intestines (the muscular walls of which have to resist internal pressure), by gradual exhaustion of muscular irritability from continuous excitement, or possibly even by over-stretching and dislocation of the fibres. The first two forms of muscular atony are well illustrated by certain instances of cardiac exhaustion; the third form is met with not only in the alimentary canal, but in the bladder, in the blood-vessels, and indeed in all muscular tubes and ducts, when over-distended by solid, fluid, or gaseous contents.

5. *Combined causes.*—In many cases two

or more of the causes mentioned under the preceding heads are combined, and give rise to want of tone or atony. Thus in a large class of cases of debility with which practitioners in large towns are familiar—and which especially includes young female subjects engaged in business—overwork, impure air, insufficient light, badly cooked or otherwise improper food, the constant strain of the muscles of the legs and back without sufficient movement, and frequently many other circumstances injurious to the nervous system, are all combined. Again, the subjects of chronic nervous affections, such as epilepsy and hysteria, are too frequently overfed, nursed in warm rooms, and spared every form of healthy exertion, with the result of producing a flabby, atonic state of system.

Symptoms.—Want of tone in the muscular system generally is characterised by a number of symptoms, which are all more or less ill-defined and difficult to describe, being chiefly of a negative and subjective kind. The chief of these are a peculiar feeling of want of muscular vigour; weakness, heaviness, and even aching of the limbs; languor, inability and unwillingness to undertake or to continue any kind of physical or mental exertion, and a desire to remain passive and undisturbed. This reacts upon the mind, causing depression of spirits, melancholy, and other subjective symptoms.

The symptoms of want of tone or atony of muscular organs vary greatly with the part affected. Thus atony of the stomach is characterised by a familiar form of dyspepsia, which is called 'atonic;' atony of the bowels is chiefly attended by constipation and flatulence; atony of the bladder is associated with retention of urine. Ulcers are said to 'want tone' when the healing process flags.

Treatment.—It will be gathered from the preceding remarks that want of tone, whether general or local, is a condition which calls for very different kinds of treatment, according to its cause. One of the principal reasons of the want of success which frequently attends attempts to restore tone to the system is failure on the part of the practitioner to appreciate this truth, and to discover and remove the cause or causes of the morbid state. Tonic drugs suggest themselves only too readily as the proper means to be employed; and so great is the number of remedies which go by this name, and so complex are the combinations in which they are now presented by the pharmacist, that recourse is often had to them before an accurate estimate has been made of the direction in which the system or the affected organ is really at fault, and hence injury, not benefit, results. These remarks apply both to loss of tone generally, and to atony of special organs. Thus it happens that the best tonic measure in one case may be rest, in another case exercise; in a third case food and stimulants may be urgently called for; in a fourth case depletory measures are essential at the commencement of treatment. Time is an equally important factor in the process of restoration to tone. This is especially true in the instances where rest is necessary; but even in the very opposite class of cases, where exercise is demanded, this regimen may need to be carried on for a long time, being commenced with caution and slowly increased.

The details of tonic treatment are indicated in a special article (*see* Tonics). Here it need only be added that when the nervous elements are distinctly deficient in activity, strychnine, cinchona, phosphorus, and cod-liver oil appear to be specially indicated, whilst galvanism and massage may be useful. Massage is a most potent agent in increasing bodily tone. But it requires careful regulation, as in some patients it proves too exhausting—it may be from too quick destruction of the muscular tissues, and insufficient elimination of the waste products (*see* Massage). On the other hand, Dr. Weir Mitchell's treatment, where massage is combined with forced feeding and seclusion, is of great value where failure of tone arises chiefly from a badly nourished nervous system. Alcoholic stimulants and iron are best adapted to cases in which nourishment and oxygenation have fallen below par. When the activity of the organs is diminished from accumulation of waste products, we must have recourse to moderate cholagogue purgation, to such diuretics as digitalis, to diaphoretics, and especially to change of occupation, and exercise of such a kind in an open healthy atmosphere as shall bring all the voluntary muscles into action, and stimulate if possible every bodily function. In the converse class of cases, where exhaustion is the result of over-exertion, we have, after removing the cause, to exhibit antispasmodic or even sedative drugs, such as belladonna and opium, which are especially useful in the first stage of atony of the stomach and alimentary canal, as well as in atony of the bladder.

Finally, no class of remedies is so likely to prove efficacious in restoring tone as that of mineral springs and baths. Where these are chosen with due discrimination, every one of the indications for treatment may be fulfilled. In *nervous failure*, whatever may have been the exciting cause, the change of air and scene, the regulated life and the freedom from daily cares, all tend to restore the due working of this important factor in maintaining a due tone of the whole system. The same remarks apply to *failure of nutrition*, where early hours and exercise, which form a part of the regimen at every Spa, are so conducive to an improved tone of the muscles, voluntary and involuntary, of the body. But it is in cases of *retention of waste products* that natural mineral springs and baths play so important a part. Besides, the principal agent is water, and the different saline or other ingredients are merely subsidiary helps. Yet even the mere flushing of the system is not to be despised; and in no other fashion can it be so thoroughly—if not always very pleasantly—secured. The fourth cause—*muscular exhaustion*—is one also which can be very successfully combated at a watering-place. One of the most necessary injunctions which require to be laid down by the bath physician is attention to graduation of the amount of exercise. The improved sleep, too, following on better digestion, inhalation of pure air, and increased elimination, tends greatly to give tone to the system by ensuring sufficient intervals of rest. Enough has been said to show that mineral waters, bathing, and the modern system of massage available at all Spas, must do much to counteract the bad effect of the combined causes of failure of tone.

William Bruce.

TONGUE, The. — Synon.: Fr. *La Langue*; Ger. *Die Zunge.*—Apart from its own particular diseases, which are described in a separate article (*see* Tongue, Diseases of), the tongue, as is well known, gives important clinical indications regarding various morbid conditions affecting the general system as well as many local diseases. To 'look at the tongue' is one of the first acts of 'clinical examination' which even the merest tyro in the medical profession performs; but there is much that is indefinite and uncertain in the ideas as to what this examination is intended for, and what information it affords. The limits of the present article will only permit of a brief summary of the subject; and for valuable practical details the reader is referred to the *Lumleian Lectures* for 1888, by Dr. W. H. Dickinson, on 'The Tongue, as an Indication in Disease.'

Mode and Objects of Investigation.—In general terms it may be stated that we examine the tongue, for clinical purposes, with reference, first, to its *subjective sensations*; secondly, to its *movements*; and, thirdly, to the *objective characters* which it presents.

1. Its *subjective sensations* chiefly include ordinary tactile sensation, and the sense of taste. In most cases we rely for information on these points upon the statements of patients; but under certain circumstances common sensibility may be tested experimentally by some suitable instrument; and taste, by applying different articles to the tongue with a brush, or in other ways (*see* Taste, Disorders of). Sir Richard Quain has called the writer's attention to a peculiar sense of heat or burning, sometimes felt in the tongue, which seems to be associated with the gouty diathesis.

2. The *movements* of the tongue are studied by watching them directly; and by noticing any abnormal affection of speech or deglutition arising from defect or disorder of these movements. A peculiar thickness of speech, or an inability to swallow properly, may result from this cause; and in extreme cases articulation and deglutition may become impossible. To examine the tongue directly as a motor organ, it should first be looked at while in the mouth, both at rest and when the patient moves it from side to side, or in other directions; then he should be directed to put it out, and to perform similar movements when the tongue is protruded. This mode of investigation gives important information in certain cases.

3. The *objective examination* of the tongue in itself is of far more frequent application than the methods just considered, being indeed called for and ordinarily practised in every case, although it may not necessarily afford any positive information. No patient thinks his case properly investigated unless he is told to put out his tongue. The examination is usually carried out by inspection; but it may also be requisite, and very instructive, to feel the tongue with the finger. In looking at the organ, an endeavour should be made to inspect its entire upper surface, and for this purpose the patient should be directed to open the mouth, and protrude the tongue as far as possible, a good light being also needed for observing it. In some instances, as in infants and rebellious children, as the result of congenital malformations or wearing false teeth, in many low febrile cases, and in certain nervous diseases, the tongue must be examined while in the mouth, as the patient either cannot or will not put it out properly; for this purpose it is sometimes necessary to open the mouth somewhat forcibly, but with due care, and it may be desirable to employ some artificial light. For more minute information in some cases it is requisite to scrape the surface of the organ, and to examine microscopically what is thus removed. The points to be noticed in the objective examination of the tongue are: (*a*) Its size and shape as a whole, as well as the characters of its point and margins. (*b*) Its condition as to firmness or flabbiness. (*c*) The colour of the mucous membrane. (*d*) Whether the surface is normal, smooth and glazed, being more or less denuded of its usual epithelium, or presenting a dry membranous covering, furrowed, fissured, or otherwise altered. (*e*) The condition and appearance of the papillæ, especially the fungiform papillæ. (*f*) Whether the tongue is moist, sticky, or dry. (*g*) The absence or presence of any accumulation on the dorsum of the organ, commonly known as 'fur'; and, if present, its arrangement, thickness, colour, and other general characters, as well as in some cases

microscopical appearances. It may be remarked that in relation to this examination of the tongue it is often advantageous to notice the condition of the mouth generally, but especially of the gums and teeth, and of the lips. Further, the patient may afford information with regard to the objective conditions of the tongue, not coming immediately under the notice of the practitioner, such as whether it is much furred on waking in the morning, or if it is inclined to dryness.

It is desirable to offer a few remarks respecting abnormal covering or *fur* on the tongue. This varies much in its extent, thickness, and characters. As regards its general distribution, it may cover the whole surface of the organ; or only its posterior or anterior part, one lateral half, or even a limited patch when due to local causes. The covering may be a mere film, or of considerable thickness. Its chief colours are white, whitish-yellow, yellow, yellowish-brown, brown, brownish black, and black. It is either moist and easily separated, sticky and viscid, or dry, being then often cracked and peeling off. It usually clears gradually from the tip and sides towards the centre of the tongue, sometimes in strips; sometimes it breaks away abruptly in scales. Under certain circumstances fur appears and disappears with great rapidity.

In a very instructive classification of tongues, Dr. Dickinson employs the following terms: (1) *Stippled* or *dotted*, where the papillæ are separately capped with a minute white patch. (2) *Coated*, where the spots coalesce and become confluent, so that the covering is continuous, the intervals between the papillæ being also more or less filled up. (3) *Plastered*, where the coat is thick, uniform, and conspicuous, and often looks as if laid on with a trowel. (4) *Furred* or *shaggy*, in which there is great elongation of the papillæ, which remain separate from each other, at least at their extremities, so as to give a shaggy look, or one suggestive of coarse hair or fur. (5) *Encrusted*, in which the papillæ are concealed by an incrustation, or thick felted coat, usually dry and brown, by which the surface is overlaid.

As regards the nature of the changes in the varieties of abnormal tongues just indicated, microscopical examination shows that in most of them the papillæ are elongated. The white coating is found to consist mainly of accumulated epithelium, which, according to Dr. Dickinson, is the result chiefly of overgrowth. In the superficial layers of many accumulations on the surface of the tongue, especially the dark encrusted form, there are also present the remains of food, amorphous material, fat globules, blood or altered blood and pigments, different micro-organisms, especially bacilli and micrococci, and sometimes the *oïdium albicans*. In the deeper parts of the epithelial structure, more especially in the Malpighian layer, there is often much profusion of nucleation or cell-growth, and the corium is in many cases distinctly hypernucleated and often over-injected. More rarely leucocytes are extruded within the papillæ and elsewhere (Dickinson).

With reference to the immediate causation of these abnormal conditions of the tongue, Dr. Dickinson concludes that the formation of more or less coating, with lengthening of the papillæ, depends partly on disuse of the organ, with want of rubbing and washing, and consequent deficient removal of the epithelium; but mainly on increased overgrowth, associated probably in some cases with a morbid poison in the system, but chiefly with pyrexia, the coat increasing in degree in proportion to the temperature, up to a certain point. Dryness of the tongue he attributes principally to deficient secretion of saliva; but it may also be due partly to habitual openness of the mouth during sleep, pyrexia, or general dehydration of the body, from deprivation of water or excessive discharge, as in diarrhœa and diabetes. The condition to which this observer specially applies the term 'furring,' as well as incrustation, he considers as essentially connected with want of saliva. Incrustation is a secondary process, in which various matters accumulate on the surface of the tongue, including parasites. The brown colour he refers chiefly to dryness, as many animal substances dry brown; partly to staining food and medicines.

The condition of tongue in which its surface is abnormally smooth, bare, and denuded, also calls for brief notice. This may be general or partial, and usually follows the removal of a coating or incrustation; but it may be a primary change. It presents various degrees, the organ being at the same time more or less red, and generally dry. A glazed, shining, or polished appearance is common. In extreme cases this variety of tongue becomes intensely red and raw-looking, being compared to raw beef; and it may be excoriated or cracked. In describing the minute changes, Dr. Dickinson states that the epithelium and the papillæ are removed down to the level of the Malpighian layer, but this usually remains, and becomes covered with fresh horny epithelium, forming a thin membrane. Should the denuding process extend further, the Malpighian layer itself is removed, exposing the corium; and this structure is sometimes encroached upon, even almost down to the muscular fibres. Vascular injection, hypernucleation, and the extrusion of leucocytes often take place; and in some cases there is a general inflammatory infiltration of the superficial parts. A completely bare tongue is comparatively rare, and such a degree of change is generally limited in extent. The variety of tongue now under consideration is that on which aphthous growths are most liable to occur. It implies failing nutrition. The appearances are due partly to want of epithelial covering; but the exposure resulting from loss of this covering also causes irritation and dryness. Dr. Dickinson attributes the changes partly to want of saliva.

Clinical Indications.—In the following remarks it is intended to call attention to some of the principal conditions in which the tongue affords useful information, and to indicate the main characters associated therewith. Dr. Dickinson affirms that 'the tongue is an index of constitutional states, seldom of individual diseases'; 'it seldom points to solitary organs or isolated disorders, but is rather a gauge of the effects of the disease upon the system than an indication as to the locality of it.' Allowance must always be made for individual peculiarities in the shape or size, and in the appearances presented by this organ; for the effects of certain habits, such as excessive smoking, or chewing tobacco and other substances; for changes in colour due to taking iron or other medicines; and for any local irritation. Moreover, most people, but especially those who sleep with the mouth open, have a more or less furred tongue in the morning, which is of no special importance, or it may tend to dryness; while in some individuals its surface presents constantly a thick coating, without evident disturbance of any organ, appetite being excellent, and the digestive functions performed in a most satisfactory manner. On the other hand, a perfectly clean and healthy-looking tongue may be associated with severe dyspeptic symptoms, or even with serious organic disease of the alimentary canal or its related organs. Many persons have the surface of the tongue more or less furrowed as the normal state.

1. **Nervous Diseases.**—In this class of diseases the tongue often affords information of much value, and it is here that its sensations and movements are mainly disordered. In many cases of cerebral lesion, one half of the tongue is paralysed in its muscles, so that the organ is unsymmetrical in the shape of its two sides; and deviates when in the mouth to the healthy side, but when protruded towards the paralysed side. In exceptional cases the entire organ is affected, so that it cannot be protruded or even moved. The way in which a patient attempts to put out the tongue when asked to do so, may be made use of to indicate the state of consciousness in various conditions affecting the brain. In many cases of cerebral disease the tongue shows a marked and speedy tendency to become thickly furred, and very foul. This is well seen in cases of apoplexy due to hæmorrhage in connexion with the brain.

The tongue is specially affected in certain peculiar nervous diseases, particularly labio-glosso-laryngeal paralysis, many cases of diphtheritic paralysis, general paralysis of the insane, and extreme cases of wasting palsy. Beginning with slight indications of loss of power, as tremulousness, thickness of speech, and difficulty in swallowing, the affection is liable to end in complete paralysis of the organ, which may also involve its sensibility. These results depend on disease involving the roots of the nerves supplying the tongue. The organ may also be thus affected in various degrees, owing to some morbid condition implicating its nerves in their course or at their origin. When completely paralysed, the tongue in time comes to present the appearance of a sodden mass lying in the mouth. In cases of severe neuralgia of one side of the face, the tongue occasionally presents peculiar appearances, such as unilateral furring, thickening of the mucous membrane, or enlargement of the papillæ; coating of one side of the tongue has also been noticed in connexion with painful teeth (Hilton). The tremulous and foul tongue of acute or chronic alcoholism may be mentioned under this head. Dr. Dickinson has often noticed the tongue to be white and sodden-looking after an exacerbation of nervousness, but attributes this to a want of saliva. Signs of the organ having been bitten may be useful in the diagnosis of obscure cases of epilepsy. Jerking and irregular movements of the tongue are very striking in many cases of chorea. During attacks of migraine its surface usually becomes much furred.

2. **General Conditions and Diseases.** The tongue is usually markedly altered in the febrile state, whether associated with specific fevers, or with inflammatory or other diseases. It becomes covered with more or less fur, often of considerable thickness, and usually either white or yellowish-white. In particular fevers the organ commonly presents peculiar characters. Thus, in many cases of typhoid fever it is small and irritable, with enlarged papillæ, and a thin whitish or yellowish fur; it may become red, smooth, and glazed or shining In this disease it may also be peculiarly tremulous, which has been regarded as a bad sign, indicating deep ulceration of the intestine. In scarlatina the papillæ tend to become peculiarly prominent as well as injected, projecting through the fur, the tongue presenting the so-called 'strawberry' appearance; this condition may, however, be met with in other diseases. In diphtheria the tongue may exhibit a diphtheritic deposit upon its surface. There is generally a very thick, creamy coating in acute rheumatism, as well as preceding and during attacks of gout, and in the latter especially it often becomes yellowish or brownish. In acute pneumonia also the tongue is often thickly plastered, but presents much variety. In the 'typhoid state,' whatever this condition may be associated with, the tongue

tends to be dry, and usually covered with a brown or even blackish crust, looking as if it were baked. It is often very red and irritable in itself, and occasionally the typhoid tongue has little or nothing on its surface, but is very dry, deeply red, like raw beef, and fissured. The organ may be in such a condition that it can scarcely be moved at all. At the same time sordes are present on the teeth and gums. The red, raw, and dry tongue is generally associated with exhaustion, especially when this is due to exhausting discharges, particularly of pus; and it is linked with the constitutional state described as hectic. It not uncommonly occurs, however, in various conditions producing prostration and depression, apart from discharges, and these are often connected with the abdominal organs. In malarial fevers the margins of the tongue are said to present sometimes a faint bluish tinge.

It may be remarked here that the tongue not uncommonly affords evidence of constitutional syphilis, owing to the past effects of this disease upon the organ. It may also indicate the general tone of the system, being often large and flabby when this is below par.

3. **Conditions affecting the Blood and Circulation.**—The tongue often exhibits abnormal characters, due to the state of the blood or circulation. Thus, in anæmia it is more or less pale; generally large, flat, broad, and flabby; and frequently indented at the sides by the teeth. In the plethoric condition it is also large, but tends to be of a deeper colour than normal, and may present a venous tint. The anæmic tongue is frequently quite clean, though this will depend much on its associations; but the tongue met with in plethora is generally furred. A temporarily congested condition of the digestive organs and liver is supposed to be accompanied by a corresponding plethoric state of the tongue. Any cause of general obstruction to the venous circulation, or of interference with the due aëration of the blood, whether seated in the heart or lungs, is likely to give rise to enlargement of the tongue, and to make it assume a congested, or even a cyanctic appearance in marked cases, such as those of congenital malformation of the heart. It occasionally happens that some local obstruction, affecting the large veins in the thorax, as from the pressure of an aneurysm, produces a similar condition of the tongue. In his classification, Dr. Dickinson applies the term *cyanotic* to a particular variety of tongue, which is injected, hypernucleated, with excess of deep epithelium.

4. **Affections of the Alimentary Canal and its Related Organs.**—The tongue is commonly regarded as of peculiar importance in relation to morbid conditions of the digestive apparatus and liver, but Dr. Dickinson's observations do not support this idea, and he attributes the changes presented by the organ rather to the pyrexia or other constitutional disturbance associated with these conditions. As already stated, there is no definite relation between the state of the tongue and the performance of the digestive functions, or the presence or absence of even serious disease, but at the same time there are certain general indications which may be worthy of note.

(*a*) The tongue is peculiarly liable to be altered in local affections of the mouth and throat. In catarrh of these parts it is more or less coated. In tonsillitis there is usually a very thick covering; and it may be most marked on the side of the inflamed tonsil. Even a local irritation, such as that caused by decayed teeth, may originate a fur, and it is under such circumstances that it is liable to be localised. Associated stomatitis may explain the state of the tongue in some cases of gastric catarrh or inflammation.

(*b*) In any acute disorder of the alimentary canal the tongue tends speedily to become coated, usually either white or yellowish-white, but it may be more or less brown. This is seen in so-called acute dyspepsia, gastric catarrh, and hepatic disorders. The fur often clears away very speedily when the cause subsides. In severe acute gastritis the organ frequently presents a strikingly red and irritable appearance, especially at the tip and edges, with enlarged papillæ, and a tendency to dryness. In acute intestinal obstruction the tongue becomes stippled at an early period, or coated and dry.

(*c*) In chronic forms of dyspepsia and gastric catarrh, the tongue often presents abnormal appearances. In the atonic variety it is usually large, flat, soft, and flabby; frequently marked with the teeth; and more or less furred, though it may be quite clean. In the irritative form it tends to be small, elongated, and pointed; contracted and firm; red and irritable; with enlarged papillæ; and generally only having a thin white fur, through which these papillæ project, but it may appear unusually clean and raw-looking. The organ may present characters more or less similar to those just described, in those cases where the food passes rapidly out of the stomach into the duodenum in an undigested state. In the more grave diseases of the stomach, namely, cancer and ulceration, the tongue has no special characters, and indeed is often very healthy-looking. Dr. Dickinson has not been able to discover any state of tongue especially connected with dyspepsia or ulcer of the stomach.

(*d*) The relation of the tongue to affections of the intestines is indefinite. The bowels are often much deranged in their functions, or diseased, without any abnormal appearances being exhibited by the organ. It may be said, however, that constipation, especially if habitual, tends to make the tongue large and furred, particularly if associated with portal congestion and deficiency of bile. Cases of prolonged constipation have not uncommonly been met with, however, in which it has remained perfectly clean and normal. Chronic accumulation of fæces in the rectum seems to give rise to thick coating, which Dr. Dickinson attributes to general disturbance, and probably pyrexia connected with morbid absorption. Diarrhœa tends speedily to affect the tongue in various ways. There is scarcely any condition in which the tongue becomes more rapidly dry, coated, furred, and encrusted, than severe diarrhœa. In dysentery, especially with hepatic abscess, it often becomes shrunken, red, smooth and polished, or fissured.

(*e*) As regards the hepatic apparatus, portal obstruction is believed to cause an enlarged and congested state of the tongue, but this is very doubtful. It tends to become more or less coated in biliary disorders, especially when acute; and is often very foul in cases of obstructive jaundice, when it may also be coloured yellow.

5. **Special Diseases.**—In diabetes mellitus the tongue is often peculiarly irritable, red, clean, cracked, and dry. In acute peritonitis it is usually remarkably small and contracted, also red and irritable, with but little fur, and tending to dryness. In advanced cases of phthisis, especially with a high temperature, it frequently becomes red and raw, and exhibits enlarged papillæ; the occurrence of thrush upon its surface may also be a sign of approaching dissolution in this disease. These illustrations will suffice to point out the special information which the tongue may afford as regards particular diseases.

Conclusion.—By a consideration of the characters of the tongue, it will be seen from the foregoing remarks that important and valuable indications are often afforded, not only as regards diagnosis, but also in relation to prognosis and treatment. Therefore it is essential that its characters should be properly studied in every case, bearing in mind the three main clinical aspects which it presents to the practitioner, namely, its sensibility, movements, and objective characters. FREDERICK T. ROBERTS.

TONGUE, Diseases of.—Synon.: Fr. *Maladies de la Langue*; Ger. *Krankheiten der Zunge.*

The principal morbid conditions affecting the tongue may be thus enumerated in alphabetical order: (1) Chronic Abscess; (2) Adhesions; (3) Atrophy; (4) Cancer; (5) Cysts (mucous); (6) Hypertrophy; (7) Inflammation and Acute Abscess; (8) Leucoma, Leukoplakia; (9) Parasitic Affections; (10) Syphilis; (11) Tongue-tie; (12) Tubercular Ulcer; (13) Tumours; and (14) Ulceration. Aphthæ and thrush are discussed under their respective headings (*see* APHTHÆ; and MOUTH, Diseases of). The simpler disturbances of the surface of the tongue, of which the practitioner avails himself as an aid to diagnosis, are separately discussed. *See* TONGUE, The.

1. **Chronic Abscess.**—This may occur at any age, and its cause is generally obscure. It is most common in front of the circumvallate papillæ, and forms a tense, elastic, more or less prominent swelling, presenting beneath the dorsal mucosa. Its outline is generally quite clear. The membrane over it is free and normal in appearance; the swelling is neither tender nor painful. However prominent, it is not translucent. Growth is very slow, and the history of the swelling may extend over some years. The disease has to be diagnosed chiefly from mucous cyst.

The treatment consists in the application of cocaine, incision, and scraping out the abscess with a sharp spoon.

2. **Adhesions.**—Occasionally the tongue is attached more or less extensively at its sides and under-surface to the corresponding surfaces of the mouth. These adhesions may be congenital, but more frequently they are the result of ulceration or sloughing.

Treatment.—In congenital cases the membranous bands may be divided with scissors or scalpel. Sometimes a well-formed tongue exists, bound down laterally to the jaws: these cases do well. When the tongue is not really formed, treatment is of no avail. Adhesions consequent upon ulceration may be dealt with similarly, but the result is much less hopeful, unless a mucous flap, from a part which will not lie in contact with another raw surface, can be twisted into the wound made. The writer is not acquainted with any case in which the transplantation into the mouth of a piece of mucous membrane from another animal has succeeded.

3. **Atrophy.**—Atrophy of the tongue may be either unilateral or bilateral. It may result from either acute softenings or chronic scleroses of the nuclei of the twelfth nerve in the medulla, and in both of these cases the palsy is usually bilateral, the two nuclei being so close together as to be almost necessarily involved by even a small lesion. Injuries to the nerve-tract between the centre at the lower end of the ascending frontal convolution and the nucleus cause paralysis, with but little and late wasting. Injuries below the nuclei, on the other hand, lead to rapid wasting of the tongue on the side of the injury.

Treatment.—Treatment must be directed to the cause of the complaint. *See* HYPOGLOSSAL NERVE, Diseases of.

4. **Cancer.**—Ætiology.—Cancer of the tongue is most frequent between the ages of forty and forty-five; it may occur at any

age after twenty-five, but is rare under thirty-five. It is more than twice as common in men as in women. Irritation from a tooth or hot smoke sometimes seems to be the exciting cause; again, the growth may supervene upon leukoplakia, glazed red tongue, a wart, or a chronic gummatous ulcer. Locality has a distinct influence.

Description.—Squamous epithelioma is the only form met with in the tongue. Its usual seat is the edge in the middle third, but it may begin at any spot. It starts as an ulcer, a fissure, or a wart—sometimes the patient says, 'as a lump in the tongue'; but growing as it does from the epithelium, this 'lump' is always intimately connected with the mucosa, and the epithelium is never normal over the whole mass, but is either destroyed by ulceration or is papillary. The earliest characteristic point is induration of the base of the lesion, from invasion of the mucosa by epithelial cells and round-celled infiltration about them; the edges of an ulcer or fissure become similarly thickened. The epithelium on the surface usually undergoes degeneration and is cast off, thus leading to the formation of an 'ulcer,' at the base and edges of which the tissues are being progressively invaded by growing epithelial columns. This invasion is sometimes more marked along the surface, at other times it takes place chiefly towards the substance of the tongue. It is sometimes slow, again rapid, and is almost always so much more rapid than the 'ulceration,' mentioned above, that induration round the ulcer is well marked. Rarely papillary masses project from the surface of an epithelioma, destruction being reduced to a minimum; unfortunately it is in these cases that infiltration of the base also is apt to be least marked, the products of epithelial multiplication escaping towards the surface instead of being pressed into the substance of the part. As the 'ulceration' and infiltration extend into the substance of the tongue, to the floor of the mouth, the jaw, the fauces or soft palate, the movements of the tongue become more limited, till ultimately it may be quite bound down. Sooner or later the submaxillary glands, or those at the base of the carotid triangle, swell and become painful. They may remain of small or moderate size, or may grow rapidly and discharge or fungate through the skin, and this with but a small growth in the mouth. Extension to distant organs by the circulation is rare. Pain may be slight or even absent, but, as a rule, it is severe, radiating over the whole distribution of the fifth nerve and often to the region of the small occipital. The tongue is tender and sensitive; when fixed, it fails to push food between the teeth for mastication. Ptyalism is constant, and may be very marked. The saliva is ropy, and is expelled with difficulty. The ulcer discharges into the mouth, while sloughs form upon its surface and putrefy; hence mouth and breath become offensive. Perhaps in relation with the increased secretion of ropy saliva the submaxillary gland is large, firm, and easily felt. In consequence of inability to take sufficient food, of chronic putrid poisoning, of pain and anxiety and other influences connected with the nature of the growth, the patient loses health and strength steadily. Death may result from simple exhaustion; not uncommonly septic bronchitis and broncho-pneumonia quicken the progress. Dangerous or fatal hæmorrhage from the epithelioma is rare. Cancer of the tongue is one of the most painful and most rapidly fatal forms of malignant disease. According to Clarke, its average duration is fifty-seven weeks; if the cases which are submitted to operation are taken by themselves, its average duration is eighty-six weeks. But the statistics of surgeons practising carefully the modern operation of removal of the growth, together with the nearest lymphatic glands, show a better result than this—including a fair number of cases of prolonged immunity. Cancer of the frænum and its neighbourhood should be mentioned, as it is credited with exceptional malignancy. This may be the consequence of imperfect treatment, due to a surgeon's reluctance to draw healthy front teeth (to get a good view), to resect the symphysis, and to remove both the submental and submaxillary lymphatics.

Diagnosis.—The difficulties in recognising a cancer of the tongue vary according as it presents itself under the form of an ulcer, a wart, or a tumour beneath the mucosa. In all cases the diagnosis should be effected before the local disease is extensive, or glands are enlarged; otherwise it is probably too late for successful treatment. A cancerous *ulcer* must be distinguished from a simple ulcer, a hard chancre, a broken-down gumma, and a tubercular ulcer. A simple ulcer generally forms quickly, and bears an obvious relation to its cause—some injury, a sharp tooth, or a projecting part of a tooth-plate. It is less defined in outline than cancer, and induration is absent or slight; the edges are not thick, rounded, raised, or everted; the base is not warty and irregular. A scraping of its surface after cleansing shows but few epithelial cells, and they are of normal appearance. After removal of the irritant, and under suitable treatment, a simple ulcer should heal. Hard chancre affects the apex; is exceedingly rare; of rapid formation up to a certain size; very hard, defined, with smooth edges, and but slightly ulcerated base. The submaxillary glands very soon enlarge, and general symptoms follow. A gummatous ulcer is usually a deep ragged ulcer on the dorsum, parallel to the raphé, with thin, irregular margins, undermined and [illegible] when the tongue is protruded, not at all indurated; in the cavity yellowish sloughs may still adhere; there are often other masses in the tongue-substance, and the surface still more frequently presents evidence of previous ulceration or of superficial glossitis; a history and other signs of syphilis are perhaps obtainable; a scraping of the side of the ulcer after cleansing shows but few epithelial cells; appropriate treatment is successful. Both the simple and the gummatous ulcer may become cancerous; so, if progressive induration leads to the suspicion of cancer, either the ulcer should be at once freely excised, or a good piece should be cut out under cocaine and examined microscopically. A tubercular ulcer in a male over thirty-five may be indistinguishable from cancer. If the ulcer is secondary, the presence of tubercle elsewhere should make us careful. Primary tubercular ulcers of the tongue are rare. They are less indurated, but may, if clean, present pale pinkish granulations not unlike those of a clean epithelioma. Sometimes in deeper specimens muscular fibres may be recognised, laid bare by the progressing ulceration. The effect of medicinal treatment is usually *nil*. It is stated that these ulcers yield a scraping like that of a simple or syphilitic sore. Fortunately, the diagnosis is of less importance here than in the previous cases, for the primary tubercular ulcer, or a secondary ulcer with but slight lesions elsewhere, should be excised.

A *warty* epithelioma resembles a simple wart. The diagnostic point is induration at the base of the epithelioma. No wise man would keep even an undoubted wart on his tongue.

An epithelioma in form of a submucous *tumour* has to be distinguished chiefly from an unbroken gumma. A normal or smooth red epithelial surface over the mass, the absence of definite outline or of marked induration, the presence of syphilitic lesions on the tongue or elsewhere, and a history of syphilis, excite suspicion as to the nature of the growth. Full doses of iodide of potassium confirm it.

So much stress has been laid upon the importance of induration in the diagnosis of cancer, that it is right to add that rapidly ulcerating epitheliomata rarely do occur in which there is but little induration.

In no case should the nature of a small ulcer of the tongue in a patient of thirty-five or over be allowed long to remain doubtful. If it does not heal after removal of any local irritant, upon the application of local antiseptics, especially borax and iodoform, and upon the administration of iodide of potassium, a small ulcer should be excised—the operation is so trifling. If there is any doubt about the nature of a larger mass, a portion should be excised for examination.

Treatment.—All epitheliomata, in which it appears possible to remove the whole of the disease, local and glandular, by an operation which the patient seems likely to survive, should be removed without delay by knife or scissors. As a general rule, the lymphatic glands supplied from the seat of disease, and, if possible, the tissue between them and the lesion, should also be removed. If no glands can be felt, and the patient is intelligent and likely to keep under observation, it may be permissible to wait and watch carefully the submaxillary region; but under other circumstances it will be best to remove the glands nearest to the disease. When there is no hope of removing all the mischief, it is still often right to remove that part which lies in the mouth, to relieve pain and the suffering which a cleanly patient undergoes on account of the foul state of the part. Excision of half an inch of the lingual nerve has been performed to relieve pain, and ligature of a lingual artery to check hæmorrhage. The treatment of incurable cases consists in the administration of anodynes in doses sufficient to give relief; in the use of antiseptic washes and powders for the mouth; and in careful feeding.

5. **Cysts.**—In addition to the rare lingual dermoids described under Mouth, Diseases of: 4, and the parasitic cysts (*Cysticercus cellulosæ*, extremely rare; and *echinococcus*, rare), cysts from dilatation of a mucous gland are sometimes met with, and at any age. They are most common where the mucous glands are largest and most numerous—behind the circumvallate papillæ, but they may occur elsewhere in the tongue. They form tense, elastic, circumscribed swellings, sometimes pushing their way into the tongue, at other times projecting sufficiently from the surface to render it evident that they are translucent. They cause no pain, and the mucosa over them is normal or simply stretched.

Diagnosis.—When a cyst is prominent, the diagnosis presents no difficulty except from chronic abscess, which generally occurs in the anterior part of the tongue, and is never translucent. A puncture will decide. When it lies deep and far back, it may be difficult to be sure even that the mass is fluid; the situation, elasticity, and smoothness of surface of the swelling will always suggest a mucous cyst, and here, again, a puncture will prove its nature.

Treatment.—This consists in application of cocaine to the surface, and excision of part of the wall. The interior should be touched over with pure carbolic acid.

6. **Hypertrophy.** — Synon.: *Macroglossia*; *Prolapsus Linguæ.*—Hypertrophy of the tongue is generally congenital; sometimes it follows an attack of inflammation. The enlargement seems to be due to blocking of the lymph-paths; the lips are sometimes similarly affected (*macrocheilia*). In the congenital cases it is often complicated with imbecility or idiocy. The enlargement of the tongue may not be evident at birth. At

first the enlarged organ has a normal appearance; but usually it becomes too large for the mouth, and part is constantly or frequently prolapsed. Gradually, from exposure to the air and constant irritation, the mucosa becomes dry, thick, and callous, or covered with a slimy secretion; the papillæ enlarge greatly. After a time, the pressure of the teeth acts as a line of constriction, and the protruding portion swells from mechanical congestion. The surface of the tongue becomes bluish or brown; the mucosa roughened and cracked; there is a tendency to ulceration and hæmorrhage; the muscles become palsied, and are unable to retract the organ. As time goes on, the lower jaw is pressed down by the superincumbent weight, and occasionally this goes so far as to produce dislocation. The teeth project forwards, the lips are everted, and there is a constant flow of saliva from the mouth. Altogether, the patient's appearance is most unsightly, and his condition very distressing; for with such a tongue mastication and deglutition are difficult, and speech is thick and indistinct.

TREATMENT.—The redundant part of the tongue must be removed by a V-incision, and the wound sutured.

7. Inflammation.—SYNON.: *Glossitis.*—Occasionally the surface of the tongue is covered by a crop of vesicles—a kind of herpetic eruption—and this without affecting the deeper structures. At other times the whole substance of the organ becomes acutely inflamed.

ÆTIOLOGY.—Fifty years ago by far the most common cause of acute interstitial glossitis was the excessive use of mercury, happily now seldom seen. Now it usually arises from 'taking cold.' Sometimes it is due to septic wounds, to wasp-stings, or to taking putrid, corrosive, or acrid substances into the mouth; it may arise in the course of fevers or eruptive diseases, or sometimes without any assignable cause.

SYMPTOMS.—The earliest symptoms of mercurial glossitis, which may be taken as typical, are a foul metallic taste, peculiarly offensive breath, and a red line along the gums, at their junction with the teeth. The gums are tender, spongy, and apt to bleed. As the case advances, the gums, the tongue, and the inside of the lips and cheeks become much swollen. The tongue is sometimes so large as to protrude constantly from the mouth. At its edges it becomes deeply marked by the teeth, and it and the cheeks and gums often ulcerate. The flow of saliva is incessant; the salivary glands are swollen and painful; the teeth ache and become loose, but seldom drop out. The pulse and respiration are hurried. There is great thirst, but the patient has difficulty in swallowing; and he is wholly unable to speak. As a rule, this state of things subsides under proper treatment, but occasionally pus forms in the substance of the tongue, or it may become ulcerated or even gangrenous.

In the acute spontaneous form, the swelling and hardening of the tongue are greater than in the mercurial, and all the symptoms are more severe; the mercurial fœtor is absent. There is a greater tendency to suppuration, localised or diffuse, and to sloughing of more or less of the organ. The fever is often marked. Sometimes the swelling is chiefly at the base of the tongue, though the anterior less swollen part is pushed out of the mouth. Abscess is probable in these cases, and the difficulty in breathing is great.

TREATMENT.—In acute inflammation of the substance of the tongue, two long incisions going through the mucosa may be needed if the symptoms are urgent. But generally milder measures will suffice, for instance, a saline purgative, or half a drop or a drop of croton oil, together with a mustard-plaster to the throat, and a suitable mouth-wash. As a wash, while the inflammation is at its height, there is nothing better than warm borax lotion. Subsequently, a lotion of alum or chlorate of potassium may be employed. At the same time ammonia, iron, quinine, or bark should be given. If an abscess form far back in the tongue, and if it can be localised by special swelling, tenderness, and softness, it should be opened. If pus is set free, the patient experiences immediate relief.

8. Leucoma.—SYNON.: *Leukoplakia Linguæ et Buccalis*; *Ichthyosis Linguæ*; Hairy Tongue; Smooth Red Tongue; Tylosis.

DEFINITION.—These names have been applied to the results of a chronic superficial inflammation (probably) of the mucosa, resulting now in a white patch or patches; now in hypertrophy of the papillæ, giving the tongue a warty or hairy appearance; again in a swollen, smooth red surface.

ÆTIOLOGY.—Nothing is certainly known on this point. Mechanical irritation, hot spices and food, ardent spirits, smoking, syphilis, gout, and various forms of dyspepsia are all regarded as causes of this condition. It is rare among women and, under twenty, among men. It does not begin after sixty. It occurs on the lingual mucosa chiefly; to a much less extent on the buccal. It is said not to occur behind the circumvallate papillæ.

DESCRIPTION.—The commonest form is that known as *leukoplakia*. Blue or yellow-white patches (leucomata) form, oval or irregular in outline, smooth on the surface, and showing some degree of resistance when pinched between the fingers. There may be but one such patch. Usually there are no symptoms; sometimes the patches are irritable, casting their epithelial scales, and prone to form fissures and ulcers. With irritability there is more or less ptyalism.

A much rarer form is that known as *ichthyosis*, in which the papillæ are much hypertrophied and covered with horny epithelium. When the filiform papillæ have been specially hypertrophied, the name *hairy tongue* has been given. Lastly, the tongue in some cases becomes smooth, red, and slightly swollen, very sensitive and irritable, and liable to fissures or ulcers.

Prognosis.—Once the disease is established, treatment avails but little as a rule. The danger of the trouble is that it tends in all forms to pass on into epithelioma; induration at the base, ulceration, or warty outgrowth being the signs to be watched for.

Treatment.—Every source of irritation must be removed, and any constitutional defect treated, in the hope that good may come. Borax and glycerine lotion, solution of bicarbonate of sodium (grs. xx ad ℥j), or chromic acid (gr. i–ij ad ℥j), may be used as a mouth-wash after meals. Honey of borax, bicyanide of mercury (grs. ij–iv ad ℥j) chromic acid (grs. v–x ad ℥j), or salicylic acid (a saturated watery solution) may be applied directly over the dried part. On no account should irritant or caustic substances be used.

A single obstinate patch may be excised under cocaine. A developing epithelioma will require prompt excision.

9. Parasitic Affections. — The most important parasite connected with the tongue is the *Oïdium albicans*, which is present in thrush (*see* Mouth, Diseases of). *Hydatid cysts* are occasionally met with; and so is the *Cysticercus cellulosæ*. Among the nematodes the *Guinea worm* (*Dracunculus* or *Filaria medinensis*) and the *Trichina spiralis* have been found. The dracunculus may give rise to an abscess, which will require to be opened; and hydatid cysts may have to be excised.

10. Syphilitic Affections. — These form five-ninths of all the lesions of the tongue which come under our notice. Primary sores are occasionally seen in this situation, but their occurrence is so rare that we need only mention them. For the sake of clearness, it is well to arrange these syphilitic affections into four classes: (*A*) *Superficial Ulcerations*; (*B*) *Mucous Tubercles*; (*C*) *Gummata and Deep Ulcerations*; and (*D*) *Chronic Morbid States of the Mucous Membrane.*

A. Superficial Ulcerations.—Slight superficial ulcerations of the tongue are very common in what is called the secondary stage of syphilis. They are usually situated on the sides, tip, and under-surface of the free portion of the organ; and are often associated with similar ulcerations upon the inside of the cheeks, the lips, and the angles of the mouth. They begin in small inflamed spots, and spread into linear cracks and fissures (rhagades). These are exquisitely sensitive; and, as it is very difficult to keep the tongue at rest, are a source of constant suffering. When these ulcerations heal, whitish scars and cicatrices are left, which are very persistent, and resemble leukoplakial patches.

B. Mucous Tubercles.—Mucous tubercles, when they occur on the tongue, are generally met with about the sides and under-surface of the organ; on the fold of mucosa that is reflected to the floor of the mouth; or on one side of the raphé far back. They occur in the early years of the disease.

C. Gummata and Deep Ulcerations.—Gummata are common in the tongue, varying in size, when they come under notice, from a pea to a marble. Not uncommonly they are multiple, or the principal mass may be set in a diffuse infiltration of the tongue. As a gumma enlarges and softens, the mucosa over it becomes red and smooth, and ultimately it gives way. A ragged opening is thus formed, through which fluid escapes, and adherent slough protrudes. The edges are irregular, thin, and flexible; the walls are not indurated; the opening gapes in certain portions of the tongue. The cavity may heal, or may remain for an indefinite time if no treatment is adopted, and some induration of the walls may supervene. It is in these chronic cases that downgrowth of epithelium (epithelioma) sometimes takes place. So long as a gumma is unbroken, there is strong hope that treatment will cause its absorption. After this, no trace of it may be left upon the surface; but when a gumma has burst, a fissure-like scar results from its healing, and there is more or less induration about it. Sometimes, though rarely, a tongue becomes generally fibroid from the development of gumma-tissue throughout (*chronic interstitial glossitis*). A tongue may thus become deeply and irregularly scarred, enlarged or diminished in size, or much deformed, by alternating contraction and swelling; whilst the mucosa presents, perhaps, patches of normal appearance, white or yellow scars with thickened epidermis, red areas where irritation is still active, and bluish surfaces indicating mechanical congestion from scar-contraction.

D. Chronic Syphilitic Disease.—Various morbid conditions of the mucosa of the tongue are often seen in association with the later stages of syphilis. Sometimes circumscribed patches of the epithelium become dead-white, and drop off, leaving a red raw surface beneath. The epithelium is speedily restored, but another patch becomes affected in a similar manner, and so the disease continues — one patch healing and another desquamating. This is the proper *psoriasis linguæ*. Again, there is a much more extensive disease, to which the name *chronic superficial glossitis* has been given. At the commencement some portions of the membrane present their natural appearance, while others are of a deep red colour and raw-looking. These patches are often oval or oblong. Their surface is smooth and glossy. They are either entirely denuded of epithelium, or this is reduced to an extremely thin layer, and the papillæ are obliterated by distension. These patches are slightly elevated and hard to the touch, in consequence of interstitial thickening. The tongue is swollen. At its edges it takes the impression of the teeth, and the lines thus produced are prone to ulcerate. Sometimes the whole organ has a bluish, congested hue. The mucous secretion all over the affected part is viscid and glairy, giving the organ a peculiar, smooth, glazed appearance; and sometimes the patient's breath is so fœtid that he is offensive to himself and to all about him. He complains of thirst; his mouth is parched, especially at night; and when he wakes in the morning his tongue feels dry and chipped. The disease is, in fact, a chronic glossitis, limited to the mucous membrane. If the more active mischief is checked, the swelling subsides, but the membrane never resumes its healthy character. The patches that have been affected remain smooth and shining. The papillary structure has been impaired, and what is left is in fact cicatricial tissue, a tissue which is sensitive to the contact of hot, acid, or pungent substances, and apt to inflame easily. At a later date, portions of this cicatricial membrane become more completely fibrous, presenting a whitish appearance, and being callous to the touch.

TREATMENT.—In the treatment of all of these affections it is important to look to the general health of the patient; to see that he smokes little or not at all—any smoke reaching the mouth should be cool; to forbid alcohol, or allow it only in dilute forms; and to order a simple, nourishing diet, from which hot spices and condiments should be excluded.

Mucous tubercles and small ulcers of the secondary stage require a mercurial course. Drying the lesions and painting them once or twice daily with a solution of the bicyanide of mercury (grs. ij–viij ad ℥j) is helpful.

Gummata and gummatous infiltrations disappear most quickly under iodide of potassium. With this, if the gummata are appearing early, or if the patient has never been satisfactorily treated with mercury, or, again, if the iodide does not act quickly, a little mercury should be given. Broken gummata should be treated with a borax wash used frequently, and dusted twice daily, after food and subsequent washing of the mouth, with a powder composed of grey powder, iodoform, and starch in equal parts.

The treatment of chronic superficial glossitis is far from satisfactory. The first object should be to improve the digestion, and to regulate the general health. When there is much superficial soreness, a mouth-wash of borax and glycerine, bismuth and glycerine, or chlorate of potassium, should be ordered. The patches may be painted with a non-irritating mercurial lotion. Irritants should never be used, in view of the danger that these cases may develop epithelioma. The treatment too often consists in combating soreness and irritation, and in watching for increasing induration, indicating the downgrowth of epithelium.

11. **Tongue-tie.**—The tongue is said to be 'tied' when the frænum is either too short or comes farther forward than it should, and thus restrains the movements of the tip, which often seems slightly bifid. The infant cannot put out its tongue, or use it in sucking; and, if allowed to remain, the defect interferes with speech.

TREATMENT.—Operative interference is required, as follows: Place the child with its head on the nurse's knees, towards the surgeon; raise the tip of the tongue and stretch the frænum with the left forefinger, and snip through the thin part of the frænum with scissors, which will, naturally, be pointed downwards, parallel to the ranine veins. A little pressure down and back into the wound with the left forefinger will still further free the tongue. Mothers often suppose that their children are tongue-tied when, in truth, they are only backward in speaking; so the surgeon should form his own opinion before operating.

12. **Tubercular Ulceration.** — This may be either primary or secondary; the former is very rare. The latter is secondary to laryngeal or pulmonary tuberculosis, suggesting the possibility of auto-inoculation.

DESCRIPTION. — Tubercular ulcers of the tongue are much more common in men than in women. They occur at all ages, are not uncommonly multiple, and rarely reach a large size (one inch square) or a great depth (quarter inch). They are most frequent upon the tip and edge adjacent, then upon the dorsum, and then underneath the free part. They begin as small nodules in the mucosa, which ulcerate, exposing a greyish or yellowish slough. Cheesy stuff may be seen on the surface. If the extension is slow, the edge becomes somewhat raised and rounded, the floor is formed of pale granulations, and the surrounding parts are little or not at all œdematous. There is little or no induration. The edges are redder than the surrounding parts. When the spread is rapid, the edge is thin and ragged, often undermined; the base may be sloughy, or the structure of the eroded tissue may be clear; there is no induration. The symptoms are soreness, sensitiveness, and more or less ptyalism; when advanced, the ulcers may be very painful. The lymphatic glands may enlarge, but this is by no means constant. Microscopically, they present all the characteristics of a tubercular ulcer.

Diagnosis.—Many tubercular ulcers have been excised as malignant—a mistake of little consequence. From gummatous ulcers, the history of syphilis, the position on the dorsum, the depth and thin ragged edges of gummatous ulcers, the absence of tubercle bacilli in them, and the effects of treatment, are the chief points of distinction.

Prognosis.—A small tubercular ulcer may heal, but only to break out again. They probably always prove fatal; or rather, after suffering much from the ulcer, the patient dies from disease of the larynx or lungs.

Treatment.—If the ulcer is primary, or if the primary disease of lung or larynx is early, the ulcer may be destroyed with sharp spoons or the cautery; or a wedge excised, and the sides sewn up. If the primary disease is advanced, and the ulcer is not painful, iodoform and starch in equal parts may be applied after food. If there is much suffering, something operative might be done under cocaine.

13. **Tumours.**—The mucous membrane of the tongue is occasionally the seat of simple warts; and fatty, fibrous, cartilaginous, bony, and nævoid growths have more or less rarely been removed from this situation. They are sometimes deep in the tongue-substance, or more or less polypoid. Sarcoma is almost unknown; cancer is *the* tumour of the tongue.

Treatment.—Small warts may be dried and touched with 30 per cent. solution of chromic acid till they shrivel and fall off; or they may be snipped off, under cocaine, together with the mucosa whence they spring. Larger masses require excision under an anæsthetic. The other tumours mentioned all require excision.

14. **Ulceration.**—Ulcers of the tongue are best classified according to their causes, so far as we know them. We thus get the following groups: *simple*, *tubercular*, *syphilitic*, and *cancerous*. Under the heading 'simple' we include *traumatic*, *dyspeptic*, and *aphthous* ulcers, and the sores on the tongue which form in non-specific leukoplakia, or in ulcerative and mercurial stomatitis. Only the traumatic and dyspeptic ulcers remain undescribed; for the other varieties reference may be made to the special sections.

Traumatic ulcers may be due to injuries of all kinds, but the injury caused by teeth often leads to an ulcer difficult to recognise. A sharp tooth or tooth-plate, though constantly present, does not irritate equally at all times, but more (it is supposed) in dyspeptic or depressed states. The ulcer at first has the characteristics of a small spreading ulcer—sloughy or bright red base, sharp-cut low margins, more or less œdematous surroundings. It is irritable and painful. After weeks or months, the base becomes paler, the margins thicker and rounder, and more or less indefinite induration of the base appears. Naturally, the seat of these ulcers is almost invariably the edge or tip. In their diagnosis, the relation to an irritant, the absence of a history of syphilis or tubercle, the absence of cancerous induration, and the effect of removal of the cause and subsequent treatment, are the chief points.

Dyspeptic ulcers are apt to occur in ill-fed children, and also in adults who habitually eat and drink freely. Such ulcers are generally situated upon the sides or upper surface near the tip; but not infrequently they are on the frænum. They are encircled by an inflamed margin; shallow; their bases being flat and covered with a greyish slough. They are very sensitive to the touch, and painful when the organ is moved. Sometimes there is offensive discharge, with a good deal of swelling of the sublingual and submaxillary glands.

Treatment.—Defects of digestion must be attended to; a cholagogue purge is often a good beginning. The mouth should be kept scrupulously clean, and all sources of mechanical irritation removed. Honey of borax should be used frequently; and the ulcers painted with chromic acid solution (grs. v–x to ℥j) every two or three days.

Stanley Boyd.

TONIC (τόνος, tension).—A distinctive term used in reference to the nature of spasms, which are usually divided into two classes, namely, *tonic spasms* and *clonic spasms*; the former being those in which the muscles concerned remain in a state of continuous rather than in one of intermittent contraction or clonic spasm. *See* Spasm.

TONICS (τόνος, tension, tone).—Synon.: Fr. *Toniques*; Ger. *Tonische Mittel*.

Definition. — Therapeutic agents which impart permanent strength to the body or its parts.

Enumeration.—Amongst the most typical medicinal tonics, which impart a feeling of strength, are Iron, Nux Vomica, Quinine, and Vegetable Bitters. As the strength of the body generally depends on the proper action of its various parts, tonics have been subdivided into those which have an especial action on the blood-circulation, digestion, and nervous system.

1. **Blood Tonics.**—Cod-liver oil and other fats, and iron and its salts, are the most important of this group of tonic remedies. Perhaps also phosphate and hypophosphite of calcium, salts of potassium and sodium, arsenic, and phosphorus should be included. Light, fresh air, good food, bathing, and exercise are valuable adjuncts.

2. **Cardio-vascular Tonics.**—The principal vascular tonics are Nux Vomica and Strychnine, Digitalis, Strophanthus, Erythrophleum, Squill, and Caffeine. The local application of warmth and cold, friction, and massage increase the effect of these medicines.

3. **Gastric Tonics.**—Small doses of Sulphuric, Nitric, Hydrochloric, and Phosphoric Acids, small doses of Arsenic, Alum, Bismuth, Copper, Silver or Zinc, Aloes, Bitter Beer, Chamomile, Cinchona, Cusparia, Cascarilla, Calumba, Hops, Gentian, Orange and Lemon Peel, Quassia, Rhubarb, Strychnine, and Vegetable Bitters generally, all impart vigour to the gastric function. Valuable adjuncts are pepsin and hydrochloric acid.

4. **Intestinal Tonics.**—These are chiefly Nux Vomica, Belladonna, Rhubarb, the Mineral Acids and Metallic Salts just mentioned, and astringents.

5. **Nervine Tonics.**—Nux Vomica and Strychnine, Cinchona and its alkaloids, Coca, Phosphorus, Arsenic and its compounds, salts of Iron, Zinc, Copper, and Silver, are all included under this head. The tonics which act especially on other parts of the system increase also the power of the nervous system, and act indirectly as nervous tonics.

ACTION. — The derivation of the word 'tonics' indicates the nature of their action. When a person feels limp and weak, and unfit for exertion, like a relaxed bowstring, tonics restore the energy and strength, and render him again fit for work, like, as it were, a re-tightened bow. The exact mode in which tonics act is not yet perfectly ascertained, but in all probability they increase the functions of the different parts of the body by aiding tissue-change, either by increased nutrition, increased tissue-metabolism, more rapid removal of waste, or possibly by all three taken together.

USES.—Tonics are employed in conditions of debility, either of the body generally or of its different parts, the selection of each depending upon the part of the body affected.

In cases where the malnutrition of the body appears to be dependent on the want of the proper constituents of the blood, as in anæmia, struma, or general debility, without any affection of a particular organ, *blood tonics*, including iron, cod-liver oil, phosphates, and hypophosphites are employed; and these are also useful where impoverishment of the blood is due to a definite constitutional disease, such as phthisis, or Bright's disease. In pernicious anæmia phosphorus or arsenic may be used. Where enfeeblement of the stomach appears to be present, as shown by loss of appetite and such signs of imperfect digestion as flatulence, weight, and pain after eating, *gastric tonics* are used. Should its muscular coat be feeble or inactive, as shown by tendency to dilatation, and splashing of the contents on movement, strychnine is especially indicated, and galvanism or systematic kneading may be also employed. Where the stomach is too debilitated to respond sufficiently to this form of treatment, as after long-continued gastric catarrh, or in old age, its work must be partly done for it, and then such substances as hydrochloric acid and pepsin are useful. When the muscular movements of the intestine are sluggish, as indicated by constipation, and by a tendency to the distension of the bowel with gas, nux vomica and belladonna may be given; and when its mucous membrane appears to be relaxed and flabby, and secreting too profusely, the mineral acids, astringents, and metallic salts may be of much service. When the pulse is soft and feeble, and there is a tendency to vascular dilatation, either general or local, as shown by local congestion and œdema of dependent parts, or by drowsiness in the upright position and sleeplessness in the recumbent posture, *vascular tonics* are serviceable. *Nervine tonics* are used where the nervous functions are imperfectly performed, as shown by dulness, loss of memory, incapacity for work, languor, or tendency to spasm, as in chorea, and also in paralysis. As the functions of this system depend very greatly upon the quality of the blood with which the nervous system is supplied, and on the rapidity of the circulation, the other tonics frequently require to be given in addition to nervous tonics.

In administering tonics, care should always be taken to ascertain that the case is suitable, for in very many cases of apparent debility the imperfect functional activity of the body or of its parts does not depend upon insufficient nutrition, but upon imperfect removal of the products of waste. The proper treatment in these cases is not to give tonics, but to remove the waste products by cholagogues, purgatives, and diuretics.

T. LAUDER BRUNTON.

TONSILS, Diseases of.—SYNON.: Fr. *Maladies des Amygdales*; Ger. *Krankheiten der Mandeln.*

The tonsils, situated between the anterior and posterior pillars of the fauces, are unusually liable to participate in all affections of the throat, both from their peculiar structure and from their position. Thus in that everyday affection, a common cold, the tonsils usually exhibit symptoms of the general catarrh. They are also involved in diphtheria, scarlet fever, and syphilis; they may be the seat of ulcers, or even gangrene; and they may be involved in malignant disease. The following affections demand special notice, namely: (1) Acute Inflammation; (2) Follicular Catarrh; (3) Hypertrophy; and (4) Tonsillar Calculus.

1. **Acute Inflammation.**—SYNON.: Acute Suppurative Tonsillitis; Quinsy; *Cynanche Tonsillaris*; *Amygdalitis*.

ÆTIOLOGY.—This affection is most commonly met with in young persons of rheumatic constitution, during the damp weather of spring and autumn; and one attack is apt to predispose to another. Exposure to damp, cold, and wet is generally regarded as sufficient to excite this disorder.

SYMPTOMS.—Quinsy usually sets in with

fever. The patient becomes restless, irritable, and hot—the temperature in very acute cases rising to 104° or 105°; complains of headache and general weariness; and may become delirious at night, especially if he be young. The tongue is covered with a thick, heavy, yellowish coating; the other symptoms of oral catarrh are present; the breath is unpleasant; and salivation is complained of. The patient loses the power of opening the mouth to any extent; and swallowing is attended with much pain and great difficulty, the food not infrequently returning through the nose. The tone of the voice is altered, becoming thick, guttural, and nasal. The breathing is not, as a rule, impeded, but the patient snores during sleep; and when he is awake, respiration may be noisy. Occasionally he becomes deaf.

The first indication of uneasiness in the throat is a complaint of pricking and dryness in the region of the tonsil, soon passing on to actual soreness; and pain of a dull character, which shoots up towards the ear on the affected side. Externally, behind the angle of the lower jaw, considerable swelling is observed, which is firm, and exceedingly painful to touch. On examination of the parts internally, one tonsil, rarely both, will be found to be greatly swollen, of a deep red colour, perhaps with patches of yellowish secretion adherent to its surface. The soft palate is also greatly swollen, red, œdematous, and falling inwards to the middle of the mouth. The uvula likewise partakes of the general infiltration, and is usually found pushed to the healthy side, and not infrequently adherent to the tonsil.

Course.—This state of matters continues for four or five days, increasing in severity; then it may gradually begin to subside, the inflammation passing off. Usually in ten days to a fortnight the patient is able to resume his employment. Quite as frequent a termination as resolution is suppuration with formation of abscess in the tonsil. In such a case the symptoms are generally aggravated before the formation of the pus, and more decided pain and throbbing are complained of, extending upwards to the ear. The abscess may burst spontaneously and unexpectedly. After the evacuation of the pus, which is often fœtid, convalescence is speedy.

Treatment.—If a case of quinsy be seen at the very outset, an attempt may be made to abort the disease. This, though seldom successful, may be tried by giving an emetic, or by administering tincture of aconite every hour in drop doses; or by drachm doses of the ammoniated tincture of guaiacum, best given in milk; or by 15-grain doses of salol every three hours. Scarification of the tonsils may be tried, afterwards painting them with a fairly strong solution of cocaine. If not seen for two days, or if these abortive measures fail, the patient should be confined to bed; hot poultices or cold compresses kept constantly round the throat; steam inhaled as often as practicable; and gargles of warm milk and water made use of every hour. A brisk saline purgative should be given. Ice, if found grateful, may be allowed at discretion. Such diet as the patient can be persuaded to swallow should be ordered, of course in liquid or rather semisolid form. This can be greatly facilitated by brushing or spraying the affected parts with a 4 to 8 per cent. solution of hydrochlorate of cocaine previous to offering the food. Stimulants, if called for, must be administered. Tonics, such as chlorate of potassium and iron, or quinine and iron, will be needed when convalescence sets in. If an abscess should form, it must be evacuated by means of a well-protected bistoury; and astringent gargles should be made use of for some time after convalescence is established.

2. **Follicular Catarrh.**—The office of the tonsils is to secrete a lubricating fluid to the bolus of food as it passes into the pharynx, as well as to moisten the fauces. Occasionally we meet with cases where this secretion is altered in character or in quantity. And this may be the result either of a simple catarrh of the tonsils; or of acute swelling of the interstitial tissue of the gland, compressing the follicles, and thus interfering with the free outflow of the secretion. The appearance of the inflamed tonsil in such a condition is at times mistaken for diphtheria, in consequence of the whitish patches of secretion deposited upon them. In this catarrhal affection it will be observed that there is no tendency to the formation of a true membrane as in diphtheria. The deposit assumes a pultaceous form, is readily removed, its borders are well-defined, and it is seen to proceed from the follicles of the tonsil. Occasionally this affection appears to be contagious, and to attack one member of a family after another. In such case examination of the contents of the crypts of the tonsils has revealed the presence of the Staphylococcus or Streptococcus pyogenes, which is probably the infectious organism. The symptoms include fever, with considerable pyrexia in children; local pain; and dysphagia.

Treatment.—The parts should be brushed with equal parts of boroglyceride and glycerine, after cleansing the throat with a warm solution of salicylate of sodium, 20 grains to the ounce of water. Internally 10-grain doses of benzoate of sodium may be given every hour and a-half. The patient should also cautiously suck compressed tabloids of chlorate of potassium and borax, or 5-grain tabloids of salol. Some iron tonic will probably be called for later.

3. **Hypertrophy.**—This condition of the tonsils is met with both in the young and in

the adult. In the former, there seems to be an hereditary tendency in some families, the tonsils becoming immensely large even as early as the second year. In such there is occasionally some scrofulous habit of body. In the adult this condition is more frequently the result of repeated angina, which induces a permanent thickening of the tissues of the tonsils, whereby the secretion, no longer finding free exit, distends the follicles, thus setting up a low form of inflammation, which results in hypertrophy of the gland. This condition is free from pain. When the interstitial tissue becomes much thickened and indurated, there occurs what is sometimes described as 'scirrhus' of the tonsil. The symptoms indicative of hypertrophy are snoring during sleep; obstruction to the breathing, in consequence of which the mouth is always open night and day; slight impediment to swallowing, with a sense of something permanently needing to be swallowed; some degree of deafness; and thickness of voice or snuffling. These are all greatly aggravated when catarrh is superadded; and persons having enlarged tonsils are specially liable to attacks of acute inflammation, and to severe throat-symptoms, when any disorder overtakes them, in which the throat is more than ordinarily the point where the disease centres itself, for example, scarlet fever.

TREATMENT.—The treatment of enlarged tonsils in scrofulous children consists in plentiful nourishment, cod-liver oil, iodide of iron, and other drugs of which iodine forms the chief constituent. The bromides of ammonium and potassium also enjoy the reputation of reducing enlarged tonsils. Locally, they should be treated with iodine dissolved in glycerine, or with the simple tincture, every other day. Bicarbonate of sodium applied locally is occasionally useful. They should not be removed in children under the age of puberty, as frequently after that period they decrease spontaneously. In adults, if they cause much inconvenience, they should be excised or treated by ignipuncture, the thermo-cautery being thrust into each crypt. In this way all risk of hæmorrhage is obviated.

4. Tonsillar Calculus.—When two or three neighbouring follicles of a tonsil, as well as the interstitial tissue, are destroyed, the cavity thereby created pours out a greatly altered secretion, the product varying in consistence from a creamy pulp up to a calcareous deposit, of a white or yellow colour. This, on examination, has been found to consist of the phosphate, carbonate, and oxalate of calcium, albumin, and other animal matter. Some authors regard these calculi as the 'resolution of tuberculous deposits in the tonsils, which subsequently give rise to inflammation, suppuration, and ejection.'

CLAUD MUIRHEAD.

TOOTHACHE.—SYNON.: Fr. *Odontalgie*; *Mal de Dents*; Ger. *Zahnweh*.—Pain in connexion with the teeth. *See* TEETH, Diseases of.

TOOTH-RASH.—*See* DENTITION, Disorders of.

TOPHUS (*tophus*, a stone).—A term associated with the concretions, consisting chiefly of sodium biurate, which are met with in gout, in connexion with the joints and other structures. It is also sometimes applied to gravel in the urine, and to the collection of tartar on the teeth. *See* GOUT.

TOPICAL (*τόπος*, a place).—*See* LOCAL.

TORMINA (Lat. griping).—This word is applied to severe griping or colicky pains in the abdomen, due to flatus and other causes. *See* COLIC; COLIC, INTESTINAL; DYSENTERY; and INTESTINES, Diseases of.

TORPOR (Lat. numbness).—SYNON.: Fr. *Torpeur*; Ger. *Torpidität*.—A condition of inactivity, bodily and mental, which may be met with in certain cerebral diseases or febrile states, more especially in aged persons. The cerebral condition associated with torpor is an unnatural state of consciousness, closely allied to that known as stupor. *See* CONSCIOUSNESS, Disorders of.

TORQUAY, in South Devonshire.—A mild, rather relaxing, and sedative marine climate. Sheltered from W., N., and E. winds. Mean winter temperature 44° F. *See* CLIMATE, Treatment of Disease by.

TORSION (*torqueo*, I twist).—This word signifies a twisting, and is used in medical literature in the following associations:—

1. In relation to certain organs or growths, it indicates a form of displacement in which the mass is twisted on itself, a condition especially noticed in connexion with the intestines. It gives rise to more or less narrowing of canals, and may close them completely, so as to cause absolute obstruction. Torsion also interferes with the local circulation, thus leading to congestion, inflammation, or ultimately even to gangrene of organs or tumours. *See* INTESTINAL OBSTRUCTION.

2. As a method of treatment, torsion is employed in checking arterial hæmorrhage, the ends of the bleeding artery being seized by the aid of suitable forceps, and twisted. It is chiefly used in bleeding from small arteries, but may prove efficient even when arteries of some size are the source of the hæmorrhage.

FREDERICK T. ROBERTS.

TORTICOLLIS (*tortum*, twisted; and *collum*, the neck).—A synonym for wry-neck. *See* WRY-NECK.

TORULA.—Description.—Torula is a form of microscopic fungus, belonging to the group *Saccharomycetes.* It consists of round or ovoid cells, of an average diameter of about $\frac{1}{3000}$ inch, without nuclei, but composed of masses of vacuolated protoplasm, confined within a definite cell-wall. Occasionally they are free, but they are frequently associated into branching chains. *See* Microscope in Medicine.

Vinous, acetous, and other fermentations are due to the presence of organisms, of which the 'yeast plant,' *Mycoderma* or *Torula cerevisiæ*, is the best known. Certain varieties of torula are of constant occurrence in the alimentary canal, and would seem to be normally associated with intestinal digestion. In those cases of vomiting where the ejected matters ferment, torulæ are always to be found, together with sarcinæ. These bodies are also of frequent occurrence in the urine of diabetes mellitus, if left standing; but they have likewise been found in non-saccharine urine. The pathological significance of torula, if any, is not known.

W. H. Allchin.

TOUCH, Disorders of.—Synon.: Fr. *Troubles du Tact*; Ger. *Störungen des Tastsinnes.*—The sense of touch may be considered as a compound of four distinct senses, namely, those of contact, pain, temperature, and muscular activity; and it is not necessary that all of these should be affected simultaneously or in an equal degree. Sometimes but one is the seat of disorder, and occasionally only one escapes. The lesion producing tactile disorder may be in any part of the sensory apparatus—in the peripheral end-organ in the skin, which receives impressions, in the trunk of the nerve which conveys them, or in the central ganglion, the reaction in which is represented in consciousness as feeling. For the most part disorders of touch must consist either in a defective or in an unnaturally heightened reaction to impressions—conditions which are termed respectively *anæsthesia* and *hyperæsthesia.* But there are besides certain abnormalities of sensation which cannot be referred to either of these categories, as, for example, when a touch causes a sensation of burning, or the electric current is felt as something cold, and in these circumstances the term *paræsthesia* is used.

1. Increased Sensibility. — Description.—It is doubtful whether the sense of touch proper, the power of tactile discrimination, is ever morbidly *increased*, except possibly in certain cases of hysteria and mental disorder. The term *hyperæsthesia* would be properly applied to such a condition instead of, as it is more commonly used, to excess of sensibility to painful impressions, which is perhaps better called *hyperalgesia.* In cutaneous *hyperalgesia* even a light touch upon the skin produces more or less exquisite pain. The patient often cannot even wash the skin, which is described as feeling raw or sore to the touch. The symptom frequently occurs in connexion with neuralgia (especially of the trigeminal nerve), and in hysteria, as well as in the various forms of local inflammation. It may precede by some days the characteristic pains of neuralgia; is often associated with excess of sensibility to heat and cold; and usually with diminution of sensibility of the tactile sense proper. It is seen in its severest form in connexion with gunshot injuries of nerves.

There may be heightened sensibility to *temperature*, either as regards heat or cold singly, or in respect to both at the same time. This symptom is observed in connexion both with peripheral and central disease—as an accompaniment of neuritis, as well as of degenerative changes in the cord or cerebral ganglia. It is often, but not always, associated with *hyperalgesia.*

Heightening of the sense of *contact* is rarely observed, and is of but little practical importance. Perhaps the condition known as 'fidgets' is best explained as depending upon a heightened sense of *muscular activity.*

Treatment.—So far as is practicable, the lesion which is the cause of hyperalgesia, whether peripheral or central, must be discovered and become the subject of treatment. But the symptom itself may be mitigated by appropriate means. Such are the local application of moist heat by fomentation or poultice; of cold, by means of ice; or of anodynes, such as veratrine ointment somewhat diluted, or atropine ointment; or the hypodermic injection of morphine (gr. $\frac{1}{10}$ to gr. $\frac{1}{6}$). Spongiopiline may be sprinkled with a liniment composed of chloroform one part and belladonna liniment three parts; or equal parts of ether, sal volatile, laudanum, and eau de Cologne may be applied. A piece of lint soaked in chloroform may be laid upon the painful portion of skin and covered with oiled silk, or the part may be rubbed with camphor-chloral and vaseline, equal parts; or painted with amyl-colloid. The application of one pole of the continuous current to the hyperalgesic spots, whilst the other is placed on an indifferent part, will often be of service, the power of bearing a gradually increased strength showing the improvement produced. Hysterical hyperalgesia can sometimes be successfully treated by the application of a strong induced current, by means of the wire brush, the patient, if necessary, being placed under the influence of ether.

2. Defective Sensibility. — Description.—Cutaneous anæsthesia may result from local abstraction of heat, as from exposure to a very low temperature. In such a case anæmia is produced, from spastic contraction of blood-vessels, followed by hyperæmia from their secondary relaxation. In the anæmic stage, whilst the other tactile sensations are lowered, that of temperature is heightened. Deficient sensibility may be caused by irritating applications, such as soda used by laundresses, and various chemicals employed in the arts. In such cases there is numbness in the hands and forearms, with a sensation of 'going to sleep' in the fingers. It may occur in connexion with *herpes zoster*, the skin between the groups of vesicles being often partially anæsthetic. In *lepra anæsthetica*, in which there are enlargements of the cutaneous nerves, the senses of temperature and pain are often abolished, and severe burns may take place without being recognised. Anæsthesia may be produced by pressure upon sensory or mixed nerves, by syphilitic and other growths in adjacent tissues. Narcotics, as chloroform and ether, may quell the sense of pain, that of contact being, to a certain extent, retained. Wounds and lacerations of the sensory or mixed nerves, followed by inflammatory processes, may, by irritating, cause pain to precede the anæsthesia arising from the interruption of conductivity in the nerve-fibres. Simple mechanical pressure upon a nerve, if long continued, will often, especially if its nutrition be impaired by constitutional causes, excite a low inflammatory condition. In traumatic cases, as also in lepra anæsthetica and in cases of new-growths pressing on the nerve, motor and nutritive disturbances are apt to accompany the anæsthesia, the nerve-trunks conveying not only sensory, but also motor, vaso-motor, and trophic fibres. Severe trophic disorder is usually associated with the anæsthesia occasioned by lesion of the fifth nerve; and to a less extent with that accompanying trigeminal neuralgia. *See* FIFTH NERVE, Diseases of.

Preceding attacks of neuralgia, the skin of the part about to be affected is often found to be anæsthetic, and during attacks of sciatica and cervico-brachial neuralgia there is often much diminution of tactile sensibility, severally in the foot and lower part of the leg, and in the fingers; whilst the skin around the eye may be greatly deficient in tactile sensibility during severe supra-orbital neuralgia. It is important to discriminate anæsthesia of the skin caused by diseases of the nervous centres from that which is of peripheral origin.

Cutaneous anæsthesia is occasionally an important symptom of an approaching cerebral hæmorrhage. A sudden and increasing numbness is experienced in one half of the face, or in the limbs on one side of the body, which may be followed shortly by hemiplegia and coma. An apoplectic seizure usually causes unilateral cutaneous anæsthesia, which is at first widely diffused, owing probably to the disturbance of circulation in, and consequent disarrangement of, the nervous molecules, which extends at first far beyond the site of the effusion. A few hours or days usually suffice for the clearing off of the anæsthesia, leaving, however, a subjective feeling of numbness, which may endure for a longer or shorter period.

The extent of anæsthesia bears no necessary relation to the amount of motor paralysis. It usually affects the paralysed side of the body, but in certain cases of hæmorrhage into or other lesion of the medulla oblongata and pons Varolii, it may occupy the opposite side. Complete hemi-anæsthesia of central origin may persist long after the paralysis of motion has disappeared, and in such a case a lesion is likely to be found in the outside of the optic thalamus, involving the internal capsule. Occasionally, too, hemi-anæsthesia may from the first be unaccompanied by motor paralysis. Much more frequently, however, cutaneous anæsthesia (except for the first few hours) is of comparatively slight and transitory character, even in cases where there has been extensive disorganisation of the brain from hæmorrhage or softening, and where the resulting paralysis of the muscles is complete and permanent. Recovery is gradual, and proceeds downwards, the fingers sometimes retaining slight anæsthesia long after the rest of the arm has entirely recovered.

Cerebral tumours may give rise to cutaneous anæsthesia by pressure upon the Gasserian ganglion, or upon the trunk or branches of the fifth nerve as they traverse the floor of the skull. Like the motor paresis or paralysis which may be occasioned at the same time, the loss of sensibility is usually, but not always, gradual, tending to increase rather than to diminish as time goes on. It is not usually a prominent symptom in cerebral abscess.

Lesion of the spinal cord or its membranes may give rise to cutaneous anæsthesia, which is frequently, in the lower extremities, extensive and complete; but it may be absent when—as, for example, in very advanced sclerosis of the antero-lateral columns—there is complete paraplegia. There is a form of progressive disease of the central and posterior grey matter of the spinal cord, giving rise to excavation, in which cutaneous sensibility is apt to be modified in a remarkable manner. The sense of touch, the sense of pressure, as well as the electro-muscular sensibility and the muscular sense, are preserved; but the appreciation of temperature and the sensation of pain (one or both) are lost in many situations. The condition is accompanied by paralysis and various forms of nutritional disturbances (*see* SPINAL CORD, Special Diseases of: 21. Syringomyelia). A varying amount of cutaneous anæsthesia, especially affecting the soles of the feet, is apt to occur in tabes Anæsthesia of spinal origin is usually bilateral; but it is believed to affect that lower extremity alone which is opposite to the one paralysed in its motility, when the causative lesion is limited to one half of the cord. Intercurrent complications from disturbances of circulation, the temperature of the limb, the extension or subsidence of inflammation, and the effusion of inflammatory products about the posterior roots, as well as the spread of sclerotic changes, may cause the extent and completeness of cutaneous anæsthesia to vary considerably in cases dependent upon spinal-cord disease. Where the lesion lies tolerably high up, tickling the soles of the feet, although quite unfelt by the patient, is able to excite the motor nerves, and produce reflex muscular contractions, which the loss of muscular sense prevents him from recognising. It is extremely important to remember that cutaneous anæsthesia of spinal origin is liable to be associated with bedsores. In certain cases, where probably trophic and vaso-motor nerves have been included in the lesion, this liability is excessive, and may defy all precautions.

Anæsthesia is of very frequent occurrence as a result of peripheral neuritis, both in its localised and multiple form. *See* NEURITIS, MULTIPLE.

Loss of the *sense of muscular activity* may occur in an isolated form, the other modes of tactile sensibility being unaffected; or it may be associated with impairment of some or all of them. The symptom is especially notable in progressive locomotor ataxy (*see* TABES DORSALIS). It may also occur in connexion with paresis resulting from coarse disease of the occipital lobe of the cerebrum. Loss of muscular sense may accompany hemiplegia, attended with strongly marked and prolonged anæsthesia, from disease of the optic thalamus. It occurs sometimes in hysteria. There is a form of anæsthesia occasionally met with in hysteria which it is important to recognise, so as not to confound it with a somewhat similar condition resulting from disease of the neighbourhood of the optic thalamus. In this the patient may lose the power of perceiving impressions of contact, temperature, and pain throughout the whole of one lateral half of the body, sharply divided from the sound side by a line passing downwards from the vertex to the os pubis. Accompanying this *hemianæsthesia*, as it is called, there is often amblyopia and colour-blindness of the corresponding eye, loss of taste and smell, together with tenderness on deep pressure over the region of the ovary on the same side. In some cases, too, the skin is unnaturally pale and cold, and pricks with a pin are said to be not followed by bleeding, which readily takes place in corresponding circumstances on the opposite side of the body.

There is a curious form of disturbance of tactile sensation in which, the patient being blindfolded, a point of contact is referred not to its true locality, but either to some part of the opposite limb, or to a distant part of the same member. *See* ALLOCHIRIA.

DIAGNOSIS.—As regards both hyperæsthesia and anæsthesia the most important consideration, after establishing the existence of either, is as to whether the cause be central or peripheral. It is impossible to do more than indicate the general principles upon which this inquiry is to be conducted. The patient's history, the condition of viscera and circulation, the existence or not of accompanying paralysis or of modifications of the organs of special sense, will lend important aid. As a rule, the anæsthesia of central origin is much more widely diffused, though less complete, than that dependent upon lesion of nerve-trunks, when it is also often accompanied with localised atrophy of muscles or other trophic disturbance. It is very rare that hemianæsthesia of central origin is so complete as the hysterical, and it is not accompanied, like the latter, with tenderness on deep pressure over the ovarian region. There is no doubt that hyperæsthesia has often been mistaken for localised inflammation, and treated accordingly. The absence of febrile movement, and the fact that it is mainly upon light surface-touching that the exquisite tenderness occurs, which fails to be felt when deeper pressure is made, coupled with the history, and a study of the concomitant condition, ought to suffice to prevent all mistakes.

TREATMENT.—Anæsthesia is a symptom of a lesion either in the central nervous system or in a peripheral nerve, and its treatment is bound up with that of the disorder which gives rise to it. But there are many cases in which, apparently as a result of disease, the sensory nerves fail to convey impressions for a considerable time after the lesion which interfered with their function has been healed. In such circumstances very much good can often be done by electrical treatment. The skin, carefully dried, should be brushed over for a few minutes every day with the wire brush, connected with an induction machine; or the well-wetted rheophore connected with the negative pole of a continuous-current battery may be slid about over the affected surface, well moistened with hot water.

Static electricity is a valuable means of combating anæsthesia of this kind. The patient, seated on an insulating chair, is connected by a conducting chain with a frictional electrical machine, and sparks are drawn from the affected surface.

3. **Paræsthesia.** — DESCRIPTION. — The varieties in disorder of the different kinds of tactile sensibility—touch, pain, temperature, muscular activity—are very numerous. Pinches or pricks with a needle may be felt as touch only, whilst a very light touch with the finger is appreciated as touch. Strong faradic currents (intolerable to the healthy) may be felt as cold. Heat may be felt as

cold, but kept still longer applied may be recognised as heat or warmth. A limb plunged into hot or cold water may get the feeling, not of heat or cold, but of pain. To such modifications, as well as to feelings of burning or cold, tingling, creeping of ants, or actual numbness, the term *paræsthesia* is often applied. A seamstress may be able to pick up and thread her needle, evincing thereby considerable delicacy of sense of contact, and yet be scarcely able to feel a prick of a needle in the finger-tip. Or the sense of contact may be in abeyance, as well as that of pain and temperature, and the movements may be then guided by the sense of muscular activity, aided by sight. T. BUZZARD.

TOXÆMIA (*τοξικόν*, a poison; and *αἷμα*, blood).—This word literally signifies poisoning of the blood. It is not employed with any very strict or definite meaning, but most commonly implies blood-poisoning due to some pathological condition within the body itself, in contradistinction to that which results from the introduction of the ordinary poisons from without. As illustrations of toxæmic states may be mentioned pyæmia and septicæmia; uræmia; and acetonæmia, upon which, according to some authorities, the comatose condition which precedes the fatal issue in some cases of diabetes mellitus depends. The accumulation of bile in the blood, in cases of jaundice, is another form of toxæmia. The morbific agents which produce the several infectious and malarial fevers are regarded by many as originating toxæmic conditions; as are also those which cause such affections as gout and rheumatism. Ptomaïne-poisoning may be likewise mentioned in this connexion. These subjects will be found discussed under their several headings.

FREDERICK T. ROBERTS.

TRACHEA, Diseases of.—SYNON.: Fr. *Maladies de la Trachée*; Ger. *Krankheiten der Luftröhre.*—The trachea is but little prone to disease, except in association with affections of the larynx, bronchi, and neighbouring parts. The diagnosis and treatment of these several diseases is greatly facilitated by the laryngoscope. With this instrument a skilful manipulator can in many cases examine the trachea in its whole length; and an accurate diagnosis being thus attained, remedies may be applied, and instruments may be introduced for the removal or destruction of growths, or for other purposes, either through the larynx, or by an artificial opening made in the trachea. The principal morbid affections of the trachea will be discussed in the following order: (1) Malformations; (2) Inflammation; (3) Ulceration and Perforation; (4) Syphilis; (5) Tuberculosis; (6) Tumours; (7) Stenosis; and (8) Foreign Bodies.

1. **Malformations.**—Defects in the development of the trachea occur as rare causes of the death of newly born infants. The tube may be short and imperforate; or communication may exist with the œsophagus. These conditions are necessarily fatal. A fistulous opening through the skin occasionally occurs, giving rise to no serious symptoms. *Tracheocele*, a hernia of the mucous lining of the trachea, is a rare malformation, easily recognised, which may arise from a congenital defect, but is more frequently acquired.

2. **Inflammation.**—Tracheitis—simple, specific, or diphtheritic—may result from the extension of inflammation, either from the larynx above, or from the bronchial tubes below; it is rare except in this connexion. Some degree of congestion is a usual condition of ordinary catarrh; and tracheitis is a frequent cause of irritable cough. *See* BRONCHI, Diseases of; DIPHTHERIA; and LARYNX, Diseases of.

3. **Ulceration and Perforation.**—Ulceration and perforation of the walls of the trachea may result from carcinoma of the œsophagus; from the pressure of an aneurysm, which ends by bursting into the air-passages, where it meets with least resistance; or from an abscess which has taken a similar course. In the last case suppuration usually occurs in connexion with a caseous bronchial gland. Occasionally, as witnessed by more than one writer, a caseous gland may become dislodged and impacted in the trachea, causing sudden death by suffocation.

4. **Syphilis.**—Syphilis, in its secondary and tertiary stages, may affect the trachea. In the tertiary stage it gives rise to a localised form of infiltration or syphiloma; and to ulcers, which contract in healing, and cause a formidable condition of stricture, to be presently considered. Tracheal syphilis, being in its advanced form so grave a matter, calls for active constitutional treatment before this irremediable stage is reached.

5. **Tuberculosis.**—Tubercle affecting the trachea occurs in connexion with pulmonary phthisis, and is rarely found without advanced tubercular disease of the larynx. Two main forms may be distinguished, namely—multiple shallow ulcers, which often coalesce to form large sinuous tracts of ulceration, mostly affecting the cartilaginous portion; and deep infiltration and ulceration, confined to the posterior or membranous part of the tube. When the disease has proceeded to ulceration, it may cause the rare complication of general emphysema, the air being forced into the cellular tissue by cough and other expiratory efforts, made when the larynx is closed. In the treatment of this affection, palliative measures are alone available. *See* LARYNX, Diseases of: 8. Tuberculosis of.

6. **Tumours.**—(*a*) *Cancer.*—Primary carcinoma of the trachea is very rare, but the organ is frequently affected by the extension of the disease from neighbouring parts. The growth first causes the symptoms of stenosis, and then, as ulceration proceeds, it gives rise to expectoration and cough; whereas, as Gerhardt has pointed out, in syphilitic disease cough and expectoration precede the onset of dyspnœa, which develops very gradually. The diagnosis may be very difficult in the primary form, and can only be made with the aid of the laryngoscope. In the case of extension from neighbouring parts the diagnosis is comparatively easy. The only treatment available for prolonging life is tracheotomy, if the seat of the disease is high enough to admit of it. (*b*) *Non-malignant growths.*—Polypi are very rare. The symptoms are those of obstructed breathing, modified by the size and seat of the growth. A certain diagnosis can be attained only by tracheoscopy. Without treatment, a polypus is very likely to cause death by suffocation, its rate of growth depending on its pathological nature. Small growths situated high up may be treated by the galvano-cautery or by other applications through the larynx; larger tumours can only be removed through a free opening made into the trachea. A tumour may be so situated that tracheotomy, without extirpation, may ensure the safety of the patient.

7. **Stenosis.**—The calibre of the trachea may be lessened (*a*) by *stricture*, or by *tumours growing within it*; or (*b*) by *pressure from without.*

(*a*) *Stenosis from true stricture, or internal tumour.*—Tracheal stricture is almost always the result of syphilis; it may be annular and limited, but usually involves the tube for some length towards its lower end, and frequently extends into the bronchi. Tracheal narrowing is indicated by inspiratory stridor and dyspnœa, unaccompanied by the up-and-down movement of the larynx, and the affection of the voice characteristic of laryngeal dyspnœa, and also in uncomplicated cases without the stethoscopic signs of pressure on, or plugging of, a bronchial tube. Under these circumstances, and in the absence of any tumour in the neck or thorax pressing on the trachea, the stenosis must depend on a stricture, or on a tumour within the tube. A syphilitic history would lead us to suspect the former; and a tracheoscopic examination may make the diagnosis certain.

Cicatricial stricture at times develops in consequence of the long-continued irritation of a tracheotomy tube.

In rare instances stenosis of the trachea may result from a chronic form of tuberculosis resembling lupus, leprosy, glanders, and rhinoscleroma.

Symptoms of stenosis are occasionally evoked by spasm of the trachealis muscle.

Prognosis.—Stricture being usually cicatricial, the prognosis is most unfavourable.

Treatment.—Treatment other than operative is seldom available. If the stricture be high up, tracheotomy must be performed below it; or, an opening being made above the contraction, a long flexible tube may be introduced and passed through it. Stricture of the trachea is less amenable than laryngeal stenosis to treatment by mechanical dilatation with hollow bougies, but this method must be borne in mind for exceptional cases.

(*b*) *Stenosis from compression.*—The source of stenosis caused by pressure from without is usually obvious, as in the common case of enlargement of the thyroid gland, thoracic tumours being diagnosed by their physical signs and concomitant symptoms. The paroxysmal dyspnœa frequently caused by these tumours is not laryngeal in most cases, but depends, as shown by Bristowe, on the accumulation of secretion below the seat of obstruction. It is not relieved by tracheotomy, except where the upper part of the trachea is alone compressed. In cases of stenosis from pressure of a goître, division of the isthmus or excision of part of the thyroid gland is sometimes very successful, and should always be tried, if possible, before tracheotomy is resorted to.

8. **Foreign Bodies.**—A foreign body entering the air-passages from the pharynx, may lodge in the larynx, either becoming impacted or lying loose. But, unless prevented by its form or bulk, it usually falls or is drawn through the open glottis into the trachea. Here it may lodge; but it more frequently passes on into one of the bronchial divisions—most frequently into the right bronchus, the orifice of which is slightly larger than that of the left, and occupies more of the floor of the trachea.

Symptoms.—Occlusion of the larynx by a foreign body, which from its bulk obstructs the passage, may cause instant death; and the same may be said of the trachea, as when a person vomiting, in a state of unconsciousness from intoxication, or from the action of an anæsthetic, draws in a quantity of food sufficient to choke up the air-passages. If the body be smaller, it causes dyspnœa, with severe exacerbations from spasm. A very small body, such as a sharp piece of bone or a pin, may be impacted in a position in which it causes only pain and dysphagia without dyspnœa. Speaking generally, it may be said that when the substance has passed into the trachea, the symptoms to which it gives rise depend on its bulk and weight. Rarely, it lies in the air-passage, giving rise to no symptoms; more frequently, varying its position with the rush of air in coughing, &c., it gives rise to paroxysmal dyspnœa, light bodies being forced up to the glottis and exciting spasm.

If the substance pass into the bronchus, it may become impacted there, and will give rise to characteristic physical signs, usually exciting a chronic circumscribed inflammation, with symptoms akin to pulmonary phthisis.

Treatment. From the larynx a foreign body may be removed by the finger or a suitable forceps, its presence having been determined from the symptoms, aided by digital or laryngoscopic examination. Although different forms of long forceps are made for passing through the larynx into the trachea, it is seldom practicable to remove *per vias naturales* a foreign body which has once passed through the rima. A free opening must be made in the trachea, and its edges held well asunder, to give a chance of the body being expelled by cough. If this fail, a forceps must be introduced through the opening, and the body, if possible, extracted. Inversion of the patient, so as to allow a heavy substance to fall back through the glottis into the pharynx, is sometimes successful, but not as a rule without previous tracheotomy.

T. J. Walker.
Percy Kidd.

TRANCE (*transitus*, a going beyond—of the soul from the body).—Synon.: Lethargy; Fr. *Léthargie*; *Maladie du Sommeil*; Ger. *Schlafsucht*.

Definition.—A sleep-like state, which comes on spontaneously, apart from any gross lesion of the brain or toxic cause, and from which the sleeper cannot be roused.

The term 'trance,' in its derivative meaning, aptly expresses the apparent reduction to a vegetative life, but the popular use of the word refers rather to the separate activity of the mind than to the inactivity of the body. Hence many writers prefer the term 'lethargy,' which also, although etymologically exact, is currently employed in a modified sense. The condition is sometimes included under the generic term 'catalepsy,' according to its etymological meaning, 'a seizing'; but this term is usually restricted to those forms which present a peculiar rigidity. It may be noted that the terms 'trance' and 'catalepsy' are both indications of the unperceived shadow of a mythical pathology.

The common form of trance (which is not frequent) is one of many symptoms of a general state of the nervous system, seldom dangerous to life. In the African malady, the tendency to sleep is the chief manifestation of a disease, the gravity of which is extreme.

1. **Common Trance.**—Etiology.—The influence of heredity in relation to trance is to be traced only in the existence of a 'neuropathic disposition.' The state occurs chiefly in the female sex, between the ages of twelve and thirty; very rarely in young men or children. The subjects are seldom in perfect health; they usually present various manifestations of hysteria, and are often anæmic. The condition has been immediately due in some cases to exhausting diseases, as typhoid fever and influenza, to excessive brain-work, to insolation, or to mechanical obstruction to the supply of blood to the head. The immediate cause is either the cumulative effect of such persistent influence, such exhaustion, or some emotional disturbance. It may succeed an hysterical convulsion. Rarely no exciting cause may be discoverable. In still more rare instances the state has been voluntarily induced, as in the well-known case of Colonel Townsend, who could throw himself into a condition of apparent death, lasting several hours. Such voluntary induction is occasionally seen in the East. Lastly, minor degrees of trance may, without difficulty, be artificially produced in most hysterical persons, and less readily in many others, by the methods described in the article on Hypnotism. The state now designated hypnotism is really induced trance, and trance has been accurately termed 'spontaneous hypnotism.'

Its various causes seem thus to involve impaired or deranged nutrition, or the action of a toxic agent (as after acute specific diseases), or an influence that disturbs function in an ill-nourished brain.

Symptoms.—The onset of the state of trance is usually sudden. For instance, in a case which came under the writer's notice, a girl went into a room by herself, and was found, shortly afterwards, in a state of trance-sleep, which lasted for thirty-eight hours. In another case (Madden) a young lady went into a room to change her dress, and was presently found on the bed in a state of trance which lasted for a fortnight. As already stated, it may succeed an hysteroid convulsion, and in some other cases the onset has been attended with an aura, resembling the globus hystericus. In the cases which succeeded typhoid fever (Madden) the delirium of the fever passed gradually into comatose sleep, which continued for several weeks. At the end of the acute stage of influenza spontaneous trance has suddenly come on, lasting hours or days.

During the state of trance, the countenance is usually extremely pale. The limbs are relaxed; although brief initial rigidity, and sometimes occasional recurrent cataleptic rigidity, or transient convulsive spasms, tonic or clonic, have been noted. In a few instances distinct hysteroid fits have occurred from time to time during the course of the trance. The eyelids are usually closed, and may resist and quiver on attempts being made to open them. The eyeballs are directed upwards in most cases; they often deviate from the middle line, and sometimes diverge slightly.

The pupils are usually moderately dilated; rarely they are moderately contracted. The state of reflex action varies according to the depth of the trance. That from the limbs is sometimes excessive, so that cutaneous stimulation produces tetanic rigidity. Much more frequently reflex action is lost; snuff blown into the nostrils causes no sneezing, ovarian compression has no effect, and pressure on hysterogenic points, which may have existed before, no longer causes the usual phenomena. Reflex action from the conjunctiva, and even from the cornea, is commonly absent. The pupil may contract to light, but in lessened degree, and sometimes no distinct action can be observed.

The mental functions seem, in most cases, to be in complete abeyance. No manifestation of consciousness can be observed, or elicited by the most powerful cutaneous stimulation, and on recovery no recollection of the state is preserved. But in some cases volition only is lost, and the patient is aware of all that passes, although unable to give the slightest evidence of consciousness. The senses may be even preternaturally acute, as in the analogous phase of induced hypnotism; or there may be spontaneous mental action, irrelevant to external impressions, and analogous to, probably identical with, the state of ordinary dreaming; it is manifested by exclamations, and even by movements. Rarely the 'obedient automatism' seen in induced hypnotism may be present; hallucinations occur, and actions are performed, according to suggestions made to the patient. The usual condition, however, is that of an entire absence of all evidence of mental activity.

The pallor of the face is the result of a profound depression of the vascular system. The pulse may be less frequent or more frequent than normal, but it is invariably weaker, and it may be imperceptible. The cardiac impulse may disappear, although the heart-sounds are still to be heard, sometimes much weakened. Very rarely they have been inaudible. The breathing may be tranquil, slightly quickened, or slowed, or it may be so feeble and deliberate that no movement of the thoracic walls can be observed, no respiratory murmur can be heard in the lungs, and a mirror held over the mouth is undimmed by moisture. Temperature, when observed, has been normal in the central parts, lowered at the periphery. The secretions go on; the urine may be retained in the bladder, or passed into the bed. The catamenia are usually absent, but menstruation has been known to occur without modifying the course of the trance-sleep. In the cases in which the depression of the vital functions reaches an extreme degree, the patient appears dead to casual and sometimes to careful observation. This condition has been termed 'death-trance' (*Scheintod*). Persons have certainly been buried in this state, and during the recent epidemic of influenza an Italian narrowly escaped interment during the consequent trance.

Duration and Course.—The duration of trance has varied from a few hours or days, to several weeks, months, or even a year. When of short duration, the trance-sleep may be unbroken; but when it lasts for more than a few days, there are usually remissions of a greater or less degree, in which, for instance, the patient will half-wake, take food in an automatic manner, and then relapse into stupor. A long trance-sleep may be more profound at first than later. Recovery may be sudden or gradual. Occasionally it is attended by some vaso-motor disturbance; in a well-authenticated case of death-trance the intense mental excitement produced by the preparations for fastening the coffin-lid occasioned a sweat to break out over the body. After the trance is over, nervous prostration remains for a time. In some cases repeated attacks occur, at intervals of days, months, or years. Most cases end favourably. The depression of the vital functions enables life to continue with a very small amount of nourishment, but occasionally death occurs in persons previously weakened.

Pathology.—The very few *post-mortem* examinations which have been made after death in trance, throw no light on its nature. The theoretical pathology of the subject is involved in the obscurity which envelops all the psychical processes in health and disease, the nature of volition, and ordinary sleep. The lowered action of the brain in sleep, and its lessened blood-supply, have suggested the existence of cerebral anæmia, which the meagre results of anatomical investigation have been supposed to confirm. It is certain that the condition is sometimes associated with defective cerebral nutrition; but that much more than cerebral anæmia is needed to explain the state of trance is evident from the facts that, on the one hand, it may occur when there is no preceding sign of defective blood-supply to the brain, while, on the other hand, the occurrence of cerebral anæmia without trance-sleep is a matter of daily observation. The phenomena of hypnotism also afford little support to the theory of the dependence of trance-sleep on cerebral anæmia; together with the symptoms of catalepsy, they suggest that the primary element is a peculiar state of inaction ('inhibition,' 'increased resistance') of some of the nerve-cells concerned in associating the highest cerebral functions with those of the lower cortical centres of motion and sensation.

Diagnosis.—The diagnosis of trance rests on the impossibility of rousing the sleeper, combined with the absence of any evidence of a local cerebral lesion or a toxic cause.

Other diagnostic symptoms are the pallor and vascular depression, the occurrence of convulsive phenomena of hysteroid type, and the history of other manifestations of hysteria. These symptoms sufficiently distinguish trance-sleep from apoplexy, for which, at the onset, it is sometimes mistaken. The distinction from catalepsy rests on the absence of the *flexibilitas cerea*, but catalepsy is merely a variety of trance. The peculiar tendency to brief sleep termed *narcolepsy* is distinguished from trance by the shortness of the periods of unconsciousness. Thus a man had from youth fallen asleep for a few minutes under various influences, and always did so when a probe was passed down a nasal fistula. It is to be remarked, however, that the term *narcolepsy* has been also applied in America to cases of true epilepsy, in which the attacks of *petit mal* are characterised by sudden somnolence.

In cases of 'death-trance,' in which no sign of vitality can be recognised, the presence of life may be ascertained (1) by the absence of any sign of decomposition; (2) by the normal appearance of the fundus oculi as seen with the ophthalmoscope; (3) by the persistence of the excitability of the muscles by electricity. This excitability disappears in three hours after actual death. In a case observed by Rosenthal, thirty hours after supposed death the muscles were still excitable, and in forty-four hours the patient awoke. *See* DEATH, Signs of.

Deepening sleepiness, not amounting, however, to coma, and scarcely to be called stupor, has attended some cases of subacute inflammation of the region of the oculo-motor nuclei described by Wernicke—a curious fact considering the manner in which relaxation of the levator is associated with ordinary sleep. Lastly, a benign form of 'summer somnolence' observed among the Swiss, has been termed 'Gerlier's disease.'

PROGNOSIS.—In cases of hysterical lethargy the prognosis is fairly good. The attack usually passes off. In very rare cases death has occurred. The slighter the degree of the trance, the shorter is likely to be its duration. The prognosis is grave only when lethargy has been preceded by a state of great physical depression, and is the most serious when the condition succeeds an acute disease.

TREATMENT.—The treatment has to be directed to two ends: the maintenance of life, and the arrest of the trance. Advantage must be taken of any intervals of semi-consciousness to give nourishment in a concentrated form. If swallowing is continuously impossible, food must be given by the nasal tube, or by enemata. Warmth should be applied to the extremities, and care taken to prevent bed-sores. In severe cases, every attempt at arrest is often fruitless. Errhines, as snuff, have usually no influence, and it is only in slight cases that this, or stimulation of the skin, as by sinapisms, is effective. The most powerful cutaneous excitant is strong faradisation. In a case under the writer's notice, which had lasted for thirty-six hours, strong faradisation to the arm quickly roused the patient. In another case, which lasted for several months, this treatment had, for a long time, no influence; afterwards the patient could be partially roused for a short time by faradisation, and by repeating the application at the same hour every day a tendency to periodical waking was established, the remissions became longer and more complete, and the attack was ultimately brought to an end. Nervine stimulants, such as ether and valerian, may be given by the bowel, or sulphuric ether may be injected subcutaneously. Alcohol must be given with caution and in small quantities; enemata of strong coffee are often more useful. A remedy which, from its effect on the vascular system, would certainly deserve trial in trance, is the inhalation of nitrite of amyl. Transfusion of blood has been proposed, and would be justified in cases following exhausting disease. The recurrence of attacks must be prevented by the improvement of health, physical and moral.

2. **African Lethargy.**—This form of trance is described separately. *See* NEGRO LETHARGY.

W. R. GOWERS.

TRANSFUSION OF BLOOD.

SYNON.: Fr. *Transfusion du Sang*; Ger. *Transfusion des Blutes.*

DEFINITION.—The injection of blood from the human subject, or from one of the lower animals, in a pure or defibrinated condition, into the veins of a patient.

DESCRIPTION.—This operation was invented in the middle of the 17th century, and is now fully established as a proceeding of great value; but authorities are still divided as to the best mode of performing it. Transfusion is most frequently undertaken as a means of saving life after a great loss of blood, and most commonly after *post-partum* hæmorrhage. It has also been employed in cases of profound anæmia from other causes, as in leucocythæmia, phthisis, and pernicious anæmia, and its use has been suggested in the so-called blood-diseases, as fevers or pyæmia. But the benefit derived from it in these cases is at most only temporary, and it is probable that the operation will ultimately be limited to cases of anæmia from hæmorrhage. Transfusion benefits the patient, first, by increasing the quantity of fluid entering the ventricles, and so encouraging their action; secondly, by increasing the number of blood-corpuscles which, as the carriers of oxygen, are essential to life; thirdly, by supplying albumin, and so giving nourishment at a time when it is probably impossible to do so by any other means. For none of these purposes is the fibrin of the blood essential, and consequently many operators prefer to defibrinate the blood, by which much trouble in the operation is saved. Experiments on the lower animals, and observations of operations performed on the human subject, seem at present to indicate that defibrinated blood is as efficient as pure blood. Yet when all the necessary appliances are at hand, pure blood is undoubtedly the most natural fluid to inject. When human blood has not been available, the blood of a calf, a sheep, or a lamb has been used instead, apparently with equally beneficial results. The difference between the size of the corpuscles in these animals and in man is of no consequence, as those of man are the larger. The corpuscles from these animals probably break up very soon, as hæmatin has been found in the urine the day after transfusion with lamb's blood; but they no doubt serve as carriers of oxygen for a short time, during which the patient may rally.

The dangers of transfusion are not very great; but as cases have occurred in which the donor of blood has died in consequence of the operation, it should not be undertaken without a clear prospect of benefiting the recipient. Care must be taken that air is not injected with the blood. The experiments of Oré (*Études historiques et physiologiques sur la Transfusion du Sang*, Paris, 1868) have, however, shown that this danger has been much exaggerated. A bubble of air does no harm; the quantity to cause death must be considerable. Too great care cannot, however, be taken to exclude air, as fatal cases have occurred from this cause. The injection of clots giving rise to embolism, and perhaps to pyæmia, is always considered one of the dangers of the operation; but evidence is wanting to show that it has been a frequent cause of death, or that in all the cases in which pyæmia or septicæmia followed the operation it was due to this cause. One case is recorded by Jürgensen (*Vier Fälle von Transfusion des Blutes*, Berlin, 1871) in which red maculæ formed on the skin after the operation, which subsequently suppurated. These were supposed to be due to minute fragments of fibrin injected with the defibrinated blood. Dr. Madge (*Brit. Med. Journ.* vol. ii. 1874; and *Obst. Journ. of Gt. Brit.* 1874) has shown, however, that with care no such fragments need be left after whipping and straining. The wounds left after transfusion present nothing special, and are to be treated as ordinary venesection wounds. The difficulties with which the operator has to contend are not great when defibrinated blood is used. When pure blood is used by any but the immediate method of transfusion from artery to artery, or vein to vein, there is some necessary hurry, as the operation must be finished before coagulation sets in. To avoid this, Dr. Braxton Hicks recommends the addition of a solution of phosphate of sodium (℥j to Oj), in the proportion of one of the solution to three of blood; and Sir B. W. Richardson a solution of liquor ammoniæ (♏xx and distilled water ℥j), to be added to a pint of blood. Both these solutions have the power of arresting coagulation. There is often some difficulty in finding the collapsed and empty vein of the patient. An ordinary venesection incision is useless; the vein must be cut down upon, picked up with forceps, and then opened.

Transfusion is either *mediate* or *immediate*. In the *mediate* operation the blood may be either defibrinated or pure. When pure blood is used, the vein of the patient must first be exposed and opened, and a silver cannula introduced. It is better to use an assistant's fingers (rather than a ligature) to retain the cannula in its place. It is well to allow a drop or two of the patient's blood to escape from the cannula, if possible, to make sure it contains no air; or it may be filled with warm water or a solution of phosphate of sodium. While this is being done, the donor is bled into a clean vessel. No precautions need be taken to keep the blood warm. Cold delays coagulation. As soon as sufficient blood has been obtained, it is transferred to a syringe which is provided with an india-rubber tube. Care being taken that the tube and syringe contain no air, they are now connected with the cannula, and the blood slowly injected. Innumerable instruments have been invented for this operation, with the objects of saving time and ensuring against the entrance of air. It is impossible to describe them here. The best known are Hewitt's (*Brit. Med. Journ.* 1863, vol. ii.), Hicks's (*Guy's Hosp. Reports*, 1869), Higginson's (*Liverpool Med.-Chir. Journ.* 1857), and Mathieu's (*Bull. Acad. de Med.* Paris, 1867). In this last the blood is received directly from the donor into a funnel at the top of the syringe, and great rapidity of operation is consequently attained. An ingenious instrument, which it is impossible to describe without a drawing, was introduced into London in 1877 by Dr. J. Roussel. When all its parts are in good order it doubtless works extremely well, but it is somewhat complicated and uncertain in its action (Dr. J. Roussel on *Transfusion of Human Blood*, with a preface by Sir James Paget; London, 1877). When defibrinated blood is used, complicated instruments are unnecessary. The blood must be received into a clean vessel, and whipped with a clean stick or a twisted glass rod, till fibrin ceases to separate. The whipping must be done gently, so as not to injure the blood-corpuscles, or to break off minute fragments of fibrin. After whipping, the blood must be carefully strained two or three times through some clean linen. It may then be injected as above described.

The operation of *immediate* transfusion was reintroduced by the late Dr. Aveling (*Obst. Journ. of Gt. Brit.* 1873). In this operation two cannulæ are required, one for the vein of the donor, and one for that of the patient. They are connected with each other by an indiarubber tube, with a small ball in the middle and a stopcock at each end. The cannulæ, having been inserted, are allowed to fill with blood so as to expel the air; or that in the patient's vein, if no blood will flow into it, is filled with warm water. The indiarubber tube having been previously filled with warm water, is now applied to the cannulæ, and the stopcocks turned on. The small ball is then squeezed, while the tube is pinched on the side of the donor by an assistant. This drives the fluid in the tube into the vein of the patient. The tube is next pinched on the side of the patient, and the ball allowed to expand and then emptied as before. Each squeeze of the ball drives in three drachms of blood.

Immediate transfusion *from artery to vein* has only been performed when an animal has been the donor. In this operation the carotid artery of a lamb or calf is connected directly with the vein of the patient by means of a simple indiarubber tube, with a cannula at each end. The force of the animal's circulation is quite sufficient to carry the blood into the patient's vein. As the result, however, of a series of experiments carried out at the request of the Obstetrical Society of London, Professor Schäfer has recommended immediate transfusion *from artery to artery* as the most efficacious method of performing the operation (*Trans. Obst. Soc. Lond.* 1879, vol. xxi.). The quantity injected in any of the foregoing methods of operating varies with the effect produced. Sometimes as much as a pint has been introduced. Half that quantity is usually sufficient to produce a marked effect. MARCUS BECK.

TRANSFUSION OF MILK. This operation, or, as it is more correctly termed, *Infusion or Intravenous Injection of Milk*, has been recommended in America by Thomas (*N. Y. Med. Journ.* May 1878), Howe (*N. Y. Med. Rec.* 1878, p. 443), and others, as a substitute for transfusion of blood. In this country it has been practised and recommended chiefly by Dr. Austin Meldon, of Dublin (*Med. Press and Circular*, Oct. 22, 1879; and *Lancet*, 1880, vol. i. p. 527). The subject has been experimentally studied in France by Béchamp and Baltus, Laborde, Culcer, and others, with the result of showing that a small amount of milk may be injected without any evil consequences; but if the quantity be too large and too rapidly injected, the animal dies asphyxiated after severe dyspnœa. The *post-mortem* examinations showed minute hæmorrhages and embolisms, caused by the milk-globules sticking in the capillaries of the lungs, kidneys, brain, and other viscera. The numerous cases in which the operation has been performed on the human subject show that it can be safely undertaken, provided that, in addition to the usual precautions observed in intravenous injections, the following points are attended to. The milk must be freshly drawn from a cow or a goat. A goat may be brought to the bedside of the patient. The milk must be alkaline; and this is best secured by the addition of a small quantity of carbonate of ammonium. It must be raised to a temperature somewhere near that of the body. Under no circumstances must more than 4½ ounces be injected (Meldon). If any dyspnœa is observed the operation must be at once arrested. The injection is usually followed by a considerable rise of temperature; and there may be some disturbance of respiration, which passes off in a short time.

The operation is reported to have been successfully performed in cases of cholera, pernicious anæmia, phthisis, and loss of blood; and it may perhaps be recommended as a last resource in some of these conditions if no blood can be obtained for transfusion. Injection of milk can only effect two of the purposes of transfusion. It can increase the amount of circulating fluid; and it can, in an imperfect way, supply food at a time when it could not otherwise be taken; but it can do nothing to increase the oxygen-carrying power of the blood. Its inferiority to immediate transfusion is self-evident; and it is more dangerous and less efficacious than the transfusion of freshly defibrinated blood, either of man or animals, or of saline solutions. MARCUS BECK.

TRANSFUSION OF SALINE FLUIDS.—Great temporary benefit and the occasional saving of life have been secured by the intravenous injection of saline fluids.

COMPOSITION AND METHOD.—The saline fluid recommended by Little for use in the treatment of cholera was composed of chloride of sodium, 50 grains; chloride of potassium, 3 grains; sulphate of sodium and carbonate of sodium, of each 2 grains; and water 1 pint. Two drachms of absolute alcohol may be added if it be thought desirable. More recently the so-called 'normal' saline solution, namely, 0·6 per cent. of chloride of sodium in distilled water, with or without the addition of alcohol, has been more commonly employed, and apparently with equally good results. The fluid should have a temperature of 98° to 100° F. A considerable quantity may be injected apparently with advantage: the amount employed has in some instances been as much as four pints. The simplest possible apparatus should be employed: a nozzle to fit into the opening in the vein, to which is attached, by means of a few feet of indiarubber tube, the glass part of an ordinary syringe. The fluid is poured into the syringe (or funnel), which is held a foot or two above the level of the patient's body; and should any obstruction occur to the flow, this may easily be overcome by the introduction of the piston.

Action and Uses.—The injection of saline fluid possesses only the first of the three functions detailed at the commencement of the article on Transfusion of Blood. It has, however, proved useful in cases of severe bleeding, such as *post-partum* hæmorrhage; and has recalled the patient to consciousness, at all events for a time, in cases of shock. It has also been employed in diabetic coma.

It is perhaps not out of place to add that it has been asserted that many of the benefits of intravenous injection of a saline fluid have been obtained by injection of a large quantity of a similar fluid into the rectum.

Rickman J. Godlee.

TRANSPOSITION OF VISCERA. *See* Organs, Displacement of.

TRANSVAAL, The. — *See* Africa, South.

TRAUMATIC (τραῦμα, a wound).—That which is associated or connected with a wound or injury, for example, *traumatic fever* and *traumatic aneurysm.*

TREATMENT. — *See* Disease, Treatment of; and Therapeutics.

TREMENS, DELIRIUM.—*See* Delirium Tremens; and Alcoholism.

TREMOR (Lat. trembling).—The most delicate form of clonic spasm, consisting of successive movements of very small amplitude. Tremors are seen principally in the hands, the head, the tongue, or the facial muscles, as a result of disease or of old age. They are commonly spoken of as 'coarse' or 'fine,' according to the amount of movement which they involve. For some account of the mode in which tremors are related to other disorders of movement, *see* Motility, Disorders of.

TRICHIASIS (θρίξ, the hair).—A morbid condition in which the eyelashes are inverted towards the eye. *See* Eye, and its Appendages, Diseases of.

TRICHINA (τρίχινος, made of hair).—*See* Entozoa.

TRICHINOSIS or TRICHINIASIS.—*See* Entozoa.

TRICHOCEPHALUS (θρίξ, a hair; and κεφαλή, a head).—*See* Entozoa.

TRICHOMONAS VAGINALIS (θρίξ, a hair; μονάς, a monad; and *vaginalis*, connected with the vagina).—A ciliated infusorial animalcule, discovered by Donné in the vaginal mucus, and somewhat resembling a spermatozoon. *See* Rape.

TRICHOPHYTON (θρίξ, a hair; and φυτόν, a plant).—A species of parasitic fungus, which attacks man and some animals. *See* Tinea Trichophytina.

TRICUSPID VALVES and ORIFICE, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of.

TRIFACIAL NERVE, Diseases of. *See* Fifth Nerve, Diseases of.

TRISMUS (τρίζω, I gnash).—Lockjaw, or tetanic closure of the jaws; a prominent symptom in tetanus. *See* Tetanus.

TRISMUS NASCENTIUM or NEONATORUM (Lat.). — A form of tetanus occurring in newly born children. *See* Tetanus.

TROPHIC LESIONS.—Description. This name is given to various departures from healthy nutrition, which are caused (*a*) by the cutting off, from certain tissues or parts, of some customary nervous influence, as in the production of 'secondary degenerations' in the nervous system (*see* Spinal Cord, Diseases of, § 6), or in the production of rapid muscular atrophy, consequent upon the severance of or severe damage to motor nerves or their related ganglion-cells in the anterior cornua of the cord; and also to lesions or morbid changes which are caused (*b*) by some irritative or perverted influences passing *outwards* along sensory nerves to certain tissues, so as to weaken or otherwise disturb their nutrition. In this latter way, the nutrition of the skin and its appendages may be variously affected, leading to eruptions of different kinds, to atrophy, to ulceration, or undue proneness to inflammation, as well as to altered pigmentation of the skin or blanching of the hair. Or the nutrition of the joints may be affected, as in some forms of hemiplegia, and of locomotor ataxy more especially. In these various cases there may be disease, secondary or primary, of the grey matter of the spinal cord, or some irritative lesions of the sensory nerve roots or trunks.

Pathology. — Much dispute has taken place during recent years as to the modes in which such nutritive changes are brought about. Some have endeavoured to establish the existence of special 'trophic nerves,' and have taught that the various trophic lesions referred to above are to be explained by a cutting off or a perversion of the influences usually operating upon the tissues through such nerves. Others believe that these nutritive changes can be accounted for by altered states of excitation of the vaso-motor nerves, leading to spasm or dilatation of the vessels supplying the parts affected, and, as consequences, to the nutritive changes themselves (*see* SYMPATHETIC SYSTEM, Disorders of). Much evidence, however, could be cited against both these modes of explanation; and it seems, on the whole, more probable that trophic lesions are due either (*a*) to the cutting off of certain accustomed influences (*viâ* motor channels), or (*b*) to the action upon the tissues of perverted or unnatural influences (travelling in a peripheral direction *viâ* sensory channels).

On the subject of these trophic lesions *see* also SPINAL CORD, Diseases of, § 7; GLOSSY SKIN; and UNILATERAL FACIAL ATROPHY.

H. CHARLTON BASTIAN.

TROPICAL DISEASES. — Diseases incident to hot climates. *See* CLIMATE; DISEASE, Causes of; and the special diseases, such as CHOLERA, ASIATIC; CHYLURIA; DYSENTERY; FUNGUS-DISEASE OF INDIA; INTERMITTENT FEVER; LIVER, Diseases of; NEGRO LETHARGY; REMITTENT FEVER; and SUNSTROKE.

TUBERCLE (*tuberculum*, a little swelling). SYNON.: Fr. *Tubercule*; Ger. *Tuberkel*.

There have been four stages in the history of tubercle, namely, the first, or etymological stage; the second, or stage of morbid anatomy studied by the naked eye; the third, or stage of morbid anatomy studied by the help of the microscope; and the fourth, or stage of experimental pathology.

Stage I.—This stage begins with the earliest writings on medicine. The word 'tubercle' has not yet been wrested from its original meaning—*tuberculum*, a little lump of any kind. And this primitive etymological meaning survives even in the present day. We still speak of 'tubercles' of the ribs and other bones; acne is a 'tubercular' disease of the skin, and so on. But down to the beginning of the nineteenth century, tubercle meant a little lump and nothing else.

Stage II.—At the beginning of the present century tubercle lost its simple etymological meaning, and acquired a pathological meaning. Tubercle is no longer a matter of special shape, for now it signifies a special structure. This great change concurred with the rise of morbid anatomy. And thus it came to pass. Many of the dead bodies examined were necessarily cases of pulmonary consumption, and in this form of disease it was that little morbid lumps or tubercles were discovered with especial frequency. Hence the tubercles found in phthisical lungs early showed a strong tendency to become emphatically the tubercles of pathology. We may remark this tendency in Morton (A.D. 1689), and in Baillie (1795). But it was Bayle (1803) who first broke with the ancient meaning altogether, and introduced the second stage of opinion. Debates concerning tubercles are henceforth debates concerning morbid structures.

Bayle thus defines tubercle: A homogeneous substance; always opaque; in colour, white or dirty white, sometimes yellowish, sometimes greyish; in size, from a millet-seed to a chestnut. He makes the criterion of tubercle to consist in its opacity. Now this opacity is most marked in the cheesy products of degeneration. Therefore, in other words, the criterion of tubercle consists in the cheesy state. Cheesy matter, wherever found, in the shape of a little lump or not, is the tubercle of Bayle. He called that tubercle which Baillie had called scrofulous matter.

Bayle did not, and could not, overlook the fact that the lungs sometimes contain little nodules which are translucent. He would not call them tubercles because they lacked his note of tubercle, opacity; he called them granulations. Granulations are never opaque. And so, between tubercles and granulations he drew an excessively strong distinction.

It was not long before Laennec (1819) reunited what Bayle had put asunder, by showing that granulations at length became opaque. And, therefore, he enlarged the definition of tubercle, so as to make it include, not only actual, but also potential cheesy matter. Thus Laennec's tubercle acquired a most inclusive pathological meaning. Moreover, he remarked that tubercle sometimes involves large, irregular tracts of tissue, a condition which he distinguished by the name of tuberculous infiltration. Each of these forms, the nodular and the infiltrated, he subdivided into three—the transparent, the semi-transparent, and the opaque or cheesy. Hence six forms of tubercle in all—three nodular, namely, the transparent or Bayle's granulations, the semi-transparent or miliary, and the opaque or crude yellow tubercle; three diffused, namely, the transparent or gelatiniform infiltration, the grey or semi-transparent infiltration, and the yellow or opaque. Laennec's descriptions relate especially to the lungs of adults. But the structure of the lungs makes the study of tubercle singularly difficult in them, and it is easy to note that our debates concerning tubercle in general show an unconscious leaning towards pulmonary tubercle in particular. The writers do not say that this is wrong; one feels that if one could master tubercle in the lungs the rest would soon follow.

Laennec's unit began to be broken up when men set themselves to discover the seat of tubercle. Carswell (1838) proved, what Broussais had guessed, that crude tubercle was often formed within the cavity of the pulmonary air-sacs. Thomas Addison (1845) went much farther. He began by examining genuine pneumonia, which he found to have its original and essential seat in the air-cells of the lungs, and the ordinary pneumonic deposits are poured into these cells. And when he, like Carswell, found this to be the chief seat of Laennec's crude yellow tubercle and grey and yellow tubercular infiltrations, he declared that, if called upon to give an expressive name to these lesions, he would venture to designate them scrofulous pneumonia. The case was altered with respect to the granulations; these he found to be seated in the delicate filamentous tissue which forms the slight filmy parietes of the air-cells. Let it be understood that Addison's criterion of tubercle lay in its formation in the septa of the air-sacs; he denied the criterion to be cheesiness, and thus, in matter of fact, his use of the word 'tubercle' was almost the exact contradictory of Bayle's. Addison revived in some degree Baillie's scrofula. The other forms of Laennec's tubercle, Addison conceived to be inflammatory exudation, mingled or not with his own true tubercle. It seems as if the naked eye could not carry us much farther.

Stage III.—About this time the microscope began to be used for examining healthy and diseased tissues. Cheesy matter being commonly deemed the most characteristic form of tubercle, men naturally supposed that the microscopical characters of tubercle would be found in cheesy matter. Tubercle being thought, moreover, to possess perfectly distinct naked-eye characters, it was expected that its minute structure must likewise be peculiar and distinct. And thus it came to pass that Lebert (1844) found certain bodies in cheesy matter which he believed to be characteristic of tubercle, and which he called tubercle-corpuscles. These corpuscles not being found in the transparent granulation, some persons went so far as to deny its tubercular nature, and so revived Bayle's doctrine, in all its severity, upon a microscopical platform. But William Addison (1849) came to a very different conclusion respecting the characters of pulmonary tubercle. He repeatedly examined with the microscope the material deposited in the air-cells of the lungs in pneumonia, and compared its characters and appearance with that forming a tubercle, without being able to detect any more essential or specific difference between them than exists between purulent matter recently excreted and that of an old chronic abscess. This was a microscopical confirmation of Thomas Addison's doctrines. Virchow (1850) arrived at the same opinion, namely, that there was nothing characteristic of tubercle in cheesy degeneration. For instance, nowhere is the cheesy degeneration better seen than in the enlarged glands of scrofula; yet, examine these glands before they become cheesy, and nothing more (so Virchow said) than a simple hyperplasia will be found, and no new-formation. On the other hand, examine tubercle before it becomes cheesy, examine the transparent granulations, and it will be found to possess a distinct lymphatic character. But granulations are formed in the connective tissue; hence they are heteroplastic. So that Virchow's tubercle signifies a heteroplastic lymphoma. The characteristic tubercle is not opaque, but transparent; in this respect Virchow's doctrine was the exact opposite of that taught by the French school. The criterion of tubercle with him is not cheesiness, but heteroplasia. Of late years both parts of Virchow's definition have been assailed: first, the connective tissues which are infested by tubercle have been shown to possess in many places a true lymphatic character, so that tubercle, if a lymphatic growth, may be simply hyperplastic as well as heteroplastic; next, the lymphatic character of tubercle has been put in question by the investigations of Langhans and others. Thus Virchow's distinction between tubercle and scrofula becomes untenable; but we will postpone further discussion of these matters for the present.

Stage IV.—The results of experiment upon living animals, or what is commonly called the inoculation of tubercle, will be narrated at the end of this article. Enough to say in this place that most important changes in the doctrines of both tubercle and scrofula have been almost entirely due to the experimental pathology of recent years.

Here ends the preliminary historical sketch. Now we will inquire into the present state of opinion concerning the characters of tubercle.

I. Concerning the structure of single tubercles.—The formation of tubercle begins at distinct foci. The primitive tubercle is a microscopic body. W. Addison (1849) taught that it consists, in greater part, of corpuscles, like blood-leucocytes, or like the corpuscles of lymph and of pus. Rokitansky (1855) showed that giant or myeloid cells are sometimes found in tubercle. Virchow (1863) taught that tubercle has a more histioid or tissue-like structure, which, on the whole, resembles most the tissue of a lymphatic follicle; so that, in the case of the spleen, tubercle is not always easily distinguished from a Malpighian body. In a tubercle there are corpuscles embedded in a reticulum. The corpuscles are round; and most of them are like lymphatic corpuscles, smaller than blood-leucocytes; some, however, are larger, it may be twice or thrice. The corpuscle is colourless, translucent, slightly granular, and easily broken up. In the fully developed cell there is a single nucleus, small, tolerably homogeneous, often shining. The larger cells contain two, three, or even as many as twelve nuclei. The reticulum consists of a fine network of connective-tissue fibres. When vessels are present in the tubercle, they are not new-formations, but only remnants of the tissue in which the tubercle has been formed. According as the cellular or the fibrous element of the tubercle predominates, it may be called cellular or fibrous tubercle, the former being more common. The fibrous element sometimes predominates so much that the tubercle can be distinguished from a small fibroma only by a concurrence of the more common cellular form, or by a tendency to undergo the further changes of tubercle, especially the cheesy change. In the fibrous tubercle there are often found large, roundish, epithelioid cells, with large oval or round, sharply defined nuclei. From this description it will be seen that Virchow recognised lymphoid, epithelioid, and myeloid or giant-cells, among the elements of tubercle. Langhans (1868) was the first to lay much greater stress upon the giant-cells; he found them to be an almost constant element of tubercle in any part. He believed that the tubercular giant-cell had characters proper to itself, namely, a finely granular protoplasma, and nuclei of equal size, peripheral, and arranged in radiate fashion. In cellular tubercle, the epithelioid cells are arranged around the giant-cell. In fibrous tubercle a giant-cell is always present at the very centre. Wagner (1871) described tubercle under the name of tubercular (*tuberkelähnlich*) lymphadenoma, the structure being the same as that of a lymphatic follicle (namely, lymphoid corpuscles, and many nuclei almost destitute of surrounding protoplasma, embedded in a fibrous reticulum), and in the middle of each tubercle a giant-cell. Schüppel (1871), who devoted himself chiefly to tubercle of the lymphatic glands, considered the gigantic cell to be an essential (though not peculiar) element of tubercle. A primitive tubercle consists of a central giant-corpuscle, that is to say, a mass of protoplasma of very varied form, spherical, flat, or elongated; the edges even, or provided with more or fewer processes; more or less granular; and containing a large number of nuclei, to be reckoned by the score, even as many as two or three hundred. Around this giant-cell lies a zone of epithelioid cells, which make up the greater part of the tubercle. They are very delicate, easily broken down, and the fact that tubercle has been supposed to consist chiefly of lymphoid corpuscles is due to the setting free of the epithelioid nuclei, which have been mistaken for leucocytes. Lastly, true lymphoid corpuscles are scattered through the tubercle, filling up the interstices between the other cells as it were. In fibrous tubercle there are no epithelioid cells, a fact which Schüppel believes to indicate an arrest in the growth of the tubercle at an early stage. Supporting all these cells, there is a reticulum like that of lymphadenoid tissue. These primitive tubercles contain neither blood-vessels nor lymphatics. Friedländer (1874), with especial reference to these giant-cells, very truly insists that they are by no means peculiar to tubercle; on the contrary, they are found in a number of other structures, both healthy and morbid. Moreover, he maintains that there are no distinguishing characters in the giant-cells of tubercle. What has been considered the reticulum of a tubercle, Friedländer asserts to be the result of the hardening processes employed in the preparation of the microscopical specimen; in the fresh state there is nothing but a small quantity of amorphous intercellular matter. Rindfleisch came to the conclusion that large epithelioid cells are the most characteristic elements of tubercular and scrofulous formations.

This conflict of opinion continued until Koch's experimental researches revealed a decisive test of what is tubercle.

II. Concerning the origin of tubercle.—William Addison believed that the lymphoid corpuscles of tubercle were the result of exudation from the blood, through the walls of the vessels. Virchow taught that tubercle proceeds from a proliferation of the fixed corpuscles of sundry tissues, especially the connective tissue and its allies, namely, marrow, fat, and bone. Hence tubercle is essentially heteroplastic, that is to say, lymphatic tissue is formed in parts where it does not naturally exist. But is there, then, no such thing as tubercle of the lymphatic structures? This is a troublesome question for Virchow. However, he does not deny that tubercle may be found in lymphatic glands; he supposes that it is formed, not in the follicles themselves, but in the connective-tissue trabeculæ which support them; also, that sometimes an adventitious connective tissue springs up in the gland in consequence of chronic inflammation, and that the tubercle grows in this new tissue. Yet Virchow was not without misgivings respecting his doctrine of the heterology of tubercle, because he saw the close relationship which exists between connective and lymphatic tissues. He pointed out (1856) the frequency with which tubercle is seated in the outer coat of the small blood-vessels, and especially those of the cerebral meninges. Now Robin (1855) and His (1865) showed that this outer coat, or adventitia, is a lymphatic tissue. Neumann (1868) showed that marrow is a lymphatic tissue. In this way, fresh difficulties arose with Virchow's heteroplastic doctrine. In fact, the opposite opinion gained ground, that tubercle is commonly hyper- or homœoplastic. Wilson Fox (1868) and Burdon Sanderson (1868) held that it is very often nothing but a hyperplasia or overgrowth of pre-existing lymphadenoid tissue. Lymphadenoid tissue has been found to be much more extensively present in the healthy body than Virchow thought; for instance, in the submucous tissue of the whole alimentary canal; in the conjunctiva; around the smaller bronchia; around capillary tufts beneath the epithelium of the pleura and peritoneum; around the smaller arteries in many parts, such as the pia mater, liver, spleen (constituting the Malpighian bodies), and choroid; besides the marrow, spoken of before. And all these are favourite seats of tubercle. So much for the lymphadenoid tissue as a seat of tubercle. Klebs (1868) maintained that tubercle of the serous membranes arises within the lymphatic vessels, by a multiplication of their epithelium. And Rindfleisch (1871) describes, under the name of lymphangitis tuberculosa, a kind of fibrous tubercle often present around phthisical cavities. Each tubercle consists of a dense fibrous capsule, within which lie concentric layers of spindle-shaped, anastomosing cells. The tubercles are, in fact, developed from lymphatic vessels, by a metamorphosis of the endothelium and outer tunic; the remnant of the lumen of the vessel may often be found in the middle of the tubercle. Last of all, a fibrous sclerosis of the whole takes place. Aufrecht (1869) supposed that tubercle was formed around the lymphatics, and was therefore a perilymphangitis. But Sanderson declares that Klebs and Aufrecht mistook veins for lymphatics, and that the perilymphangitis of the latter is a hyperplasia of the lymphatic sheath of blood-vessels. Wagner (1871) leaned to the belief that tubercle (his lymphadenoma) is always heteroplastic, even when it occurs in parts which naturally possess a certain quantity of lymphadenoid tissue. And Rindfleisch (1871) teaches that the lymphoid cells of tubercle do not come directly from the blood, but from proliferation of the fixed cells of connective tissue; the endothelium of blood and lymphatic vessels, the epithelium of serous membranes, lungs and kidneys, and even the muscle-cells of the smaller bronchia and vessels, undergoing a tubercular metamorphosis. Schüppel (1872) reduces the question to the origin of what he deemed to be the most important part of tubercle, namely, the giant-cell. It arises, he thinks, within a blood-vessel. Masses of molecular matter, very tenacious and adherent, grow up in small blood-vessels (capillaries or small veins), and become bigger and bigger, until the vessel is quite choked, or even distended at the spot. At first there are no nuclei in the protoplastic mass, but afterwards they begin to appear; and their number is proportionate to the age of the corpuscle. Where the nuclei come from is uncertain. The epithelioid cells next appear around the giant-cell, and are most likely derived from processes of the giant-cell. The lymphoid cells come from the cells of the tissue in which the tubercle is formed. The reticulum, in chief part, is a neoplasm; it grows with the multiplication of the cells, and is always connected with the gigantic corpuscle. So soon as the giant-cell becomes surrounded by other cells, the wall of the blood-vessel disappears. Other authorities differ from Schüppel with regard to the origin of the giant-cell: some supposing it to be formed from the endothelium, some from blood-leucocytes, and some from free protoplasm. Others considered that it resulted from fusion of several cells. And here the question rested until new light was shed upon it by experimental pathology.

III. **Concerning the growth of tubercles.**—The primitive tubercle increases in size until it becomes visible to the naked eye. The enlargement is brought about by the formation of fresh tubercular foci around the original focus; so that when six or more of the primitive tubercles become agglomerated into one body, it becomes visible as a small nodule (tuberculum). Sometimes the agglomeration does not assume the nodular form, but is diffused and of irregular shape; this is called an infiltration. The difference between nodular and infiltrated tubercle is merely a naked-eye difference; whether the confluent tubercles retain the nodular shape or not, the primitive tubercle is always a tuberculum. 1. *Nodular tubercle* corresponds to most of Bayle's granulations, and Laennec's miliary tubercles, which were spoken of before. The epithet 'miliary' is much older than Laennec, and has lost its original etymological meaning. Miliary tubercle may or may not be of the size of a millet-seed. Tubercle the size of millet-seed may or may not be miliary. All that is now meant by miliary tubercle is a small nodule, roundish, seldom larger than a hemp-seed, almost colourless or greyish, consistence almost equal to that of cartilage, and either quite transparent or opalescent. Lastly, miliary nodules may or may not be tubercular. Miliary tubercle must be distinguished from other small nodular neoplasms: minute disseminated carcinoma and sarcoma, lymphosarcoma, leukæmic nodules, small fibromata. The diagnosis depends upon the discovery of more definite lesions in the same body, and upon the microscopical structure. In the lungs, miliary semi-transparent nodules are sometimes wholly pneumonic in character. The peribronchitis of Virchow possesses, according to Wagner, a lymphadenoid structure, and may therefore be considered a tubercular lesion. 2. *Infiltrated tubercle*, when present in the lungs, corresponds with much of Laennec's gelatiniform and grey infiltration. The gelatiniform infiltration may often be seen surrounding nodular tubercles, in cases of acute pulmonary tuberculosis. In the liver, tubercular infiltration runs along the capsule of Glisson between the lobuli. In the cortex of the kidney, it appears as streaks between the bundles of tubuli, or as ill-defined roundish patches. Tubercle, not nodular, often may be seen alongside the small arteries in the cerebral meninges. Wagner describes a diffuse lymphadenoma (tubercle) of the pleura, which is indistinguishable by the naked eye from chronic pleurisy; and even the microscope shows all stages of transition between lymphadenoid and granulation tissue, in these cases. A similar diffuse lesion occurs in the mucous membranes.

IV. Concerning the lesions which surround tubercle. Tubercle is commonly associated with surrounding hyperæmia, and with inflammatory exudations in the neighbourhood. These secondary lesions are well seen in the serous and mucous membranes. Pleurisy, peritonitis, pericarditis, local or general, are sure to follow upon tuberculosis of the respective membranes. In the mucous membranes, hyperæmia and catarrh are the necessary results. But in the tissues which are themselves undergoing transformation into tubercle an obliteration of the bloodvessels proceeds very quickly. Tubercle, wherever formed, is non-vascular; the only approach to vascularity is when tubercle surrounds arteries or veins without closing them.

V. Concerning the metamorphosis of tubercle.—Sooner or later, the tubercles, which have now been described, undergo sundry changes. These changes sometimes take place very quickly, certainly within two or three weeks from the formation of the tubercle. On the other hand, tubercle may remain unchanged for a long time, even for two or three years, as Schüppel's observations upon one case seem to prove. There are two kinds of metamorphosis—the fibrous and the caseous, and they correspond to the two kinds of tubercle which Virchow describes, the fibrous and the cellular. 1st. *The fibrous metamorphosis* is by far the less common. The reticulum of the tubercle becomes greatly hypertrophied, so as to constitute a dense intercellular substance, interspersed with a few small spindle-shaped nuclei. The cells of the tubercle undergo the caseous change. The result is either a small fibroma with a cheesy centre (which may afterwards calcify), or a simple fibroma, the cheesy matter being wholly absorbed. In the writers' opinion, there is reason to believe that much larger tracts of tubercular infiltration may undergo the fibrous metamorphosis—may cicatrise, in fact. Friedländer (1873) denied the fibrous metamorphosis altogether, and declared that it proceeds from the tissue around the tubercle, and not from the tubercle itself, which must caseate. Whether it be a direct or indirect result, the fibrous condition, when once attained, is permanent and final. This process represents the natural healing of tubercle. 2nd. *The caseous metamorphosis* is very much more common. To the naked eye minute white specks appear towards the centre of the tubercle; they become larger and more numerous, and at last coalesce. The caseous mass, at first firm and white, subsequently acquires a more yellowish colour, and may undergo softening and liquefaction. The microscope shows that the process is essentially a form of necrosis, or death of the affected tissues, 'necrobiosis' (Virchow). The cells shrivel, become indistinct, and often contain granulo-fatty particles. In this state they constitute the tubercle-corpuscles of Lebert. Similar changes take place in the reticulum, and ultimately all traces of the tissue-elements are lost, the result being a finely granular amorphous mass. This metamorphosis is regarded by Weigert and others as an instance of coagulative necrosis. But why tubercle should take on the cheesy metamorphosis could not be explained: the deficient supply of nutritious juices will not alone meet the case. The cheesy change usually begins before the tubercle has reached the size of a millet-seed. But sometimes much more minute granulations degenerate, and to this, the very smallest cheesy tubercle, Rilliet and Barthez have given the name of tubercular dust. The change begins much more quickly in generalised than in local tubercle. Large nodules, formed by the aggregation of smaller cheesy nodules, may reach the size of a peeled horse-chestnut. This caseous tubercle is the crude yellow tubercle of Laennec, and *the* tubercle of Bayle. Before Bayle it was called scrofulous matter, and looked upon as wholly a deposition from the blood. Unlike the fibrous metamorphosis, the cheesy change is not permanent: five further changes may occur: 1. Softening: the whole caseous mass breaks down into a molecular detritus of oily and albuminous particles. When the supply of blood allows of it, these molecules float in a serous fluid, which to the naked eye looks purulent: curdy pus, or a tubercular abscess. The abscess, when superficial, bursts, and leaves a tubercular ulcer. When all the caseous matter has been cast off, the ulcer may heal, and so the local disease come to an end. But usually the ulcer steadily enlarges, by the perpetual production and destruction of tubercles around it: this is phthisis, in the anatomical sense of the word. The cicatrix-tissue of tubercle has a tendency to contract strongly. 2. Capsulation: sometimes a capsule of dense fibrous tissue will form around the cheesy matter, whether softened or not. This is the encysted tubercle of Bayle. 3. Calcification: the oily particles become gradually replaced by carbonate and phosphate of calcium. The different degrees of calcification are denoted by such words as mortary, chalky, stony. In itself, it is a permanent change; but ulceration may occur around, and thus the petrified tubercle be discharged. 4. Absorption no doubt occurs to some degree. Virchow believes that cheesy glands may wholly disappear in this way. 5. [illegible] may occur. The cheesy nodule becomes a sequestrum, which is gradually loosened by surrounding suppuration, until it separates, and lies loose in a cavity. The cheesy metamorphosis cannot be by any means looked upon as being peculiar to tubercle, although no doubt most common in tubercle. Simple inflammatory exudations, cancer, syphilitic gummata, lymphosarcoma, all sometimes undergo the same change.

VI. **Concerning the tubercular diathesis and dyscrasia.**—It was not possible that careful examinations of dead bodies should be made without two prominent characters of tubercle being noted, namely, the fact that certain tissues, organs, or persons are liable to tubercle, and certain others not so; also the frequency with which tubercles are disseminated over a number of organs in the same subject. Hence arose the doctrine of tubercular diathesis and dyscrasia.

1. *Tubercular diathesis* is a phrase first used by Bayle (1803), and means a particular disposition to the generation of tubercles. The contradictory word to diathesis is immunity, or privation of diathesis. The tubercular diathesis relates to tissues, organs, or persons. (*a*) Tissues: it has been already shown that the connective tissues (and especially the variety lymphadenoid tissue) are particularly predisposed to tubercle. The other tissues—namely, the epithelial, and the higher, muscular and nervous tissues, have been said to possess complete immunity. Some would deny this last assertion, but their opinions have been narrated before, and need not be repeated here. Of late years tubercles have been found in sundry morbid tissues. Köster (1869), in cases of scrofulous disease of joints, found innumerable tubercles embedded in the granulations; not only in those which spring from the synovial membrane and bone, but also in those which line abscesses or sinuses. Friedländer (1873) declares that, under these conditions, tubercles are never absent. They are visible, even to the naked eye, as whitish or greyish specks, surrounded by a ring of enlarged capillaries. He finds tubercles in scrofulous ulcers of the skin, and in the walls of scrofulous abscesses, cutaneous or connected with caries of bone. The microscopical structure of these tubercles is identical with that which Schüppel has assigned to tubercle of the lymphatic glands, and which has been already described. (*b*) Organs: the serous membranes (pleura, peritoneum, pericardium) are a very frequent seat of tubercle. Endocardium, very uncommon. Dura mater, not very common. Pia mater, very common. Ependyma, uncommon. The mucous membranes (alimentary, respiratory, genito-urinary), very common. Lymphatic glands and lungs, most common. Liver, spleen, kidneys, common. Suprarenals, not very common. Testes, not uncommon. Prostate, not common. Heart, not very common. Brain and spinal cord, tolerably common. Salivary glands and pancreas, uncommon. Ovaries, voluntary muscle, and thyroid, very uncommon. With regard to the skin, tubercles have been found around scrofulous ulcers; and Friedländer (1872-4) has assigned to lupus a microscopical character identical with that of tubercle. The diathesis of organs seemed to be partly explained by the diathesis of tissues. Lymphatic organs are predisposed; and hence the spleen is prone to tubercle whilst the thyroid is not; also the intestines are more liable than the stomach, because they are much richer in lymphatic structures. But since tuberculosis has been proved to be an infective disease depending on the presence of a specific microbe, a modification of these views has become necessary, as will be seen in the section on Experimental Pathology. (*c*) Persons: the tubercular diathesis, with respect to persons, will be discussed under the head of Ætiology.

2. *Tubercular dyscrasia.*—The word 'dyscrasia' signifies a mis-composition, or a qualitative lesion. Strictly speaking, there may be a dyscrasia of any tissue, but the word has come to be applied to qualitative lesions of the blood only. The dyscrasia which is believed to exist in tuberculosis, and to be peculiar to it, is called tubercular. Bayle was the first to note the frequency with which tubercle implicates a number of organs in the same subject and at the same time. Laennec remarked that the tubercles often seem to have been developed in distinct crops: the age of the tubercles being judged of by the degree of their degeneration. So that he came to speak of primary and secondary eruptions of tubercle. He noted that a secondary eruption often seemed to follow the softening of the primary tubercle. And this he deemed to indicate an actual and peculiar change in the juices of the part—a local dyscrasia: as if the primary tubercle were the source of an infection. It is then the multiple eruption of tubercle which suggests the notion of a dyscrasia. For the matter stands thus. The multiple eruption is either protopathic or deuteropathic. Either many organs simultaneously and spontaneously generate tubercle, or they are simultaneously subjected to a common tuberculising influence. Of the two hypotheses, the latter is certainly the more probable. And if so, it is not asking much to suppose that the common cause exists in the common bond of all organs and tissues—that is to say, the blood. And granting this, the further question arises: How does the blood acquire this tuberculising property? Is it protopathic or deuteropathic? Is it a spontaneous generation of the blood, or is it derived from some other source? Now, the prevailing theory of dyscrasiæ asserts

that every dyscrasia is due to the constant afflux of morbid material derived from foci external to the circulating blood itself: in other words, dyscrasiæ are always secondary to a local lesion. The justification of this doctrine is believed to be found in certain dyscrasiæ which seem to be less obscure than the tubercular; for instance, pyæmia and melanæmia. Admitting that, in the case of the tubercular dyscrasia also, there is a necessary local antecedent lesion, we have next to inquire what this lesion is, both in itself and in its relation to the blood.

First, concerning the *nature of the lesion* which infects the blood. Dittrich (1853) taught that detritus, derived from the breaking up of tissues of any kind, and entering the blood, would produce the tubercular dyscrasia. But to this doctrine it is justly objected that detritus, the result of degenerations, is often absorbed and is not followed by tubercle. There must be something peculiar to the detritus which sets up tubercle; what we may call a tubercular virus. Buhl (1857) held that this virus proceeded from the sundry forms of Laennec's tubercle alone: that is to say, from undegenerated tubercle, and from any kind of cheesy matter. He remarked, what is very true, that it is exceedingly uncommon to find disseminated miliary tubercle, without also finding cheesy matter somewhere, especially in the bronchial and mesenteric glands, and in the lungs. And no one would deny that the formation of the cheesy matter must have preceded, in point of time, the formation of the miliary tubercle. Against Buhl's theory there lie three objections, but they cannot be said to overthrow the theory by any means. Cheesy matter often occurs without the tubercular dyscrasia; but this proves nothing more than that cheesy matter sets up the dyscrasia under certain conditions only, or that all cheesy matter will not set up the dyscrasia. In very rare cases of general tubercle no cheesy matter has been found; but it is not denied that recent undegenerated tubercle may infect. The last objection is this: the tubercular dyscrasia implies the tubercular diathesis; and it is not surprising that the signs of former tubercular disease, in the form of cheesy matter, should be found in persons who have died from a more general tuberculosis; but this objection will lose much of its force when we have discussed our second topic, which we will now proceed to do.

The *relation between the local lesion and the blood*, or the mode in which the tubercular dyscrasia is developed. There are two ways by which the blood is known to become contaminated. First, by a lesion of some part of the sanguiferous system. In several cases Weigert has found a tubercular growth involving the walls of the pulmonary veins. Koch and others have met with a similar lesion of the small arteries in different organs. The entrance of the virus into the circulating blood sets up a general tuberculosis, depending on the impaction of the specific microbes in the capillaries of various parts; in other words, an infective embolism. Secondly, by means of the lymphatic system: a source of infection which is extremely common. The local tuberculising lesion first of all infects its immediate neighbourhood, through the juice canals. In serous membranes, mucous membranes, the lungs, and the brain, it is very common to see what may be called the mother tubercle surrounded by a number of daughter tubercles. The lymphatic glands are next infected; and when they have become tubercular, they pour tubercular virus into the blood, and thus the disease is spread. In exceptional instances the thoracic duct itself may become invaded by tubercular infiltration, as shown by Ponfick.

VII. Concerning the experimental pathology of tubercle.—Passing over the earlier experiments of Cruveilhier, Lombard, Erdt, and others, we will come at once to Villemin (1865), who was the first to draw general attention to the present topic. He inoculated rabbits with fresh tubercle, both transparent and opaque; that is to say, he inserted small pieces of tubercle into an incision made through the skin of the animals. When the rabbits were killed, about a month afterwards, an abundant crop of tubercles was found in many of the viscera. On the other hand, Villemin proved that rabbits are not subject to spontaneous formation of tubercle. He concluded that tubercle contains a peculiar virus, which can be reproduced in the body. Since Villemin's time many pathologists have worked at the artificial production of tubercle. The results of their work may be conveniently arranged under six heads.

1. *Animals used in the experiments.*—In rabbits, guinea-pigs, oxen, sheep, goats, and monkeys, artificial tubercle is easily generated; in cats and dogs, not easily. Villemin failed in his attempts to inoculate a cock and a dove.

2. *Material inoculated.*—Villemin used fresh tubercle. But soon afterwards (1867) Andrew Clark and Waldenburg succeeded in rendering rabbits tubercular, by inoculating them with materials other than tubercle. It was next found that not only animal tissues, but even the vegetable, such as a cotton seton or a piece of cork, could set up tuberculosis. And, lastly, the fact was discovered that a simple wound, into which nothing was inserted, would suffice to generate tubercle in rabbits, guinea-pigs, and certain other animals. However, Sanderson (1868) showed that, of all the means for producing artificial tubercle by inoculation, none is more certain or more active than the material taken hot from the

diseased glands of a living animal already infected. The dose required is almost infinitesimal. If a diseased gland is squeezed into a little distilled water in a capsule, and the slightly turbid liquid injected, results are certain. Both Sanderson and Wilson Fox (1868) discovered that when non-tubercular matters are inoculated, they become encapsuled by cheesy matter formed beneath the skin; so that the tubercles appeared to follow, not the material inoculated, but the inflammatory products which surround it. Wherefore it was thought that the infectious virus, which excites the general tuberculosis, is not introduced from without, but is generated by the animal itself; that the animal must possess a tubercular diathesis; and that, given the diathesis, any kind of inflammation, set up in any way, may call forth tuberculosis. Cohnheim and Fränkel at first obtained results similar to those of Clark and Waldenburg. But on repeating their experiments in other buildings where previous contamination could be excluded, they failed to induce tuberculosis by inoculation with any material other than tubercle, which they therefore regarded as containing a specific virus.

3. *Manner of introducing the exciting substance.*—Villemin inoculated the tubercle. He also succeeded by injecting a watery suspension of tubercle into the air-tubes. Feltz (1867) injected cheesy detritus into the right side of the heart, and produced, in the lungs, embolic nodules which underwent caseous degeneration. Injections into the left side of the heart caused similar changes in other viscera, especially the brain. Lebert and Wyss obtained the same results from injections into the veins. Sanderson injected the serous cavities. Chauveau (1868) found that infectious matters may be introduced into the body through the alimentary canal: he rendered calves tubercular by feeding them with small quantities of tubercle, or with muscle, milk, or sputa of a tubercular animal. Tappeiner succeeded in producing pulmonary tuberculosis in dogs by causing them to inhale phthisical sputum in a finely divided state. Lastly, Cohnheim and Salomonsen injected tubercular matter into the anterior chamber of the eye of rabbits. Tuberculosis of the iris developed, and was followed by infection of the cervical lymph glands, lungs, and other viscera.

4. *Lesions produced.*—The results of inoculation beneath the skin of guinea-pigs have been well described by Wilson Fox. (*a*) The material inserted becomes surrounded by dry cheesy stuff, which is shown by the microscope to consist of dried-up detritus, rather than true puriform cells. (*b*) Around the cheesy mass are a number of small round granulations, some transparent and some opaque, in size from that of a poppy-seed to that of a hemp-seed. These granulations consist of many nuclei, embedded in a homogeneous substance, together with some large epithelioid cells. (*c*) Indurated cords reach, beneath the skin, from the seat of injury towards—or to—the nearest lymphatic glands. These cords are sometimes cheesy in the centre. Microscopically they consist of strings or rows of cells and nuclei, like those of the granulations, contained in a limitary membrane. These cords are probably altered lymphatics. (*d*) The next change is found in the associated lymphatic glands. They are enlarged to twice or thrice their natural size, and are also apparently much increased in number—that is to say, very small glands become visible. On section, they look semi-transparent and confused in structure: scattered through them are spots and streaks of cheesy degeneration. The microscope shows a great increase in the number of the natural lymphoid corpuscles, and some larger epithelioid cells. (*e*) The lungs are next most frequently affected. They contain scattered granulations of different sizes, from the minutest speck to the size of a hemp-seed, or even larger; semi-transparent and firm, with a cheesy centre, sometimes softened. A distinct connexion with the air-tubes and vessels can often be made out, the granulations being seated in the peribronchial or perivascular sheath; but sometimes they have no particular relation to either. From these granulations proceeds an infiltration of the septa of the air-sacs; and concurrently with this change, the capillaries collapse and cease to be permeable by blood. The bronchial glands also are affected, in the same manner as described above. (*f*) The next most important changes are in the liver. It is much increased both in size and weight, in consequence of a diffuse infiltration of the capsule of Glisson and the tissue between the acini, with small corpuscles (such as before described) embedded in a fibrous network. The new tissue looks semi-transparent and glistering: scattered through it are spots of cheesy change. Here and there the lesion tends to assume the nodular form. The proper liver-cells degenerate and disappear. (*g*) The spleen is enlarged. Nodules, transparent or cheesy, and transparent diffuse infiltrations, are scattered through it. (*h*) In the agminated and solitary follicles of the intestines are sometimes found white or caseous nodules, or even ulcers. The stomach is unaffected. The lymphatic glands in the mesentery and in the hilum of the liver are usually affected. (*i*) Ascites is common, and probably due to the state of the liver and peritoneum. (*j*) In the omentum numerous granulations are often found, both around the small vessels, and also in the tissue where there are no vessels.

Sanderson found that when the serous cavities are injected with tubercle the membranes become studded, in two or three weeks, with granulations, small, but visible to the naked eye; and, for the most part, mere overgrowths of lymphadenoid tissue previously existing beneath the epithelium. The lungs undergo the change described by Wilson Fox, and also a pneumonic change, consisting in a filling of the air-sac with roundish cells, like those which are always found there in small numbers.

5. *Nature of the lesions.*—The great majority of pathologists were of opinion that these lesions, thus artificially produced in the lower animals, were the same as those which we call tubercular in man. On the other hand, Friedländer holds that these artificially produced nodules do not possess the structure of true tubercles, to which he holds a giant-cell to be essential. In his opinion, the nodules are nothing but disseminated chronic inflammatory nodules, with a disposition to caseate. He declares that in the lungs the lesion consists in nothing but miliary pneumonia, an assertion which is directly contrary to the experience of Wilson Fox and Sanderson. Sanderson classed tuberculosis among the infective inflammations, and regarded it as being closely allied to pyæmia. Cohnheim warmly adopted the theory that it is a specific infective disease, and recommended inoculation of animals as the only criterion of what is tuberculous, in view of the prevailing uncertainty as to the essential structure of tubercle.

6. *Characters of the virus.* Villemin supposed it to be liquid, but almost all subsequent observers deemed it to take the form of minute solid particles. Thus Klebs, Aufrecht, Baumgarten, Schüller, and Toussaint succeeded in discovering different kinds of micro-organisms in tuberculous tissues, without adducing any convincing proof that the microbes were the cause of the disease. In 1882 Robert Koch announced the discovery by him, in tuberculous structures and in the sputa of phthisis, of the specific bacillus of tubercle. This is a thin motionless rod-shaped organism, in length from one-quarter to a-half the diameter of a human red blood-corpuscle.

Staining properties.—The tubercle bacillus differs from all other bacilli, except that of leprosy, in its behaviour to certain aniline dyes. When stained with fuchsin or methyl violet in combination with a watery solution of aniline oil, the bacillus takes up the colouring-matter rather slowly; but, unlike other microbes, with the exception of the leprosy bacillus, it resists the decolorising action of strong acids—nitric, sulphuric, hydrochloric, acetic. Tubercle bacilli thus stained appear as delicate red or violet rods, in which a faint beading is often visible. In the latter case the rod seems to be composed of a row or string of stained granules, which are believed to represent spores. The above method, devised by Ehrlich, differs from that originally employed by Koch, who stained the bacilli with an alkaline solution of methylene blue and decolorised with vesuvin. This process was not altogether satisfactory, and Koch quickly recognised the superiority of Ehrlich's method, which he himself adopted and recommended. Ziehl found that a watery solution of carbolic acid may be substituted for aniline water when fuchsin is used; and it is now generally admitted that Ziehl's and Ehrlich's solutions give equally good results. For further details of the process the reader is referred to the articles, MICRO-ORGANISMS; and SPUTUM, Examination of.

Distribution of the bacilli in the tissues.—The bacilli are most abundant in and among the epithelioid cells, and in the giant-cells, though they may also be found in varying numbers among the small round-cells, and in caseous masses. The same appearance and staining reactions distinguish the bacilli of tubercle, whether in man or in the lower animals.

Cultivation of the bacilli.—Cultivations were made from the following sources: In man, from miliary tubercle, sputum, and secretion from cavities in cases of phthisis, caseous pneumonia, scrofulous glands, tubercular testicle, fungous arthritis, and lupus. In the case of animals, from 'Perlsucht,' spontaneous tuberculosis in a guinea-pig, and caseous pneumonia in a hog; also from the organs of various animals which had been inoculated with tubercular matter. In all the cultures taken from these various forms of tuberculosis 'the bacilli behaved exactly the same.'

After numerous trials it was found that the microbe could best be grown on blood-serum sterilised and solidified by repeated heating. A minute portion of tuberculous tissue was spread over the surface of the solid serum in a suitable tube, which was then kept carefully at a uniform temperature of 37° to 38° C. (98·6° to 100·4° F.). 'Often-repeated experiments proved that at a temperature of 42° C. (107·6° F.) no growth occurs in the course of three weeks; and between 28° and 29° C. (82·4° and 84·2° F.) it ceases entirely.'

The growth of the bacilli thus cultivated is very slow, the first signs of increase appearing in ten to fifteen days, in the shape of tiny dry scales adhering loosely to the surface of the serum. These afterwards coalesce, to form a uniform thin coating. The cultures generally attain their maximum development at the end of four weeks; but after having been in existence for months, they can still be used for obtaining fresh crops of bacilli. From the first cultivation a second was started, and from the second a third, and so on for successive generations until a perfectly pure culture of the bacilli was obtained. As many as thirty-four generations were grown from one culture over a period of nearly two years.

Inoculation experiments.—Animals were inoculated with pure cultures in various ways, with the strictest antiseptic precautions, the bacilli being injected into the subcutaneous tissue, anterior chamber of the eye, abdominal cavity, and into veins. Lastly, the cultures were introduced into the respiratory passages in the form of a fine spray. With the exception of a few animals belonging to species only slightly susceptible to the disease, inoculation was invariably followed by the development of tuberculosis. Koch's experiments therefore demonstrated that a special bacillus is invariably present in tubercular lesions, that this microbe can be isolated and grown outside the animal body, and that inoculation of animals with pure cultures thus obtained causes tuberculosis. The tubercle bacillus was consequently proved to be the *vera causa* of the disease.

Full details of Koch's researches cannot be given here, but it may be added that he failed to cultivate the bacillus on potato, and he was only able to obtain a slight growth on nutrient agar-agar and in broth. Other observers were not so successful with Koch's method of cultivation. But Nocard and Roux discovered that a more rapid and luxuriant growth can be secured in nutrient agar to which a small quantity of glycerine has been added. They also obtained good results with chicken-broth, beef-broth, and Cohn's fluid, after the addition of glycerine. Crookshank succeeded in growing the bacilli in milk, sterilised urine, and nutrient gelatine containing 5 per cent. of glycerine. Paulowsky grew them on potato. Beevor found that a slow growth may take place on glycerine agar and on potato at 82° F., and in broth at even a lower temperature.

Koch instituted numerous control experiments with other pathogenic and non-pathogenic bacteria with similar antiseptic precautions, but in no case was tuberculosis induced. These results have been amply verified by Watson Cheyne and other careful observers.

Wilson Fox's experiments with setons and indifferent irritants were repeated, at his request, by Dr. Dawson Williams under modern antiseptic conditions, with the result that none of the animals contracted tuberculosis.

HISTOGENESIS OF TUBERCLE.—Koch inclined to the view that the epithelioid and giant-cells are derived from the migratory cells or leucocytes; and seeing that the bacilli have no power of locomotion themselves, he considered that transference of the microbes from one spot to another is due to active movement of the wandering cells, carrying the bacilli with them, after inclusion in their protoplasm. But the exact origin of the epithelioid and giant-cells was still a matter of inference only. In order to clear up this point, Baumgarten carried out an elaborate research on the development of tubercle in albino rabbits inoculated with pure cultures of the bacilli. The virus was introduced into the anterior chamber of the eye, where the early changes could be easily followed. Tuberculosis of the iris and other structures of the eye was succeeded in due time by a similar affection of the cervical lymphatic glands, lungs, and other organs. The histological changes were minutely investigated in the iris, cornea, lymph glands, lung, spleen, liver, kidney, bones, intestine, and peritoneum. But inasmuch as the details of the process are essentially the same in all the organs examined, tubercle of the iris may be selected as a convenient type.

The freshly excised iris was hardened by Flemming's method in a weak solution of chromic acid alone, or mixed with a certain proportion of osmic acid. No change could be detected with the microscope for five or six days after inoculation, but about this time the bacilli became incorporated with or closely applied to the fixed connective tissue and endothelial cells of the iris, which then commenced to proliferate. By means of the above method of hardening, combined with suitable staining, it was discovered that proliferation of the cells is preceded by the process of karyokinesis or karyomitosis—morphological changes in the nuclei shown by Strassburger and Flemming to occur preliminary to actual division (*see* CELL). The cells which evinced these nuclear changes always contained one or more bacilli. Karyomitosis was accompanied by swelling of the protoplasm of the cells, which gradually assumed the epithelioid type. Division of the nucleus and cell follows, and the result is a crop of young epithelioid cells, the offspring of the fixed cells of the tissue. Many of the new cells go through the same process of karyomitosis and division. Some of them have two or three nuclei, but at this stage no true giant-cells are seen. At a later period karyomitosis seems to be arrested when the epithelioid change has attained its full development. Now, for the first time, small cells or leucocytes, migrating from the vessels, begin to appear in increasing numbers at the margin of the tubercular focus. Baumgarten was unable to detect any karyomitosis in the leucocytes, and concludes that these take no part in the formation of the epithelioid or specific tubercle cells. The appearance of a reticulum is mostly confined to the periphery of the tubercle, and is regarded by Baumgarten as the result of a separation or fraying out of the pre-existing connective-tissue fibrils in consequence of the overgrowth of the cells lying in their meshes. The number of bacilli continues to increase, and the leucocytes gradually infiltrate the tubercle, hiding in part or altogether the original epithelioid cells, though careful examination with an oil-immersion lens and condenser will often discover the presence of epithelioid cells in what at first sight appears to be a simple small-celled tubercle. Regressive changes now set in; the leucocytes undergo molecular disintegration, and break up into granular masses. The nuclei of the epithelioid cells no longer take the stain, the protoplasm shrivels up, the cells become partially fused together and are transformed into indistinct non-nucleated epithelial scales containing tubercle bacilli. Gradually the necrotic process extends from the centre to the periphery, all cellular structure is lost, and the nodule is converted into a granular caseous mass teeming with bacilli. If giant-cells develop at all, it is only in the latest stages. The above description refers to animals inoculated with virulent cultures swarming with bacilli. If less active cultivations or 'Perlsucht' nodules containing relatively few bacilli be used, the process is somewhat different. The reaction of the tissues is more chronic and less intense. The formation of epithelioid cells is succeeded by the development of typical giant-cells containing bacilli, whereas the invasion of leucocytes occurs much later and is a comparatively insignificant feature in the process. The microscopical appearances in this case closely resemble those met with in chronic tubercular affections in man. In the tubercular lesions of other organs karyomitosis and cell-proliferation are manifested not only by the connective-tissue elements, but also by glandular and epithelial cells, and by the endothelium of blood and lymphatic vessels. Baumgarten holds with Koch and others that the giant-cells of tubercle are formed from individual cells, not by fusion of several cells; but he was not able to detect karyomitosis in the giant-cells. The localised lesions known as pseudotuberculosis of animals, excited by indifferent foreign particles, were also investigated; and it was shown that, although the nodules may be composed of epithelioid and giant-cells, they never contain tubercle bacilli, and do not caseate—that is to say, they are not tuberculous.

These observations have greatly elucidated the histology of tuberculosis, and enable us to reconcile some of the conflicting statements of earlier writers. Thus the epithelioid and giant-celled tubercle of Langhans and Schüppel, and Virchow's small-celled lymphoid tubercle, are seen to represent different stages of development of the same growth. The lymphadenoid character of tubercle can no longer be maintained. The epithelioid cell, the product of the proliferation excited by the bacillus, must be regarded as the special cell of tubercle, as Rindfleisch long ago maintained. A fresh light has been thrown on many obscure questions of pathology by the researches of Koch and his followers. The caseous transformation, which plays so important a part in the process, has long been a difficulty, but Watson Cheyne suggested, what is highly probable, that it is the result of some poisonous chemical substance generated by the bacillus. The special proclivity to tuberculosis manifested by lymphoid structures is now seen to depend on the fact that the bacilli, so frequently entering the body through lymphatic spaces, are first arrested in corresponding lymph follicles or glands, and there is no longer any necessity to invoke the hypothesis of a special diathesis of tissue.

Dissemination of the disease in the body is the consequence of the entry of the microbes into the blood.

The pulmonary veins and the thoracic duct have been shown by Weigert and Ponfick to become involved in the tubercular process in certain cases. The former is by far the more common and important channel of infection, and the bacilli have been found in the walls of small arteries and veins by Koch and others. The passage of bacilli from diseased lymphatic glands into the thoracic duct and subclavian vein is another very common means by which diffusion of the disease is effected. The acute development of general tuberculosis is probably determined by the sudden discharge of large numbers of the bacilli into the circulation.

The diathesis of organs admits of a natural and simple explanation. The lungs are so often attacked because, as Koch points out, the bacilli are commonly introduced through the air. The spread of tuberculosis through the lungs is mainly due to inhalation of bacillary secretion from cavities into distant bronchioles; but local extension by lymphatic paths also plays an important part. The intestines are generally infected by swallowed sputum, the stomach escaping in consequence of the protective action of the acid gastric juice, not because of the small amount of lymphoid tissue in its walls.

The frequent implication of the spleen, pia mater, and kidney in cases of general tuberculosis is partly, and probably mainly, to be explained by the intricate arrangement of the circulation in these parts, favouring the occurrence of bacillary embolism. But the comparative immunity of organs like the pancreas, ovaries, and thyroid gland has still to be accounted for. The long-continued localisation of the tubercular process so often witnessed in the lymphatic glands, bones, joints, and other parts of the human body cannot yet be completely explained, though the small number of bacilli found in such lesions accords well with the chronicity of the disease. Possibly in these very chronic forms the lymphatic vessels of the part become blocked with caseous and other products, and thus extension is hindered. The occurrence of primary tuberculosis of deeply seated organs like the kidney, joints, and bones is believed by Koch to depend on arrest in the capillaries of single infective germs. How these enter the blood is somewhat uncertain, but it may be, as Koch hints, that in many instances the primary origin of the disease in these localities is apparent only, infection being the result of an undetected tubercular bronchial or other lymphatic gland. The arrest of tubercular disease is attributed by the same author to some alteration in the conditions of growth of the bacilli taking place in the human body. The solution of this question involves the explanation of immunity; but whether this be due primarily to phagocytosis or to chemical action of animal juices is still a matter of dispute. It seems not impossible that arrest may be to some extent the consequence of local inflammatory and other conditions favouring encapsulation of tubercular foci. *See* Immunity.

Ætiology.—Without the presence of the tubercle bacillus there can be no tuberculosis. From this central point all ætiological inquiry must start. In the early days of Koch's discovery it was generally assumed that the bacillus is ubiquitous, and that everyone is constantly being exposed to its influence. Recent researches have thrown doubt on this assertion. The inhalation experiments of Tappeiner, Koch, and others have demonstrated the possibility of tubercular infection taking place through the medium of the atmosphere, and the fact that in man the lungs are affected more frequently than any other organ suggested to Koch that this is the route by which the virus commonly enters the body.

Pulmonary tuberculosis must, without doubt, be regarded as the source from which the bacilli are derived in the great majority of instances, owing to the fact that swarms of these microbes are constantly being discharged with the sputum. When allowed to dry on floors, pocket-handkerchiefs, clothing, bedding, &c., the sputum is liable to become pulverised, and is then easily carried about by currents of air, and inhaled into the air-passages and lungs of other persons. Experiments by Koch and his pupils have proved that dried tubercular sputum retains its virulence for months; hence the danger of infection lasts long after the sputum has been expelled from the lungs. It may be taken as a well-established fact that the bacilli are not exhaled from the lung in the free state, though they may be ejected with small particles of mucus by violent coughing. Attempts to discover them in the air have been unsuccessful. Recognising the fact that all bacilli are relatively heavy bodies, and therefore tend to sink in the air and to adhere to foreign particles, Cornet proceeded to investigate the deposits of dust in various localities in Berlin. His method consisted in the inoculation of animals with dust collected from the walls of hospitals, prisons, asylums, and private houses, and from the public streets. The dust was collected with a sterilised spatula or sponge, and was thoroughly mixed with sterilised broth. The fluid was then injected into the peritoneal cavity of guinea-pigs with strict antiseptic precautions. Many of the animals died rapidly of septic peritonitis; a few remained in good health, and, when killed after an interval of two months, were found to be free from tubercular disease. Lastly, in a certain number of instances the animals developed tuberculosis. As the result of his researches, Cornet found that the presence of the tubercle bacillus could frequently be demonstrated by inoculation experiments in the dust of rooms inhabited by phthisical patients; but that where the inmates had not been tubercular no evidence of the virus could be discovered. Further details of this interesting and important investigation cannot be given here.

Accidental inoculation of a wound or abrasion of the skin of a healthy person with tubercular sputum has been known in more than one instance to cause tuberculosis. It has been thought that house-flies may act as carriers of the virus.

The question of contagion between husband and wife has been much discussed; but, though there can be no doubt that contagion does at times occur, infection can with more probability be attributed to inhalation of dried sputum. Instances of direct inoculation of the genito-urinary apparatus are rare, whereas tuberculosis of this system is comparatively common in both sexes. The marked liability of the abdominal organs of children to tubercular affections points to the entrance of the virus through the alimentary canal, and attention has been specially directed to milk, the main article of diet of young children. Cows are known to be very prone to a chronic form of tuberculosis, 'Perlsucht,' in which the lungs and other viscera are involved, but the mammary gland itself is not very often diseased. The flesh of animals disposed to tuberculosis, such as oxen, swine, and poultry, is another possible source of infection, when insufficiently cooked; but the ætiological importance of milk and meat has yet to be precisely defined.

Although it is no longer doubtful that tuberculosis depends on the invasion of the bacillus, the conditions necessary for the development of the microbe in the human body are still imperfectly known. The anatomical arrangements of the nose, pharynx, and larynx, coupled with the ciliary movement of the epithelial cells lining the respiratory tract, are eminently adapted to arrest fine particles of any kind on their way towards the lungs, and to promote their extrusion from the body. The extreme rarity of primary tuberculosis of the upper air-passages lends indirect support to this statement. Again, the slow growth of the bacilli must operate against their chances of taking root wherever they may be deposited. Furthermore, it is probable that the amount of tubercular dust inhaled is usually very small, and infection must be, to a great extent, a question of dose. The vital resistance of the body, whether it be exercised by its cells or fluids, must be impaired by debilitating influences of various kinds. Insufficient food and sunlight; overcrowding; imperfect ventilation; noxious trades, especially those associated with much dust; frequent pregnancies; hyperlactation; exhausting diseases like diabetes; pleuritic adhesions, and local conditions affecting the thoracic walls; diseases of the respiratory organs, more particularly those associated with influenza; feeble ciliary action; defects in the epithelial lining of the respiratory tract, supposed to occur in measles, whooping-cough, and scarlatina—all these are probably concerned, in varying degrees, in the production of a certain predisposition to tuberculosis.

HEREDITY.—TUBERCULAR DIATHESIS.—The fact that tuberculosis so commonly affects many persons in a family was always regarded, till recent times, as a sufficient proof of the strongly hereditary character of the disease; but Koch's discovery has led some writers to minimise the importance of heredity, and to ascribe an almost exclusive influence to the bacillus. The exponents of this view would explain the occurrence of tubercular disease in a family by the opportunities of infection which arise when one member is attacked. If we except the very rare cases of congenital tuberculosis, we may assert that the bacillus is not communicated by the parents to the fœtus—that is to say, the disease itself is not inherited. But there are no facts contradicting the belief that a certain vulnerability or disposition to tuberculosis is transmitted from one generation to another. In this restricted sense we may unhesitatingly affirm the existence of a tubercular predisposition or diathesis, without denying that many cases of family phthisis are really the outcome of family infection. Tubercular disease manifesting itself in the kindred of a person suggests the probability, though it is no actual proof, that the person akin possesses the same diathesis. The recognition of the diathesis in the person himself is fraught with difficulty. In the first place, a special conformation of body, or 'tubercular habit,' cannot be discovered in most cases; and, secondly, many of the symptoms of scrofula, supposed to indicate a predisposition to tubercular disease, are in themselves a positive proof that the patient is already tuberculous (*see* SCROFULA). No age is exempt from the disease, but it is especially common from the fifteenth to the twenty-fifth year. The belief is gaining ground that it is far less rare in infants than was formerly assumed. It is certainly not very uncommon in advanced life. The two sexes are almost equally affected. Tuberculosis is a disease of civilisation, and is to be found in all populous communities, without much regard to conditions of climate or soil.

PROPHYLAXIS.—This topic can only be alluded to very briefly. Recognising that tubercular sputum is a source of infection, our efforts must be directed to its disinfection or complete destruction. When large fires or furnaces are available, as in hospitals, the sputum should be burnt. In other cases, it may be treated with suitable disinfectants and discharged into the drains. The sputum must on no account be allowed to dry, and should be received into suitable earthenware spittoons, containing carbolic acid solution (1 in 20). Patients should be instructed not to expectorate into handkerchiefs, owing to the possibility of the dried sputum becoming diffused in the air. Contamination of clothing, bedding, carpets, must be guarded against. All body-linen and woollen articles should be boiled, or otherwise disinfected, before they are sent to the laundry. Rooms that have been inhabited by bedridden patients should be disinfected.

Meat ought to be well cooked, and all milk must be boiled, especially if intended for the use of children. If the disease is suspected, marriage should, if possible, be postponed. In the case of husband or wife becoming affected, clear and simple instructions should be given as to the precautions necessary, and it should be explained that the sputum constitutes a danger. In delicate persons and in children, more particularly after such diseases as measles, whooping-cough, influenza, and typhoid fever, all catarrhs, however trifling they may seem, require careful treatment. In addition, the general rules of personal hygiene must be enjoined in such cases.

S. J. GEE.
PERCY KIDD.

TUBERCULAR ERUPTIONS.—This term is applied to eruptions consisting of small prominences of the skin. The use of the expression is somewhat arbitrary, inasmuch as a small tubercle would fall under the denomination of 'pimple,' and a large tubercle under that of 'tumour.' It is also objectionable on account of its double meaning. Willan defines tubercle to be 'a small, hard, superficial tumour, circumscribed and permanent, or suppurating partially.' In this definition prominence and bulk alone are regarded; and, as a consequence, in his group of tubercular eruptions of the skin, Willan brings together an incongruous assemblage of superficial growths, wholly discordant in their nature, some being grave and some only trivial, and of which the greater part can only be dealt with under their separate heads. For example, he enumerates as members of this group: 'phyma, verruca, molluscum, vitiligo, acne, sycosis, lupus, elephantiasis, frambæsia;' and omits altogether that very important group of tubercular eruptions which are due to syphilis.

Erasmus Wilson.

TUBERCULAR MENINGITIS.—A form of meningitis dependent on the presence of tubercle. *See* Meninges, Cerebral, Diseases of.

TUBERCULAR PHTHISIS. — A synonym for pulmonary consumption associated with tubercle. *See* Phthisis; Tubercle; and Tuberculosis.

TUBERCULOSIS.—Synon.: Fr. *Tuberculisation*; *Tuberculose*; Ger. *Tuberculose*; *Tuberkelbildung.*—By tuberculosis is meant the production of tubercle. The anatomical and ætiological aspects of tuberculosis are discussed in the articles on Scrofula and Tubercle. The present article is devoted to the semeiotic aspect of tuberculosis; that is to say, to the signs whereby we discover the tubercular process in the living man.

We lay down two prime distinctions at the outset. First, although tubercle tends to be disseminated more or less widely, yet it commonly affects some one organ more than the rest, so that during life this organ alone seems to suffer. Wherefore tuberculosis is distinguished according to the organ most affected, a rule to which there is but one exception—namely, the form of tuberculosis which does not predominate in any part, which is a disease of the whole substance, which resembles typhus or enteric fever, and which will be described presently. Secondly, tuberculosis is acute or chronic; words which we take in their common meaning, without further definition.

In the article on tubercle will be found a list of the organs prone to tubercle. The signs of the corresponding local forms of tuberculosis are described in the appropriate articles. We speak of tubercular pleurisy, peritonitis, pericarditis, meningitis; tubercular disease of the fauces, of the intestines, of the larynx; pulmonary tuberculosis or phthisis; tubercle of the kidneys, of the genito-urinary passages; of the lymphatic glands, of the suprarenals, of the testicles, of the brain, of the skin, of the choroid, and of other parts.

Tuberculosis tends to be chronic. But some of its forms are acute, specially tubercular meningitis, tubercular pericarditis, acute pulmonary tuberculosis, and the typhoid disseminated form of the disease.

Acute typhoid tuberculosis.—The signs of this disease may be summed up thus: Fever, and the usual attendants thereof; without signs of local inflammation, or of typhus or enteric fever. Marked by the thermometer, the fever is not high, seldom rising above 103°. The face devoid of expression, pale or dusky. The patient heavy, loth to be disturbed, but answering to the point. Sleep disturbed; much dreaming. Progressive emaciation. Skin dry and harsh; no eruption. Tongue dry, sordes on teeth, thirst. Belly not distended; spleen large. Nausea, vomiting; bowels costive and stools pale, or temporary looseness with yellow stools. Frequent short cough; no expectoration; no physical signs of disease in chest, except, perhaps, of slight catarrh. Pulse frequent and weak. Urine high-coloured. In a case such as this, probability would become certainty if tubercles were discovered in the choroid. Trousseau says that headache more or less severe, and delirium more or less violent, may be present.

The onset is somewhat sudden: the duration, from three to six weeks; and the termination, death. We may suppose that slight forms of the disease end in recovery; but proof is difficult or well-nigh impossible.

Treatment.—The treatment of acute tuberculosis is the same as that of any severe fever; for instance, typhus. *See* Phthisis

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TUBULAR. — A peculiar quality of sound, indicated by the name, either elicited by percussion, or heard on auscultation, in certain conditions. *See* Physical Examination.

TUMOURS.—Synon.: Fr. *Tumeurs*; Ger. *Geschwülste.*

Definition.—In the broadest sense of the word, a tumour signifies *a swelling*, and must therefore include conditions so far apart as a phantom-tumour, a hypertrophied muscle, an abscess, a hernia, or a cancer; but in its more restricted sense its application is confined to *a swelling caused by some form of new-growth.*

Classification.—The separation of new-growths into benign and malignant, though very useful as an approximate clinical distinction, is not admissible in a scientific discussion. Nor again is one that is founded upon the seat or shape of the tumour sufficiently accurate for the purpose. This arrangement would involve such antiquated terms as parenchymatous or superficial, nodules, infiltrations, fungus-growths, &c. The true classification must depend upon the actual structure, that is, the microscopical characters of the growth. Such a classification is the following:—

A. Tumours composed of a normal tissue of the adult human body, or of such a tissue very slightly modified.—(1) Fibroma, hard and soft, including Cheloid; (2) Lipoma; (3) Chondroma; (4) Osteoma; (5) Papilloma (warts and corns); (6) Adenoma; (7) Lymphoma; (8) True myoma, including Myo-fibroma; (9) True Neuroma; (10) Angioma; and (11) Lymphangioma.

B. **Tumours consisting of some modification of embryonic connective tissue,** that is, the *Sarcomas.* (1) Round-celled sarcoma, including Glioma; (2) Oval-celled sarcoma; (3) Spindle-celled sarcoma, large and small; (4) Alveolar sarcoma; (5) Mixed sarcoma; (6) Myeloid sarcoma; (7) Myxoma; (8) Osteo-sarcoma; (9) Chondro-sarcoma; (10) Melanotic sarcoma; (11) Fatty sarcoma; and (12) Psammoma.

C. **Tumours consisting of a modification of epidermic, epithelial, and secreting-gland structures.**—(1) Cancers; and (2) Rodent ulcer. These forms of new-growth are described in special articles. *See* Cancer; and Rodent Ulcer.

D. **Tumours consisting of an inflammatory growth.**—(1) *Simple.*—Granulation-tumours, Osteophytes, &c. (2) *Specific.*—Depending on the presence of syphilis, tubercle, struma, leprosy, glanders, actinomycosis, and other parasitic organisms.

The inflammatory tumours included under this class do not come strictly within the scope of the present discussion; its various sub-divisions must be sought under the description of the diseases which give rise to them, in the several articles bearing their respective names.

E. **Cysts.**—This division is also dealt with in a separate article. *See* Cysts.

A. **Tumours composed of a normal tissue of the adult human body.**—In this class are included representatives of each of the primary tissues of the adult body. The members of it, therefore, differ widely in structure and appearance; but they are distinguished from those of the second and third classes by one important feature, namely, that, though often multiple, they show little or no tendency to return after complete removal—that is, they are essentially *benignant.* To this may be added another less characteristic distinction, namely, that they have but little tendency to ulcerate; and that, as a result, if they interfere with life at all, it is by pressure on important organs, or in such an accidental way as by the bleeding which may result from a uterine fibroid, rather than by the production of direct constitutional disturbance.

1. **Fibromata.**—Definition.—Tumours consisting simply of fibrous tissue or some modification of it.

Varieties, Clinical Characters, and Microscopical Appearances.—Fibromata may be divided into *hard* and *soft fibromata.*

(*a*) *Soft fibrous tumours.*—The soft fibromata are simple masses of connective tissue, occurring in the submucous or subcutaneous structures, and generally, but not always, more or less pedunculated. In many cases there are overgrown papillæ on the surface; and overgrown and distorted glands of the skin or mucous membrane are often entangled amongst the meshes of the tumour. The *subcutaneous* variety occurs in all parts of the body, but is perhaps most common in the labia majora and the lower limbs; and to it the name of *molluscum fibrosum* has been applied. These tumours often contain a considerable amount of fat, and thus approach the lipomata. They often appear œdematous; and may undergo calcareous or other forms of degeneration. The *submucous* variety includes the simple polypi of the nose and, if such occur, of the middle ear. In these the fibrous tissue is somewhat modified; the ordinary connective-tissue cells, oval, oat-shaped, or branched, being embedded in a more or less copious gelatinous (? mucous) matrix. Such tumours are nearly related, on the one hand, to the myxomata, and are covered by a mucous membrane corresponding to the region in which they occur—ciliated, for example, in the nose (fig. 161), and columnar in the intestine. On the other hand, they often contain in their interior the characteristic glands of the part they affect, and thus approximate to the adenomata. To the naked eye they have a gelatinous appearance. The reader will observe that the varieties of *elephantiasis*, a disease which presents a complex structure, are not included under this heading.

(*b*) *Hard fibrous tumours.*—These tumours are made up of pure fibrous tissue, but it is very difficult to draw the line between them and some forms of sarcoma. They are firm, usually encapsuled, and often pedunculated. To the naked eye a section is white or pinkish, and presents an appearance as if its component parts were arranged concentrically round a number of points. This appearance is more marked on microscopic examination, which, while it shows this concentric arrangement in bundles that have been cut across, exhibits others which have been divided longitudinally (*see* fig. 160). Hard fibromata occur in many situations: in the subcutaneous tissue, including amongst others the cheloid tumours, the fibrous tumours of the pinna, which are sometimes caused by the piercing of the ears for ear-rings, or may result from the hæmatomata not infrequently met with in idiots, and some, at least, of that peculiar class of tumours called 'the painful subcutaneous tubercle'; in submucous tissues, including many of the naso-pharyngeal polypi, and some of the fibrous tumours and polypi of the uterus; in connexion with the periosteum, including the fibrous epulis, which probably often starts as a myeloid, the so-called [illegible] tumours of bone, and, according to some authorities, though this is doubtful, some kinds of subungual exostosis; in nerves, including the common neuromata, and bulbous nerves in a stump; and in the intermuscular planes. They are liable to various forms of degeneration; they often calcify; and those in connexion with the periosteum may undergo ossification. Some fibrous tumours cause serious danger to life from the position they occupy; it will be enough to cite the cases of naso-pharyngeal polypi, and polypi of the uterus.

Treatment.—Fibromata can only be treated, if interference of any kind be necessary, by complete removal, the nature of the operation depending upon the position of the growth. If completely removed, they have no tendency to recurrence.

2. **Lipoma.**—Definition.—A tumour composed of normal adipose tissue.

Varieties and Clinical Characters.—Occasionally more or less local hypertrophies of the subcutaneous fatty layer occur, and merit almost the designation of a tumour; but the true lipoma is a pretty well-defined tumour, made up of a larger or smaller number of overgrown fat-lobules. These are sometimes of enormous size, so that only two or three are found in a tumour of considerable dimensions. The skin presents a very characteristic dimpling, when moved to and fro over such a subcutaneous fatty tumour. The superficial parts of the mass may generally be easily separated from the surrounding structures during an operation for its removal; but the deeper parts, often consisting of smaller lobules, and generally containing a vessel of some magnitude, require more careful enucleation. Fatty tumours are met with in all parts of the body in which adipose tissue is normally developed. The writer once met with a fatty tumour inside the spinal column. They may occur congenitally, but are more common in middle and advanced life. They are often multiple, and are apparently in some cases developed as the result of pressure; and sometimes they are remarkably symmetrical. They involve no danger to life, but are often very painful, as the result of pressure upon cutaneous nerves. Microscopically, the structure is that of ordinary adipose tissue.

Treatment.—Though fatty tumours are said to shift their position, and sometimes to diminish in size spontaneously, they are not to be dispersed by internal remedies or external applications. If necessary, they must be removed by the knife, an operation which, as already mentioned, is usually easy. It is to be observed that recurrence may take place unless they be completely removed.

3. **Chondromata.**—Definition.—Tumours made up altogether, or in great measure, of cartilage.

Varieties, Course, and Clinical Characters.—Cartilage-tumours may be divided into those which grow in connexion with a *bone*; and those which are developed in the *soft parts.*

Cartilaginous tumours growing in connexion with bone.—These may be again subdivided into those which grow from the surface of the bone—*ecchondromata*; and those which grow from the interior—*enchondromata.* The latter are the simplest form of cartilage-tumours; they commence usually during the period of adolescence, and affect by preference the fingers and toes, but are occasionally found elsewhere; they are almost always multiple, but never show a malignant tendency; they may reach a very considerable size; and they are generally coated with a thin layer of bony tissue. The *ecchondromata* are developed, as a rule, during a later period of life; are found in connexion with any of the bones of the body; and often attain an enormous size, as, for example, in the pelvis. Some of these tumours, to which Virchow has given the name of *osteoid chondroma,* such as are occasionally found forming elongated swellings in the shaft of a long bone, present a high degree of malignancy, recurring as such in distant parts of the body.

Cartilaginous tumours of the soft parts.—These tumours occur principally in connexion with certain glands, and especially in the neighbourhood of the parotid, and in the testicle. It has been suggested that they may originate from some remains of fœtal structures. Rarer situations for such tumours are the submaxillary gland, the breast, the ovary, the lacrymal gland, the kidney, and, it is said, the lung. These tumours are comparatively seldom pure, but are usually mixed with myxomatous, adenoid, or sarcomatous structure; the degree of such admixture determining in great part the benignness or malignancy of the growth.

An account of the so-called *ossifying chondromata* is given under heading 4.

Naked-Eye Appearances.—Cartilaginous tumours vary very much in density; the hardest contain fibrous tissue, and are, in fact, fibro-cartilaginous growths; the softest are very soft, and are very closely related to the myxomata; indeed, it may be held that many myxomata are merely varieties of chondroma. Some chondromata soften, either in many parts or in the centre, giving rise to one or more cysts in the interior; the bursting of such may lead to a permanent sinus. Other forms of degeneration are not uncommon, and especially calcification. True ossification is not rare.

Microscopical Characters.—Microscopically the structure often differs widely in different specimens of chondroma, and in different parts of the same tumour; the matrix may be hyaline or fibrous; and the cells

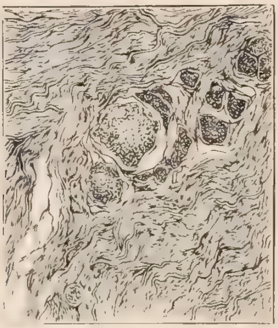
Fig. 160. Fibroma (Neuroma).

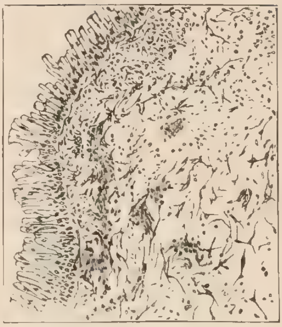
Fig. 161. Polypus of Nose.

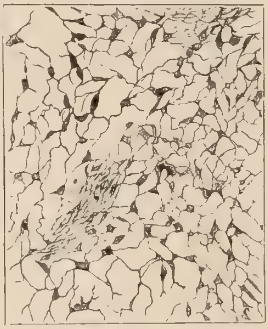
Fig. 162. Myxoma.

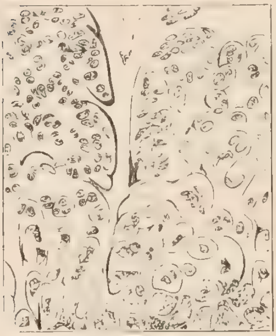
Fig. 163. Ossifying Chondroma.

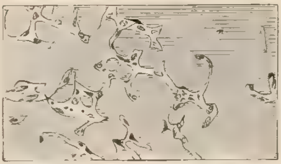
Fig. 164. Enchondroma (of Jaw).

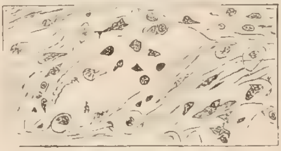
Fig. 165. Enchondroma (of Orbit).

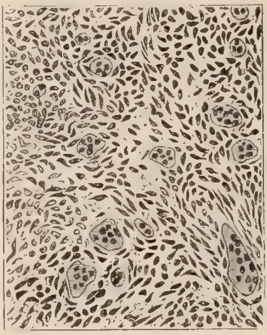
Fig. 166. Myeloid of Jaw.

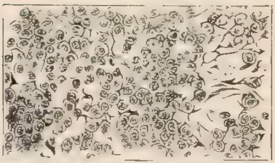
Fig. 167. Large Round-celled Sarcoma.

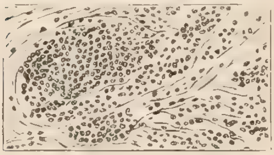
Fig. 168. Small Round-celled Sarcoma.

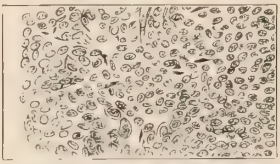
Fig. 169. Oval-celled Sarcoma.

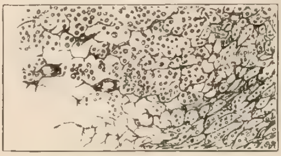
Fig. 170. Lymphoma.

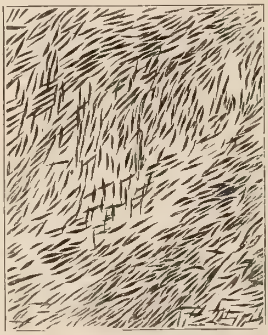
Fig. 171. Small Spindle-celled Sarcoma.

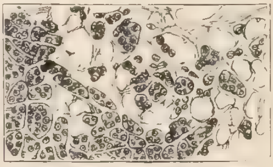
Fig. 172. Alveolar Sarcoma.

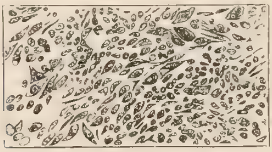
Fig. 173. Mixed Sarcoma.

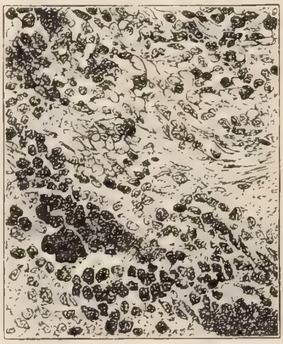
Fig. 174. Melanotic Sarcoma.

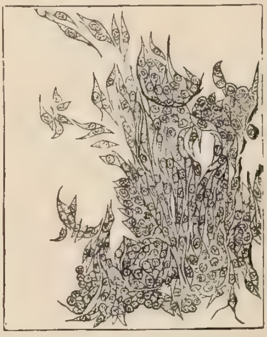
Fig. 175 Large Spindle-celled Sarcoma.

Drawings illustrating a Series of Tumours of the Connective-tissue Type.
All drawn to the same scale (× 87 diameters).

round, irregular, stellate, or much-branched (figs. 164 and 165). It will easily be understood that with a soft hyaline matrix and much-branched cells, the appearance of myxoma is very closely simulated.

Treatment.—Bearing in mind the great variety of these tumours, it will be seen that it is impossible to sum up the treatment of them in a few words. The simple enchondromata of the fingers should only be removed to cure deformity or similar inconvenience. As a rule, other forms should be removed as early as possible; but many chondromata spring from regions which are altogether beyond the reach of the surgeon's knife.

4. Osteomata.—**Definition.**—Tumours composed of bone.

Varieties.—If the inflammatory exostoses be excluded, such as those which are found round a joint affected with chronic rheumatic arthritis, or those which depend upon the ossification of a node, or of inflammatory products in the external auditory meatus, we may divide this class of tumours as follows:—

(*a*) Osteomata developed as such on the exterior of a bone, including the ivory exostosis—*periosteal exostoses.*

(*b*) Osteomata developed as such in the interior of a bone—*enostoses.*

(*c*) *Pedunculated exostoses.*

(*d*) Osseous tumours of *the soft parts.*

(*e*) Osseous tumours produced by the *ossification of other kinds of new-growths.*

(*f*) And lastly (though not strictly coming under the same category) the *odontomata.*

(*a*) *Periosteal exostoses.* — These are irregular bony tumours, appearing usually in adult life; they are directly continuous with the bone from which they spring; and are composed sometimes of cancellous structure, with a thin coating of compact tissue, but much more frequently of denser material. They most often affect the bones of the face, where they produce horrible and distressing deformities; but are also found on the skull, in the meatus of the ear, or, more rarely, on the long bones. From the importance of the neighbouring structures it is, in most cases, impossible to remove them, but where it is possible and advisable, as for example in the ear, they should be removed with the gouge and hammer, or by means of a drill. Some of these tumours are of extreme density, and have hence been called *ivory exostoses*; these, when they affect the upper jaw, their commonest seat, must be distinguished from the *odontomata*, to be presently described.

(*b*) *Enostoses.*—Enostoses need only be mentioned in order to point out their extreme rarity; but it may be remarked that many of the last-described series of tumours probably spring from the diploë of the cranial bones, and should thus, perhaps, more properly be included under this heading.

(*c*) *Pedunculated exostoses.*—The pedunculated exostosis, or ossifying chondroma, is a subperiosteal chondroma, with a tendency to ossification, developed in young persons, near the junction of an epiphysis with a diaphysis.

Pedunculated exostoses approach the spherical shape, but are sometimes irregular or flattish, and often tuberculated. The peduncle varies in its relative size, the growth being often nearly sessile. On section the tumour shows a layer of periosteum superficially; beneath this is a layer of cartilage, sometimes thick, sometimes almost imperceptible. The deeper part of the cartilaginous layer is calcified, and looks like imperfectly formed bone. The centre of the tumour consists of true bone, with Haversian systems complete, and is directly continuous with the tissue of the bone itself. The cancelli are sometimes dilated so as to form actual cysts containing clear fluid. In adult life the layer of cartilage disappears, and the tumours cease growing.

The microscopical appearance answers exactly to the structure which is apparent to the naked eye (fig. 163).

These tumours occur most often near the ends of the long bones, but may be found elsewhere; on the scapula, for example. They are often multiple and symmetrical, and if multiple are frequently hereditary. In certain situations, as, for instance, on the inner side of the knees, they may cause much inconvenience, from the pain produced by pressure as in riding, or from the catching and sudden slipping over the tumour of tendons or other fibrous structures in the neighbourhood. For this reason, or from their size, they may require removal. This may be done freely if antiseptic precautions be adopted; otherwise the opening of the cancellous structure of the bone, and the danger of wounding the contiguous joint, may perhaps involve greater risk than the amount of inconvenience entailed by the tumour would justify. They have sometimes been either purposely or accidentally separated from their attachment by a blow, without inflicting a wound on the soft parts at all. Unless the whole cartilage-layer be removed, recurrence will probably happen, as growth of the tumour takes place by increase of this layer only, the process of calcification and subsequent ossification being secondary and, so to speak, accidental.

(*d*) *Osseous tumours of the soft parts.*—These osteomata are also uncommon. They include such conditions as the following: tumours springing from the periosteum, but not actually united to the bone; ossifying chondromata not connected with the bone; detached exostoses; ossification taking place in muscles or tendons, such as that which is occasionally met with in the adductor longus; and perhaps some other instances of greater rarity.

(*e*) *Osseous tumours produced by the ossification of other kinds of new-growths.*—These are only secondarily, and often only partially, worthy of the name of osteomata; they are the result of a process of ossification taking place in tumours of a different nature originally, such as fibromas or sarcomas. It must be remembered that, while calcification of new-growths is a common form of degeneration, the occurrence of true ossification is very rare.

(*f*) *Odontomata.* — Odontomata are tumours composed of one or more of the constituents of the teeth. The simplest variety consists of a sort of exostosis from the fang. These are usually of small size, and may extend from one tooth to another. Such tumours are composed altogether of cement. The other kind is more or less covered with enamel, and contains dentine and cement in varying proportions; these, the true odontomata, may sometimes attain a very considerable size. They are only found in connexion with the jaws.

5. **Papillomata.** — Definition. — Papillary and villous over-growths, whether occurring on the mucous membrane, skin, or serous membrane, which do not present malignant characters.

Varieties and Symptoms.—Mucous papillomata are found on the lips, tongue, and soft palate, and in the larynx; in the intestines, especially at the lower part; round the anus (condylomata); in the bladder (the simple villous tumour); on the conjunctiva; and at the orifice of the female meatus urinarius. Epidermic papillomata include warts and corns, and may occur on any part of the skin; those about the external genitals may reach an enormous size, and are frequently the result of gonorrhœa. The serous and synovial papillomata are more rare; under this class must be named the Pacchionian bodies, and the enlarged synovial fringes which are often the commencements of loose bodies in joints. Many papillomata are of syphilitic origin; others may be caused by local irritation, as, for instance, the cadaveric wart, in which the papillary growth is accompanied by inflammation and suppuration beneath the skin. But with regard to the last-named affection it must be added that recent observations point to its dependence on, or constant association with, the presence of the tubercle bacillus.

Naked-Eye Appearances. — The naked-eye appearances vary very much with the locality in which the growths are developed; but they present this character in common, that they are obviously composed of the papillæ or villi of the part from which they grow, though these may be of much more than the natural size. Those springing from mucous and serous membranes are soft, and usually moist on the surface; while epidermic papillomata are dry and hard.

Microscopical Characters.—Microscopically papillomata are made up of connective tissue containing numerous vessels, covered by the characteristic epithelium or epidermis of the part (fig. 7, vol. i. p. 270). The arrangement of the connective tissue and epithelial elements is a close imitation of that of the normal tissues from which they grow. The microscopical structure of the benign polypus of the intestine (fig. 10, vol. i. p. 270) is hardly to be distinguished from that of many malignant growths in this situation. *See* Cancer.

Treatment.—If affecting the larynx or bladder, papillomata may give rise to distressing and dangerous symptoms, and may necessitate severe operations for their extirpation. Those which occur on accessible parts are generally removed without any risk, except such as arises from their great vascularity; and show, as a rule, but little tendency to recur after complete removal. The common wart, however, often gives great trouble. Various caustics may be used, such as the acid nitrate of mercury, fuming nitric acid, caustic potash, acetic acid, or nitrate of silver; salicylic acid is also often extremely useful; but while these remedies are sometimes efficacious, the warts will often recur with the greatest possible inveteracy. At the same time it must be remembered that they frequently show a most capricious tendency to spontaneous cure; the surgeon will sometimes be mortified at finding that while his energies have been devoted with but partial success to the cure of one or two out of an extensive crop of these growths, the remainder have, in the meantime, spontaneously disappeared. The cadaveric or dissecting-room wart is best treated in the early stages by soothing applications, and may perhaps be cured by the external use of belladonna; should this, however, prove unsuccessful, the employment of a powerful caustic must be resorted to (*see* Post-Mortem Wounds). The best local treatment for condylomata and gonorrhœal warts is the application of some desiccating powder, such as dried alum. It is well to remember that warts which remain a long time uncured are apt to become epitheliomatous; and not only so, but that any chronic irritation, whether from the application of insufficient methods of cure or other causes, is likely to lead to the same result.

6. **Adenomata.** — Definition. — An ill-defined group of tumours, a typical member of which is essentially non-malignant, and is made up of tissue exactly resembling that of the gland from which it springs; but the departures from the ordinary type are so many and so varied, and, at times, so indefinite, that it becomes impossible to draw a clear line between the adenomata and the carcinomata, or indeed between the adenomata and the sarcomata.

(*a*) *Adenoma of the Sweat-glands.*—This class is said to include some non-ulcerating cutaneous tumours (the tubular epitheliomata of some authors); and some ulcerating ones—the cancroids or rodent ulcers have been erroneously placed under this heading. *See* RODENT ULCER.

(*b*) *Adenoma of the Sebaceous Glands.*—This is a rare tumour, growing on different parts of the skin.

Though not strictly a tumour, that local hypertrophy of the skin of the nose, to which the popular name of 'grog-blossom' has been given, must be mentioned here. This forms a nodular purplish tumour, growing from the end of the nose, and often reaching an enormous size. When cut into, it bleeds freely, and exudes from innumerable cavities in its interior an inspissated sebaceous secretion. *Microscopically* it is seen that the connective tissue and the vessels are hypertrophied, as well as the sebaceous glands. The *treatment* consists in removal by the knife; and cicatrisation generally occurs with wonderful rapidity. Recurrence is not uncommon.

(*c*) *Adenoma of the Mucous Glands.*—Under this heading might be included some of the simple polypi of the nose (*see* Fibromata). The best representation, however, is the simple polypus of the rectum. This is a sessile or pedunculated roundish tumour, occurring mostly in children and young subjects. It bleeds freely from the surface, and is often the cause of painful and somewhat troublesome symptoms, amongst which prolapsus ani is the most common. *Microscopically* it consists of tissue closely resembling that of the mucous membrane of the rectum, but the hypertrophied follicles are often embedded in a tissue very similar to that which forms the basis of the mucous polypus of the nose (fig. 10, vol. i. p. 270). The *treatment* is by removal either with the knife or ligature, or some form of snare or écraseur. Recurrence does not, as a rule, take place.

As is stated in the article CANCER, and as is shown in figs 10 and 11, vol. i. p. 270, it is often almost impossible to distinguish, by their microscopical appearances, the simple adenomata of the large intestine from the malignant growths affecting the same structures. The same observation applies to many tumours of the jaws, such as that in fig. 18, vol. i. p. 270, which, though classed amongst the adenoids, often exhibit a high degree of malignancy.

(*d*) *Adenoma of the Breast.*—The most typical adenoma of the breast is a rounded tumour of moderate size, occurring often at the margin of the gland and frequently near the axillary border, completely encapsuled, and consisting of tissue which hardly differs from ordinary mammary structure (fig. 19, vol. i. p. 270). It occurs usually in young women, often during the child-bearing period. It shows no tendency to recur after removal. A large number of adenoids of the breast do not, however, agree with this description, either as regards position or structure. In structure departure may take place from the normal type in two directions: by an excessive or abnormal development either (1) of the epithelial or (2) of the connective-tissue elements. In the former case the tumour, in proportion to its abnormality, approaches the cancers; in the latter it assumes more and more closely the characters of the sarcomas. Thus we find some of the softer adenomata, as shown in fig. 21, vol. i. p. 270, exhibiting a tendency to recur after removal, in the same way as a carcinoma, and with an almost equal degree of malignancy; while others, presenting characters like those of fig. 22, vol. i. p. 270, may follow the same course as a sarcoma, both as regards the manner of involving surrounding tissues, and the way in which they recur in the viscera. These latter are called *adenosarcomata*, and often attain an enormous size. If the stroma of one of these tumours be in large amount, and fibrous or myxomatous, the names of *fibro-adenoma* and *myxo-adenoma* may be applied. Adenomata often contain cysts, and these cysts not infrequently intracystic growths. They must be treated by removal of the growth.

The reader must be content with the foregoing approximate description of this important class of tumours, the varieties in the nomenclature of which are equal to the number of the authors who have written on the subject. The writer believes that much unnecessary confusion has been caused by this multiplication of names, for a detailed account of which special works must be consulted, as their discussion would lead far beyond the limits of the present article.

(*e*) *Other forms of Adenoma.*—Amongst other rarer forms of adenoma, bearing a more or less close relationship to the glands from which they spring, may be enumerated the following: Adenomata of the testicle or ovary, of the salivary and lacrymal glands, of the liver, and some tumours of the thyroid. Many of the symmetrical enlargements of the thyroid, however, are simply hypertrophies of the gland itself, and should therefore be classed with simple hypertrophy of the breast and ordinary enlarged prostate, rather than with the tumours now under discussion. It should be noted that many of the less typical adenomata, especially those of the salivary glands and the testicle, frequently are found in combination with other heteroplastic growths, such as chondroma, myxoma, or some form of sarcoma.

7. **Lymphoma.**—Under certain circumstances, for an account of which the reader is referred to the article LYMPHADENOMA, the lymphatic glands throughout the body become enlarged, forming tumours, often of enormous size. Occasionally these growths

assume a more malignant character, involving the parts in the neighbourhood of the glands from which they spring, and being followed by the appearance of secondary growths in other parts of the body. To such a condition as this the term *lymphoma* has been applied. The glands are usually soft, but sometimes hard, and in the early stages easily movable amongst, or removable from, the surrounding tissues; in colour they are a yellowish-white, as also are the secondary growths. *Microscopically* they show the structure of an ordinary lymphatic gland, which, it will be observed (fig. 170), differs from that of a small round-celled sarcoma only in the fact that the stroma is much more definite and characteristic. Some of them are perhaps more appropriately called *lymphosarcoma*.

8. **Myoma.** — DEFINITION.— A tumour composed of muscular tissue.

With certain very rare exceptions, the only form of muscle-tissue occurring as an integral part of a tumour, is the *unstriped* variety; and almost the only position in which this is found is in the so-called 'fibroma' (myoma) of the uterus. This growth consists of a mixture of fibrous tissue with plain muscular fibres in varying amount, usually exhibiting the concentric arrangement of its elements, which was described as characteristic of fibromas generally. Fibromata of the uterus may form pedunculated tumours on the external or internal surface of the uterus, or they may not extend beyond the uterine wall. They give rise to a variety of special symptoms, and require special methods of treatment, which it is beyond the scope of this article to discuss. *See* WOMB, Diseases of.

Striped muscular fibre has been found in a few cases of congenital tumour of the kidneys; and the writer has also seen it in a fatty tumour growing inside the spinal canal.

9. **Neuromata.**—DEFINITION.—Tumours composed essentially of any form of nerve-tissue.

The majority of neuromas are really fibromas, that is, fibrous tumours developed amongst and around the fibres of the nerve from which they spring. The idiopathic forms are sometimes single, but generally multiple, of small size, very hard, and affecting usually the branches of a particular cutaneous nerve. The amount of pain and tenderness caused by these growths varies very much, but is sometimes excessive. A clinical feature of some use in diagnosis is the fact that they usually move readily in the lateral, but very imperfectly in the vertical direction. What may be called traumatic neuromata, are fibromas containing tortuous outgrowths of the nerve-fibres developed at the end of a divided nerve in a stump. These often cause excessive pain, and peculiar reflex phenomena; while they show a remarkable tendency to recur after removal. Neuromata on the cranial nerves are rare; they may cause serious and characteristic symptoms. Still rarer are the true neuromata of the brain and spinal column, and those occasionally met with in connexion with the nerves or ganglia of the sympathetic.

It must not be forgotten that less simple tumours not infrequently affect nerves, such as the various forms of sarcoma, or myxoma. No special description of these growths in this situation is, however, required.

10. **Angioma.**—SYNON.: Teleangiectasis.

DEFINITION.—A tumour composed of blood-vessels.

Angiomata divide themselves naturally into those in which the *capillary* element predominates; and those which are chiefly made up of vessels of *larger* size.

(*a*) *Capillary angiomata.*—DESCRIPTION.—These are the *nævi*, which, while they sometimes form tumours of some magnitude, often, as in the case of so-called 'claret-cheek,' involve no increase in the size of the affected part. Nævi are nearly always congenital, hence the term 'mother's mark.' They may be subdivided into *cutaneous* and *subcutaneous* nævi. The former are of a more or less bright red colour, and affect only the cutaneous structures or mucous membrane; the latter, as seen through the skin, in cases where this remains unaffected, have a purplish tint, and may involve any of the deeper structures of the body. They are usually as circumscribed as fatty tumours, and very commonly involve the skin. Nævi often grow with extreme rapidity, and though they involve no danger to life (except in such rare conditions as when serious or fatal hæmorrhage occurs from a nævus of the pelvis of the kidney or of the rectum), they may cause serious inconvenience and great disfigurement. Sometimes, however, they exhibit a tendency to spontaneous disappearance, and often they remain permanently stationary. They are liable to various forms of degeneration, notably the cystic, and the ulcerative or suppurative.

Microscopically a nævus is composed of large capillaries, amongst which are seen arterial and venous trunks of larger size. Between the vessels is found connective tissue or fat, and sometimes the special constituents of the skin, such as sweat or sebaceous glands. The nævus-element enters rather largely into the composition of some other tumours, and notably of congenital moles (*benignant melanoses*).

TREATMENT. — Inflammation of a nævus generally leads to spontaneous cure; nature thus suggesting one of the best methods of treatment at the disposal of the surgeon, namely, the injection of the tumour with some suitable irritant, such as carbolic acid. In adopting this line of treatment, it must be remembered that a danger exists of the irritating fluid entering a larger vessel, and by passing to the heart and setting up coagulation there causing instant death; this may be guarded against by the application of a temporary ligature. Other recognised and useful plans of treatment are the following: the ligature, pressure, the application of caustics—and especially fuming nitric acid, electrolysis, puncture with the actual cautery, and complete excision of the mass. The last in available situations affords the most speedy cure, and often leaves the least conspicuous scar.

(*b*) *Cavernous angiomata.*—Description. Those angiomata which are made up of larger vessels, and which are hence called the cavernous angiomata, from their resemblance in structure to erectile tissue, consist of cavernous spaces, communicating by smaller or larger vessels, and separated by trabeculæ of greater or less thickness and substance. These are the *pulsating nævi*, and perhaps some of the so-called *aneurysms by anastomosis*. They are of a more dusky colour than simple nævi, and often present a distinct thrill or bruit, which is perceptible both to the patient and to the surgeon. They are sometimes encapsuled, sometimes diffused; and in the latter case show an almost malignant tendency to involve neighbouring structures. The pulsation is often a most distressing symptom to the patient, if the tumour be found occupying such positions as the pinna of the ear or the fat of the orbit, both of which situations are not at all uncommon for the occurrence of the disease. *Microscopically* a cavernous angioma presents fibrous trabeculæ, lined with the characteristic vascular endothelium, and in parts perhaps separated by layers of areolar or any other tissue which the tumour may happen to involve.

Treatment.—The treatment must be pursued on the same lines as that for the simple forms of nævus. But injection is a much more dangerous proceeding on account of the large size of the vessels, and excision is apt to be accompanied with serious hæmorrhage, because of the enlargement of the vessels in the neighbourhood.

11. Lymphangioma.—Definition.—A rare kind of tumour, which may briefly be described as a cavernous angioma made up of lymphatic vessels.

To this class belong some curious and uncommon flat pinkish elevations of the skin, characterised by the presence of minute vessels containing clear fluid, and particularly prone to erysipelatous inflammation. It also in all probability includes the *cystic hygromas* occasionally met with congenitally, forming large masses in the neck, beneath the tongue, on the upper extremities, or, rarely, in other parts of the body, and perhaps also some forms of elephantiasis Arabum. Our knowledge of the pathology and treatment of these tumours is at present very imperfect, and the literature on the subject is extremely meagre. The reader is referred, for an account of all forms of angiomata, to the fourth volume of Virchow's *Die krankhaften Geschwülste*.

B. **Sarcomata.** Definition.—It is to be regretted that the term 'sarcoma' has not been allowed to slip out of pathological terminology. From the days of Galen almost to our own time it has served, in the hands of different authors, to designate different classes of tumours, sometimes of the simplest, sometimes of the most malignant character. Virchow, however, has given a meaning to the word which is now generally recognised by pathologists. He includes under *sarcomas* those new-growths which, while they do not actually consist of any of the tissues of the adult body, are evidently built on the connective-tissue type, and consist of a modification of the connective tissue of the embryo. They are thus very closely related to some of the simple tumours, and indeed often include portions of some normal tissue, such as bone, cartilage, or fibrous tissue—a fact which necessitates the employment of complicated and confusing names, including *osteo-sarcoma*, *chondro-sarcoma*, *fibro-sarcoma*, and such-like.

Microscopical Characters.—Histologically, then, a sarcoma is made up simply of cells of the connective-tissue type, which may assume very various shapes and sizes in different tumours, and which are surrounded by a varying amount of intercellular substance.

Clinical Characters.—Theoretically sarcomata should always be developed in one of the connective-tissue structures, and practically they are not very often seen to originate in a secreting gland. But a glandular origin is not by any means very uncommon, as indeed might have been expected when it is remembered that every gland contains a considerable amount of connective tissue. Sarcomas present all degrees of malignancy; but, as a rough rule, it may be stated that the higher the degree of development of the tumour, the less likely is recurrence to take place after removal. In connexion with this point it is interesting to note that each recurrence of a sarcoma often shows a more rudimentary structure, but at the same time a greater degree of malignancy.

Recurrence does not follow the same rule that has been observed in the case of cancer. The lymphatic glands often escape altogether, or are but slightly affected; while fresh tumours spring up in abundance in distant parts of the body.

Sarcomas increase in size in the same way as cancers, but in the less malignant forms are often surrounded by a more or less distinct capsule.

Naked-Eye Appearances.—The naked-eye appearances of sarcomata are subject to very wide variations. It may, however, be observed that they never present the hollowed surface on section which is characteristic of some cancers; and they do not, except in the case of the softest tumours, exude a milky juice on scraping. Sarcomata are well supplied with vessels.

VARIETIES.—1. *Round-celled Sarcomata.* These are the most rudimentary, and, as a rule, the most malignant of this class. They are usually soft—sometimes very soft, seldom encapsuled, and generally of a whitish colour. Formerly they were classed amongst the medullary cancers. They are made up of round cells, as the name implies, and have a tendency to group themselves into two classes, in one of which the cells are *small* and uniform in size (fig. 168), closely resembling those of granulation-tissue; and in the other large, sometimes very large, and often somewhat irregular (fig. 167). The intercellular substance may be copious and homogeneous, in which case the tumour approaches the myxomata; or smaller in amount and fibrous, when, if the cells are small, it may be difficult to separate such a sarcoma from the lymphomata. To some of these the term *lymphosarcoma* has been applied. Such tumours occur in the tonsil, or may start in the lymphatic glands.

Under this head must be placed the *Gliomata*—soft medullary tumours met with in the brain or in connexion with nerves, frequently with the retina, and occurring commonly in children. They show microscopically a delicate stroma.

2. *Oval-celled Sarcomata.*—This variety of sarcoma represents the next stage in advance from the simplest towards a more complex structure. They differ, in fact, but slightly from the round-celled growth, either in clinical or in microscopical characters (fig. 169), but may be looked upon as intermediate between these and the spindle-celled sarcomas.

3. *Spindle-celled Sarcomata.*—This class must be subdivided into the *small spindle-celled*, and the *large spindle-celled* varieties.

The *small spindle-celled sarcomata* are firm, whitish, well-defined tumours, which approach the fibromata, sometimes very closely, and which after complete removal show a comparatively slight tendency to recur. These were the *recurrent fibroids* of older writers. *Microscopically* (fig. 171) they consist of broad interlacing bands of elongated cells, with but little intercellular material—a structure which does not differ widely from imperfectly formed fibrous tissue.

The *large spindle-celled sarcomata* (fig. 175) are softer growths, frequently supplied with a very imperfect capsule, generally pinkish on section, or stained in parts dark red from extravasated blood, and often showing cysts. They may occur in any fibrous structure, but are rather common in connexion with the periosteum. The malignancy of these growths is much greater than that of the small-celled class. *Microscopically* they consist of very large nucleated cells, with long tapering tails, and but little intercellular substance. These are the *fibro-plastic* tumours.

4. *Alveolar Sarcomata.*—Examined *microscopically* this rare form of tumour (fig. 172) bears a superficial resemblance to a cancer. There is, that is to say, a coarse stroma forming alveolar spaces, each of which contains a variable number of large, round, nucleated cells; each space is, however, again subdivided by a very delicate secondary intercellular stroma. This is only demonstrable on pencilling out the cells, which, unlike a similar process applied to a cancer, is a work of considerable difficulty. Alveolar sarcomas affect most commonly subcutaneous tissues primarily; they are apt to recur in other parts of the body, and ultimately in internal organs, but often run a very chronic course.

5. *Mixed Sarcomata.*—Tumours are often met with which present a mixture of the different structures just described. Such are conveniently called mixed sarcomata; and the term may with advantage be made to include those growths which contain, besides sarcoma-tissue, bone, cartilage, gland-tissue, and what not. The latter growths will necessitate the employment of such names as osteo-sarcoma, chondro-sarcoma, adeno-sarcoma, &c.

6. **Myeloid.**—SYNON.: Giant-celled Sarcomata.—These tumours are best classed amongst the sarcomata. *Microscopically* (fig. 166) they present the following elements, one or other of which may greatly predominate: fibro-plastic or spindle-cells, oval or round cells, and very large nucleated cells, the so-called 'myeloid' or 'giant' cells. These last are irregular or rounded collections of granular protoplasm, in which occur numerous clear oval nuclei, containing a well-marked nucleolus. The amount of intercellular substance is small. In a fresh scraping, the clear oval nuclei are set free by the breaking up of the giant-cells. To the naked eye a section of a myeloid tumour is pink or yellowish, but almost always mottled with darker spots, the result of extravasations of blood. Very frequently, tumours of this class present points of ossification or calcification, and not infrequently cysts. They are very soft, and usually yield a thick juice on scraping. They generally originate in, or, more rarely, close to, the end of one of the long bones; probably most often in the medullary cavity or the cancellous structure. Another frequent seat is the alveolar border of the jaws, where they form the myeloid epulis. They occur most often in young people, and if the bone involved be removed completely or in great part, have no tendency to recur; but, on the other hand, they

may exhibit a high degree of malignancy, recurring not only in other bones, but in internal organs. It is said that myeloid epulides may in time become completely fibrous.

7. **Myxoma.**—It is not easy to say whether myxomata should be classed amongst the sarcomata or amongst the simple tumours. On the one hand, the tissue of which a myxoma is composed finds no representative in the adult, unless that of the vitreous body be taken as such; but, on the other, they approach very closely some of the soft fibromata, and are nearly related to fatty tumours. At the same time a large number of myxomas appear to be actual chondromata.

Microscopically (fig. 162) a myxoma presents elongated or roundish much-branched cells, the prolongations of which intercommunicate freely. These cells are embedded in a copious, homogeneous, transparent matrix. The structure thus resembles that of fœtal fat; but, in myxomata developed from cartilage, each cell is contained in a space similar to that enclosing a cartilage cell.

Clinically these tumours are very soft and elastic, strictly encapsuled, gelatinous, semitransparent on section, and exuding a peculiar mucous juice. Myxomata are not malignant; and as a rule, if completely removed, do not recur locally. They may be found in many parts of the body, but perhaps most frequently in the subcutaneous tissue, or in connexion with some gland, particularly the parotid. Here, however, they are often mixed with adenoid and cartilaginous material. Not infrequently myxoma-tissue is combined with that of an undoubted sarcoma, which necessitates the term *myxo-sarcoma*. These tumours may occasionally be mistaken for colloid cancers. Histologically some of the soft enchondromata resemble them very closely.

8 and 9. **Osteo-Sarcoma; and Chondro-Sarcoma.**—These forms of sarcoma have just been referred to under the head of *Mixed Sarcoma*.

10. **Melanotic Sarcomata.**—These tumours are, in the experience of the writer, usually of the mixed, round, and spindle-celled variety. Some, but not all, of the cells contain a brown pigment, but in very varying amount, and pigment is also found outside the cells (fig. 174). This gives the tumour a brown or blackish appearance. These tumours, though often completely encapsuled, show a high degree of malignancy; but are often succeeded by a mixture of white and black tumours, or sometimes by white tumours alone. They are not uncommon in connexion with the choroid of the eye, and as affecting the papillæ of the skin (malignant mole), but have often been met with primarily in other parts of the body. The secondary growths are often found disseminated through every tissue of the body, forming tumours in such situations as the intestine, of peculiar and characteristic appearance. Secondary deposits in lymphatic glands are more common than is the case in other forms of sarcoma. It has been observed that in some cases of melanosis black pigment, accompanied with other morbid appearances, has been found in the blood, and also in the urine.

11. **Fatty Sarcomata.**—These are rare tumours in which some of the cells are distended with globules of fat.

12. **Psammoma.**—It is only necessary to mention this very rare tumour, which is found only in connexion with the membranes of the brain. It is composed of flattened cells, and is characterised by the peculiarity of containing brain-sand in its interior. It seldom or never gives rise to symptoms.

Teratoma.—Mention must be made, in conclusion, of a form of growth, which does not come within the classification here selected. This is a congenital tumour not infrequently met with in the region of the sacrum (*congenital sacral tumour*), but occasionally seen elsewhere; often reaching a size almost equal to that of the infant itself. In structure these tumours consist of various imperfectly developed fœtal or mature elements of the body, mixed together in apparently great confusion. Various theories as to their causation have been propounded such, for example, as that they consist of an imperfect attached fœtus, or that they originate from Luschka's gland; but we have not sufficient data at present to express an opinion on this point. Attempts at their cure by removal are attended with great danger.

R. J. Godlee.

TUNBRIDGE WELLS, in Kent.—Iron waters. *See* Mineral Waters.

TUNNEL-WORM.—A synonym for the Ankylostoma duodenale. *See* Entozoa.

TURGESCENCE (*turgesco*, I swell).—A term applied to a swollen condition of a part, generally associated with fulness of the blood-vessels, as in the mucous membrane of the conjunctiva, the fauces, or the rectum. *See* Swelling.

TUSSIS (Lat.).—A synonym for cough. *See* Cough.

TUSSIVE.—This word is applied to certain physical signs which are elicited by the act of coughing, such as *tussive fremitus* and *tussive resonance*. *See* Physical Examination.

TYLOSIS (τυλόω, I make hard or callous). Synon.: Callosity.

Definition.—Thickenings of the epithelium, occurring on parts of the body that are habitually subjected to pressure or friction. Tylosis is found, for example, on the feet, from the wearing of shoes; on the hands, from rowing or the constant use of some implement or tool; and on other parts of the body unduly submitted to pressure. A corn begins by being a callus, and only rightfully acquires the title of corn when it has forced itself at a given point against the derma, and has depressed the latter to a greater or less extent, thereby producing pain and suffering. Callosities are inconvenient rather than painful; but occasionally treatment is necessary. *Tylosis linguæ* is described under TONGUE, Diseases of: 8. Leucoma.

TREATMENT.—The best remedy under the above circumstances is the removal or avoidance of the cause. Next to this, the hardened cuticle may be softened by soaking in hot water, or by means of a water-dressing, and afterwards scraped. Or it may be painted over with a solution of salicylic acid in flexible collodion, until the excess of cuticle exfoliates in laminæ and flakes. In either case, the skin must be subsequently protected, in order to prevent it from retrograding into its former state. ERASMUS WILSON.

TYMPANITES (*tympanum*, a drum). SYNON.: Fr. *Tympanite*; Ger. *Windsucht*.—This word is associated with the distension of the abdomen that results from excessive accumulation of gas within its cavity. As a rule, the gas collects in the interior of the alimentary canal, especially the intestines; but in exceptional cases it occupies the peritoneal cavity.

ÆTIOLOGY.—Tympanites is chiefly met with under the following circumstances: 1. In connexion with certain diseases which, from their local effects, tend to paralyse the intestines, especially acute peritonitis, typhoid fever, and dysentery. 2. In cases of intestinal obstruction from any cause, but particularly when this condition is acute, and situated low down. 3. In certain low febrile diseases, accompanied with the 'typhoid state,' and tending towards a fatal issue, such as typhus fever, small-pox, erysipelas, and typhoid pneumonia. 4. As a result of perforation of the stomach or intestine. 5. In certain cases of chronic disease of the spinal cord. 6. In connexion with hysteria sometimes. In all these conditions, except where the gas escapes into the peritoneal cavity, the immediate cause of the tympanites is a more or less paralysed state of the walls of the intestines; but there is often, at the same time, an excessive formation of gas in their interior.

SYMPTOMS.—The symptoms of tympanites are due to the mechanical effects of the gaseous accumulation. The patient is usually conscious of the distension of the abdomen, and the sensation may amount to extreme discomfort or actual suffering and great distress, there being a feeling in some instances as if the abdomen must burst if the condition is not relieved. The mental state of the patient may, however, be such that he is unconscious of, or indifferent to, any unusual sensations. Breathing is often interfered with in various degrees, and the act may be very hurried, with a feeling of urgent dyspnœa. The heart is also liable to be affected, and its action more or less disturbed. The secretion of urine may be interfered with, even almost to actual suppression.

PHYSICAL SIGNS.—These are usually very characteristic. 1. The abdomen is uniformly enlarged, often to an extreme degree; being of a rounded shape; equal and symmetrical in every part, unless there happen to be a portion of bowel specially distended, and without any tendency to undue prominence in dependent parts. The skin is stretched more or less, but there is no protrusion of the umbilicus. 2. The sensations on palpation are those of perfect smoothness and regularity, with great tension or a drum-like feel. 3. Percussion gives a general tympanitic sound over the abdomen, and also brings out the drum-like sensation. If, however, the distension is extreme, the sound becomes more or less muffled and toneless. Generally the dulness of the solid organs in the abdomen is partially or entirely obscured, or is displaced upwards. 4. Change of posture produces no alteration in the physical signs. 5. There may be indications of displacement of the thoracic organs. It must be mentioned that tympanites may be associated with some fluid in the peritoneal cavity, or with other conditions, and the physical signs will be modified accordingly.

TREATMENT.—In the first instance, any obvious and immediate cause of tympanites must be removed, if practicable, such as intestinal obstruction, or an accumulation of fæces. If the symptom calls for direct treatment, relief may be afforded in some cases by applying heat, sinapisms, or turpentine stupes over the abdomen; and administering internally such remedies as brandy, aromatic spirit of ammonia, the various ethers, the volatile oils, camphor, musk, valerian, sumbul, galbanum, asafœtida, or other gum-resins. Should these fail, enemata containing asafœtida or turpentine may not uncommonly be used with advantage. The passage of a long tube through the anus into the bowel, reaching as high up as possible, such as an œsophagus-tube, is often very serviceable. In extreme cases it is allowable to puncture the large bowel in several points by means of a very small trocar, and thus afford an exit for the contained gas. This operation, however, must not be practised if there is any danger of fæcal matters gaining access into the peritoneal cavity through the punctures. When gas accumulates in this cavity, it can only be got rid of by surgical interference, should such interference be otherwise indicated.

FREDERICK T. ROBERTS.

TYMPANITIC (*tympanum*, a drum). A peculiar drum-like quality of sound elicited by percussion (*see* PHYSICAL EXAMINATION). The term is also applied to the abdomen, when it is distended with gas. *See* TYMPANITES.

TYMPANUM, Diseases of.—*See* EAR, Diseases of.

TYPES OF DISEASE.—*See* DISEASE, Types and Varieties of.

TYPHLITIS (τυφλόν, the cæcum).—Inflammation of the cæcum. *See* CÆCUM, Diseases of; and PERITYPHLITIS.

TYPHOID FEVER (τῦφος, stupor).—SYNON.: Enteric Fever; Pythogenic Fever; Gastric Fever; Infantile Remittent Fever; Fr. *Fièvre Typhoïde*; *Fièvre Gastrique*; *Dothiénentérie*; Ger. *Typhus Abdominalis*.

DEFINITION.—A continued fever of long duration; usually attended with diarrhœa; and characterised by peculiar intestinal lesions, an eruption of small rose spots, and enlargement of the spleen.

ÆTIOLOGY.—In common with other continued fevers, typhoid fever is due to the introduction from without of a specific poison into a system more or less predisposed to the disease. The nature and origin of the poison, and the modes in which it is propagated, are questions of extreme interest and importance, and they will be the first to be considered.

With regard to the origin of the poison two distinct views have been entertained: one that it is specific in its nature, and derived only from some pre-existing case of the disease; the other that, while usually produced in and derived from a person suffering from fever, it may also be generated anew by the decomposition of sewage, and perhaps of other forms of animal filth. The former of these views is associated with the name of the late Dr. Budd of Bristol; the latter, or pythogenic, hypothesis had its chief supporter in the late Dr. Murchison. Fortunately, the practical issue of both theories is the same, namely, that the great preventive measure is the prompt removal of fæcal matters, so that neither air nor water may be contaminated by them.

Typhoid fever is now generally supposed to be due to a specific *typhoid bacillus*; but for details on this subject the reader is referred to the article MICRO-ORGANISMS.

It is accepted on all hands that the typhoid poison is reproduced in the system during the fever, and that its chief, if not exclusive, outlet is in the intestinal discharges. There is no evidence that it is conveyed at all by the breath or perspiration, or by the urinary secretion. While, however, the contagium is present in the fæces, it has not apparently at the moment of their passage its full virulence, but requires for its complete development a certain period of time, and this is forwarded by some conditions, retarded or prevented by others. Exposure to sunlight and open air, as in flowing rivers, is inimical to the development of the typhoid microbe, and probably indeed destroys it. On the other hand, warmth, stagnation, seclusion from open air, accumulation and concentration of the infected discharges intensify the poison, and it would seem that a small amount of typhoid evacuations may give rise to a large development of the contagium in excretory matters with which they become mingled, and even in milk to which they may obtain access. This increase by a sort of fermentation explains the autumnal prevalence of typhoid fever observed in large towns, and the association pointed out by Dr. Murchison between a hot and dry summer and a high fever-rate in London; the drains not being flushed by abundant rainfall, sewage accumulates and stagnates in them, and typhoid stools never being wanting, the specific fermentation goes on rapidly under the influence of the high temperature, and produces the poison in quantity and intensity. It is possible, however, to put another interpretation on facts of this kind, and to attribute the generation of contagium to fermentation of fæcal matters, independently of any specific germ introduced in typhoid evacuations. Such is, indeed, the basis of the pythogenic theory of origin of typhoid fever. It is impossible to reproduce here the discussion of the question as to the specific or non-specific character and source of the contagium. There is overwhelming evidence that, as a rule, the poison is derived from some previous case; and the only facts which seem to require the supposition of its independent origin are occasional outbreaks of fever in villages or isolated buildings which cannot be traced to any known source. On similar grounds, however, we should have to admit the origin *de novo* of small-pox and all other contagious affections, and it should be added that, with increasing experience in investigations of this kind, unexplained outbreaks become more and more rare. There are again many instances known in which water largely contaminated by sewage has been consumed for years without giving rise to fever, until the sewage has itself been contaminated by typhoid excreta, when an epidemic has at once broken out. So with regard to milk, impure water has been habitually employed in its adulteration without traceable bad effects; but when to this water typhoid poison has gained access, the disease has immediately begun to be distributed with the milk.

The modes in which typhoid fever is disseminated are various. It is rarely, if ever, transmitted directly from person to person. Medical men, clergymen, and others visiting those who are suffering are not attacked nurses very rarely, when proper precautions are observed. If, however, bedclothes or carpets soiled by the evacuations are not removed, and still more where gross neglect of cleanliness and decency is permitted, attendants will contract the disease.

The most common vehicle of the poison is drinking-water, which may be contaminated in various ways, mostly through sewage. The water-supply of a town may be thus poisoned at its source, such as a river into which drains empty themselves, or a reservoir or well accidentally contaminated; or the pipes of distribution, when the supply is intermittent, may while empty become charged with sewer gases, or may even receive sewage; or excessive rainfall may, in villages and small towns, wash the contents of cesspools into wells. This same rainfall, by flushing the sewers of well-drained towns, and washing away the specific poison, has often a contrary effect in towns and country. In some places the subsoil water, permeating a bed of gravel, is at the same time the well-water of a village and a reservoir of its sewage. An imported case of fever will under these conditions poison almost the entire community. With these examples of wholesale dissemination of typhoid fever must be mentioned the so-called 'milk epidemics' already alluded to. A case of fever occurs at a farm, or among the employés of a dairy; from defective sanitary arrangements the water used at the farm or dairy becomes contaminated by the excreta; this is added to the milk as an adulteration, or, as is usually said, is used in washing out the cans, and in this way the poison obtains access to the milk, where apparently it must increase very rapidly. Hundreds of cases have been traced to a single dairy.

More commonly, perhaps, the occurrence of typhoid fever is traceable to the absence of proper sanitary arrangements in individual houses. Not to speak of cesspools and leaking drain-pipes allowing the basement to be sodden with sewage, sinks or water-closets may be imperfectly trapped, and sewer-gas diffuses through the apartments or is drawn into the living-rooms by fires, or is forced into the house by pressure in the main drains, when the poison probably enters the system through the lungs. Or the waste-pipe of the cistern is in direct communication with the drains, and sewer-gases conveyed by it are confined in the space under the cistern-lid, and absorbed by the water used for drinking purposes, which conveys the poison. In connexion with these modes of dissemination it should be borne in mind that well-made and close-fitting doors and windows may aid in compelling foul air to enter from the drains or subsoil, and that houses in elevated situations, and thus apparently well placed for drainage, are in greater danger from pressure of gases in the main drains.

It is again possible that emanations from a newly opened drain, or cesspool, or foul privy, may communicate the disease by atmospheric contagion—though this is comparatively rare—it being understood always that typhoid excreta form part of the contents. But a drain open to the air throughout its course, however offensive, is not so likely to give the disease as closed and unventilated sewers; and sewage-farms, if at all well managed, are quite harmless.

It should be added that while, in this country and in Europe generally, all the evidence tends increasingly to confirm the dependence of typhoid fever on pre-existing cases, and the dissemination by drinking-water as its chief mode of propagation, observations and investigations in India appeared till recently to show either that typhoid fever can there arise independently, or at least differently, or that there is a disease not yet distinguished from typhoid fever which has a different method of rise and spread. Dr. Climo, however, has in a series of admirable papers brought forward convincing evidence that the part played by water here is in India played by dust, which conveys the poison in the dry state to articles of food and drink.

It is unnecessary here to discuss Pettenkofer's hypothesis that the varying prevalence of typhoid fever is connected with the varying level of the subsoil water, which as it rises displaces gases which have become saturated with poison from the soil into the atmosphere. It certainly does not apply to the facts as observed in this country.

One word must be said with regard to individual susceptibility to the disease, and with regard to predisposing causes acting on the individual. It is a matter of almost daily observation that some persons never contract typhoid fever, however much they may be exposed to the poison, while others take it readily; and it is almost equally obvious that certain families are extremely susceptible, and liable to have the disease in a severe form. It is always a reason to apprehend a formidable attack if a parent have died of the fever. Typhoid fever may occur at any age, but it is very rare in advanced life. It is probably more common in infancy than is generally supposed, as it is easily overlooked or confounded with common infantile ailments. The period of life at which the disease is most common is during adolescence and the first decade of adult age. Among the predisposing causes are mental depression or shock, over-work, and debility, however induced. A person habitually imbibing the poison may not be attacked until his power of resistance is impaired by some depressing influence. In this way a chill may appear to bring on the disease. It is natural to suppose that unfavourable hygienic conditions would generate a predisposition, but doubt is thrown on this by the fact that typhoid fever does not by any means predominantly affect the poor. The influence of habitual consumption of impure water, again, is not very clear. In some instances it has appeared to make an epidemic severe, but, on the other hand, it would almost seem that the inhabitants of some towns, the water of which is constantly contaminated, acquire an immunity from the disease.

Anatomical Characters and Pathology. Special interest attaches to the structural lesions which take place in typhoid fever, as they are closely associated with the symptoms, and are accountable for many of the complications which occur. The relation of the intestinal lesions to the febrile process has been differently interpreted. They have been considered, on the one hand, as the focus in which the morbid germs multiply, and from which the blood is infected; and, on the other, the primary change has been supposed to take place in the blood, the lesions being secondary to this, like the pustules in small-pox. In fatal cases local congestions and inflammations are met with in the lungs and other organs, but the special and characteristic lesions are those taking place in the intestines and mesenteric glands. The intestinal mucous membrane of the ileum generally presents the appearances of acute catarrh; but the chief seat of the morbid changes is Peyer's patches, and the changes consist in a gradual infiltration of the glands here crowded together, followed by ulceration. The process is divisible into three stages — of *infiltration*, *ulceration*, and *separation* or *resolution*, each of which may be said, speaking roughly, to occupy a week. In the first, that of infiltration, the glands of Peyer's patches are swollen and distended by a corpuscular exudation. The entire patch is thickened and raised above the level of the surrounding mucous membrane; has a reddish, or fawn, or grey colour, according to the intensity and stage of the inflammation, and an irregular surface; is firm to the touch; and opaque when the intestine is held up to the light, often showing through the peritoneal covering.

The patches are attacked successively from below upwards; and as they are largest and most numerous at the lower end of the ileum near the ileo-cæcal valve, it is here that the lesions are most extensive and most advanced.

In about a week the follicles begin to ulcerate, or, as it is sometimes said, burst. This marks the beginning of the second stage; as it progresses, the minute ulcerations extend and coalesce, the patch having first a worm-eaten appearance, and later becoming one large ulcer, which may be superficial or deep; in very severe cases the patches slough and fall off as a whole, a deep line of demarcation forming round them. At this period they are stained with bile, or when gangrenous are almost black.

During the third week in mild cases a sort of resolution may occur, the infiltrated material being broken down and absorbed; and this change probably takes place in patches high up in the ileum when in those lower down there is ulcerative destruction. For the most part this stage is occupied by the separation by ulceration or sloughing of the affected patches, and an ulcer is left of corresponding size and shape. Of course, as the patches run longitudinally along the aspect of the bowel, away from the mesenteric attachment, the ulcers also have their long diameter in the same direction. The superficial layer only of the mucous membrane may be ulcerated, or its entire thickness may be destroyed, and where there has been necrosis of a patch as a whole, the muscular coat may be implicated, and even in some cases the peritoneal covering. When the muscular fibres are laid bare, and especially when they are partially destroyed, the base of the ulcer will have a shreddy appearance. Large vessels may be opened, giving rise to hæmorrhage; or perforation of the intestine may take place from necrosis of the serous coat, near the centre of the ulcer, and a perforation formed in this way will usually be large.

At the end of the third week the separation of the diseased patches will be completed, and the ulcerations left begin to granulate. There is for some time a liability to hæmorrhage from erosion of vessels, and perforation may still occur, the apertures now, however, being as a rule minute. Unless perforation has been preceded by adhesion to some neighbouring coil of intestine, which may possibly be the case at this period, the escape of gas and extravasation of liquid fæcal matter will set up general peritonitis, which is almost always fatal. The time required for complete healing of the ulcers varies.

Besides the large ulcers formed in the patches of Peyer, it is not uncommon to find small circular ulcerations scattered over the mucous membrane, and at times minute disseminated ulcers constitute the predominant lesion, Peyer's patches being absent, or, if present, little affected. The large intestine is usually healthy or nearly so, the ileo-cæcal valve forming a sharp demarcation between healthy and diseased mucous membrane, but in some cases there are numerous small ulcerations in the cæcum and colon.

The changes in the mesenteric glands are secondary to those in the intestinal mucous membrane. The glands are enlarged, firm, pink or fawn-coloured, and present on section a corpuscular infiltration like that affecting the agminated glands. Later, they become paler and softer, and may gradually return to a normal condition, or may undergo caseation. Ulcerations, superficial or deep, are not uncommonly present in the larynx.

The spleen is almost always much enlarged, dark in colour, and soft.

Granular degeneration of the gland-cells of the liver and kidneys, of the muscular fibres of the heart, and of the voluntary muscles generally, is a constant morbid change. It is due to the prolonged high fever, and proportionate to its severity and duration; when it reaches an advanced stage, it may be the cause of fatal syncope from failure of the heart.

SYMPTOMS.—The period of *incubation* of typhoid fever is not definitely known. There is great difficulty in fixing it, as the date of exposure to the poison can rarely be exactly ascertained, and the onset of the attack is usually insidious. It is certain, however, that the incubation-period is long, probably in most cases from fourteen to twenty-one days. Cases are met with from time to time which suggest that the poison may reside in the system for an indefinite period until the resistance is lowered by a chill, or an attack of influenza, or by great fatigue. On the other hand instances are on record in which the disease appears to have come on immediately after exposure to powerful emanations from sewers which have burst, or have been opened on account of obstruction, but they are quite exceptional. The incubation is not attended by any marked symptoms; sometimes the appetite falls off, the tongue becomes furred, and there is headache or depression; but, as a rule, the patient is not debarred from his avocation, and there may be no complaint of any kind.

Invasion.—The invasion is almost always insidious. Occasionally severe headache sets in suddenly, with depression, muscular weakness, general pains, and chilliness almost amounting to rigor; but, as a rule, the patient at first feels simply out of sorts, loses appetite, and is indisposed for his usual work or for exertion of any kind. Epistaxis is not uncommon. The headache increases; the prostration becomes greater; sensations of cold down the back, alternating with heat and slight flushing, come on at intervals. At this point medical advice is usually sought, when the patient, giving the above history, will be found to present the ordinary indications of the febrile state—the pulse will be increased in frequency, the temperature raised, and the tongue will have a whitish or yellow coat, thick or thin in different cases. The bowels may be confined or relaxed; the urine high-coloured and diminished in quantity, or so far apparently normal.

In endeavouring at this early period to decide whether the case is one of enteric fever, the first thing to be done is to exclude local inflammation as a cause of the pyrexia. Among the positive indications the appearance of the patient is often a guide; he may look more heavy and oppressed than is accounted for by the temperature or the duration of the illness, and may be more prostrate. The tongue, as a rule, is not thickly coated, and the fur does not extend quite to the margins or tip, which even now may be unduly red. The abdomen may be tumid, and there may be some tenderness over the right iliac fossa, but the absence of these symptoms does not exclude enteric fever. The recurrence two or three times of slight epistaxis during the first few days of a febrile attack would increase the presumption of the disease being typhoid. The temperature, however, if it is watched from the first, affords the most conclusive early evidence of the disease; it rises with remarkable regularity from day to day, and is from one to two degrees higher in the evening than in the morning; the appearance of the temperature-chart recording morning and evening observations is highly characteristic, and may, indeed, almost be called diagnostic. The opportunity of watching this gradual rise, however, is often wanting; but if, on the third or fourth day of an illness, without obvious local cause we find a temperature of 103° or 104° F., and especially if the evening rise and morning fall are marked, the probabilities are that the case is one of enteric fever.

As has been stated, the fever is of long duration, lasting from twenty-one to thirty days on an average, and probably the clearest idea of the course and progress of the disease will be conveyed by a brief description of the condition of the patient week by week, during a fairly severe attack.

At the end of the first week the temperature will have reached the level, whatever that may be, which will be maintained, in the absence of complications, throughout the dominant stage of the disease—103°, 104°, or 105° F. in the evening, 1° or 1½° F. lower in the morning; in mild cases it may not be more than 102° F. when highest. The fever is now well-established, and all its characteristic features will be more or less pronounced. The initial headache will in most cases have disappeared; the patient lies on the back or on either side; the face is flushed, often presenting a bright patch on the cheeks, rarely dusky; the expression is good, though usually suggestive of the disease; the eyes are bright and observant; the skin is more or less hot, usually dry, but often moist at some period of the day. The pulse is frequent, 80, 100, or 120—short, large, and very often dicrotous. A short cough is common; and a scattered sibilus, heard on auscultating the lungs, is so frequent as to constitute a feature of the disease. The tongue will be moist, with a white or yellowish fur thinning off towards the edges and tip; the margins are red, and a red triangle invades the dorsum at the tip. The abdomen will be more or less tumid; and on pressure tenderness may be elicited in the right iliac fossa, and gurgling of liquid and gas may be felt in the intestine. It is to be understood that the gurgling is an incident attendant on diarrhœa, and is absent in cases where there is constipation. The spleen may sometimes be felt below the ribs, and when not reached from the left hypochondrium may give an enlarged area of dulness on percussion, but it will not yet have reached its full size. The characteristic spots may occasionally be found, but though they have been seen as early as the fourth or fifth day, they do not usually come out till after a week or more of fever. The bowels will mostly act loosely, and sometimes frequently, so that there is diarrhœa. The urine will be high-coloured and generally turbid; it not infrequently shows a trace of albumin and may contain an appreciable amount. The motions will have a powerful and offensive peculiar odour; they will be copious, liquid, rather pale, yellowish or drab in colour, with flocculi. A familiar descriptive comparison is to 'pea-soup.'

A week later, that is on the fourteenth or fifteenth day, the disease will have told obviously upon the patient. He will lie mostly on his back, and little on his side. The face, still flushed, and presenting often the red patches on the cheeks, will begin to look worn and thin; the eyes, still bright, will be less observant. The aspect and expression of the countenance are so characteristic as to be at once recognised by an experienced observer. The hand may be unsteady when held out, and there may be slight twitchings of the lips. There may be restlessness or even sleeplessness, and very often delirium. It has been stated that delirium mostly sets in about the twelfth day, but the time varies greatly. At first the patient is confused on waking from sleep, does not quite know where he is, and appears to have been dreaming, but soon collects himself; later he fails to shake off the confusion of thought, and he may talk incoherently, may ramble, in fact, as it is said. At this period the delirium does not go beyond slight rambling, and it is rarely violent at any stage. In severe cases there may be retention of urine.

The pulse will be more frequent, still less full, weaker; dicrotism is rarely well-marked. The lungs will not have undergone much change; the sibilant sounds may be more numerous.

The tongue will be more characteristic; the fur will be represented by a thin yellow or brownish streak down the centre, while the tip and edges will be red and angry. There will be a tendency to dryness, and generally the entire tongue looks shrunken and pointed.

The abdomen will be larger and more tense, and the tenderness and gurgling in the right iliac fossa more marked; the spleen will be larger. Now the eruption may be expected to present itself, if at all; but it must be remembered that it is absent in a considerable proportion of cases—a proportion estimated by some observers at 30 per cent. The eruption consists of small pink spots, about the size of a pin's head, slightly raised and pointed, well-defined, and disappearing on pressure, or when the skin is stretched, to reappear when the pressure is withdrawn. They are usually few in number, and are distributed irregularly over the abdomen and chest; but sometimes they are very profuse, the number having no relation whatever to the severity or character of the attack. The spots do not all come out at once, but in successive crops, till the end of the fever; the duration of individual spots, as observed by surrounding them with a ring of ink and dating them, being about four days. It has been recommended that the back should be searched for spots, but conclusions from eruption found here only would be untrustworthy, as the back is seldom free from spots, and there is nothing very peculiar in the spots of typhoid fever to distinguish them from others.

If the case is characterised by diarrhœa, it is usually at this period that it begins to be most troublesome; the stools have the appearances already described.

The temperature will be maintained at about the same height as at the end of the first week, but not uncommonly there is about this time a deceptive remission of fever, and it is perhaps worthy of remark that the active ulceration is now coming to an end. The fever which persists after this period has indeed been attributed to septic absorption from the intestinal ulcers—with doubtful justice, however.

It is from the latter part of the second week onward that complications, both local, such as hæmorrhage or perforation from ulceration and separation of sloughs, and general, such as pneumonia, are to be apprehended.

The end of the third week finds the sufferer at his worst. If he is now able to turn in bed and to lie on either side, and if other symptoms correspond with this indication of power, the case is favourable. In a severe attack he will lie on his back, and probably tend to slip down in bed. The face may be either pale or dusky; its look will be that of prostration. The patient is mostly very deaf, often dull of apprehension, so that he is with difficulty made to put out his tongue; he may be half unconscious, or in the condition of coma-vigil, a stuporous sleep with the eyes half open; or he may be restless, with muttering delirium, picking at imaginary objects in the air, or at the bedclothes. Sometimes the slightest pressure on any part of the body appears to give pain, or the patient may start in great alarm when spoken to. The body will be emaciated; the skin thin, pale, dry, and harsh; the muscles wasted; the tendons starting up, from sudden irregular muscular contractions (*subsultus tendinum*) when the limbs are at rest, while attempted movements are attended with jactitations and tremors; the lips tremble when the patient speaks, and the tongue twitches when protruded. A tap with the end of the finger on the pectoral muscle will cause a small swelling to rise on the spot—the so-called 'myoidema,' due to contraction of the degenerated fibres; it lasts for twenty or thirty seconds. The tongue is shrivelled, brown or even black, destitute of true epithelium, or dry and shiny, or coated with sticky slime or with black sordes. Sometimes it cannot be protruded at all. The roof of the mouth will be similarly coated; and there will be sordes on the teeth, and perhaps on the lips.

The pulse will be small, soft, extremely weak, often very frequent—130 or upwards per minute in bad cases; the beats run into each other, and are not distinct, giving the undulatory sphygmographic trace. The heart is extremely weak: the impulse absent, or a mere tap; the first sound short and feeble, or altogether extinguished. The lungs exhibit evidence of hypostatic congestion, impairment of resonance, and imperfect entry of air all over the posterior aspect of one or both sides of the chest.

The abdomen will usually be distended; spots may be present and continue to come out. There may or may not be diarrhœa. The stools may be passed unconsciously; and there may be retention, or more frequently incontinence, of urine. Bedsores often form rapidly, unless the nursing is both careful and skilful.

A tendency to recovery is usually indicated by improvement in the temperature, pulse, tongue, and abdomen. The temperature gradually falls, but at first this is shown chiefly by the increasing morning remissions, giving a greater difference between the morning and evening temperatures, and showing on the chart greater zigzags; the evening temperature then begins to fall day by day. The pulse becomes less frequent, and more full and distinct; the tongue gradually cleans, beginning at the margins; the abdomen subsides, the diarrhœa ceases; and strength returns little by little. In fatal cases the mode of death, when not due to some complication, may be by asthenia, or more frequently by coma and asthenia combined; hyperpyrexia is not uncommon as a phenomenon of the moribund condition; and, as the heart fails, hypostatic congestion of the lungs is usually very marked.

Relapses.—Relapse is very common in enteric fever. It usually occurs about ten days after the subsidence of the temperature in the primary attack, and is sometimes attributed to premature administration of solid food, but more commonly has no such cause. A true relapse is not merely a recurrence of pyrexia, but a return of all the phenomena of the fever. Fresh Peyer's patches are attacked, and there is frequently a fresh outbreak of the spots at about the same period after the initial symptoms, or often earlier. The relapse, however, is rarely as long as the original fever; very commonly, indeed, the third stage, that of so-called infective or pyæmic fever, is wanting; and when this is so, it is probable that there is no ulceration of the intestinal glands. Fortunately, also, it is not so often fatal as might be expected, seeing that the patient is reduced by the first attack. A second or a third relapse may take place; the writer has even indeed seen a fourth, the patient recovering, and surviving five distinct attacks of fever, each of which was severe. No satisfactory explanation of the relapse of typhoid fever has been given. It has been said that there is a re-infection of the subject by poison lodged in the mesenteric glands; but it is not easy to understand why he should be susceptible to the influence of the poison from this source, when for the most part the susceptibility to the disease is exhausted by an attack.

Special Symptoms and Complications.—These are so numerous and varied that it has been thought better to describe them separately, rather than to interrupt the account of the fever.

Hæmorrhage.—This occurs in about 6 or 8 per cent. of the cases. It may come on as early as the tenth day, but more commonly it is between the fourteenth and the twenty-fourth days, and in the later rather than the earlier part of this period; bleeding may be provoked by imprudence in diet, or by exertion later still. The hæmorrhage is due to the erosion of some vessel during the ulceration of Peyer's patches, without protective plugging by fibrin, or to vessels being laid open by the detachment of a slough. The quantity of blood lost, and the rate at which it is poured out, vary greatly. Sometimes the fact of hæmorrhage having taken place is only known by the stools being black, sticky, and offensive. At other times the blood is discharged in large clots, or it may be extravasated so rapidly that it is liquid and red, not having had time to become blackened and coagulated by the intestinal contents or secretions. When the hæmorrhage is considerable, the patient is rendered pale and pulseless. The temperature always falls, and not infrequently the loss of blood can be recognised before it appears in the stools by this fall of temperature, and by the pulse and general appearance of the patient. It is said that severe and persistent headache early in the attack is often followed by hæmorrhage in a later stage.

This complication is always attended with anxiety, and often exhausts the strength of the sufferer; but it is not by any means necessarily fatal. In many cases, indeed, the occurrence of considerable hæmorrhage marks the setting in of improvement; the temperature which falls on account of the loss of blood does not rise again; the patient becomes clearer and less heavy and oppressed; the tongue cleans; and all unfavourable symptoms gradually subside.

Perforation.—This, like hæmorrhage, may occur early, or at a late period; when early it is due to the entire thickness of the intestinal wall being implicated in the necrosis of the Peyer's patch, and the perforation may then be large. Later, at the end of the third week or afterwards, the perforation results from ulceration, and is often very minute. Unless adhesive inflammation at once glues the affected point to a neighbouring coil of intestine or to the abdominal wall, there is extravasation of intestinal gases and liquid into the peritoneal cavity, producing general and usually fatal peritonitis.

It might be expected that this occurrence would give rise to severe pain, but very often there is neither pain nor tenderness. The abdomen, however, rapidly becomes distended, often to an extreme degree; its walls are absolutely motionless in respiration; and on the application of the hand and making pressure, there is not only tension but resistance of a peculiar kind, which is highly characteristic. With the local symptoms there are evidences of shock: great anxiety of countenance, which may be flushed and beaded with perspiration, or pallid and livid; extreme frequency of pulse, often 140, 160, or 200, which is small and weak; and very great frequency of respiration. The respiratory distress is so marked that, in some instances which the writer has been called to see, the perforation had been overlooked, and the condition attributed to some lung-complication.

Peritonitis.—Peritonitis, without antecedent perforation, is an occasional complication of typhoid fever. It differs from the peritonitis caused by perforation in the more gradual onset, and in the less urgent character both of local signs and general symptoms—of the latter especially.

Tympanites.—Great distension of the abdomen by flatus is not uncommon in the course of typhoid fever, coming on independently of peritonitis or perforation. Most frequently it gradually appears late in the disease, together with other symptoms of prostration of the nervous system, but it may set in abruptly within the first week, and it is then prognostic of an early fatal issue. Simple tympanites is distinguished from peritonitic distension by the difference in the feel to the hand; but chiefly by the fact that the respiratory movements of the abdomen are not suppressed, they are, of course, impeded. Absence of pain is so common in the peritonitis of typhoid fever, that it is no criterion by which to distinguish inflammation from tympanitic distension.

Diarrhœa.—As has been stated, the bowels are usually loose in typhoid fever. Not infrequently this looseness becomes excessive, and is thus a cause of exhaustion and a source of danger. Unless there is blood in them, the stools are more liquid, frequent, and copious, but not otherwise different from the usual typhoid motions.

Albuminuria.—Albuminuria is not uncommon as a complication of typhoid, and it may be accompanied with convulsions, though it is by no means so dangerous as in typhus. The albuminuria may be the effect of the poison or of the fever-processes on the blood, or it may indicate nephritis. In the former case, which is much more common, the urine does not differ in appearance from this secretion as usually seen at the stage of the disease at which it is present, and the albumen is only detected by examination; in the latter, the urine will be scanty and dark-coloured, as in desquamative nephritis when it is not a complication of typhoid fever.

Pneumonia.—Inflammation of the lung may come on early or late in the course of typhoid fever. When early, it is usually a lobar croupous pneumonia, not differing greatly from ordinary pneumonia; in the later stages it is often a combination of lobular catarrh with hypostatic consolidation. The symptoms are not marked. The temperature rises or is more sustained; there is increased frequency of the pulse and respiration, and perhaps obvious respiratory distress; the face may be flushed or anxious. As a rule, there is little or no cough or expectoration. Examination, when practicable, reveals the ordinary physical signs.

Pulmonary gangrene.—Gangrene of the lung may occur from obstruction of branches of the pulmonary artery by fibrinous coagula carried from the heart.

Pleurisy.—Pleurisy is occasionally met with as a complication of typhoid fever. It does not give rise to much pain, and may easily be overlooked, the condition of the patient precluding careful examination.

Thrombosis.—Thrombosis may be either a complication or a sequel of typhoid fever. It arises from the languid state of the circulation, and from the condition of the blood, which is liable to coagulate. The femoral vein and its branches are the vessels most commonly obstructed, the thrombosis usually beginning in the small deep-seated branches and extending to the larger trunks, so that there may be deep-seated pain and tenderness in the calf or in the gluteal region for a day or two before the large vein is affected.

Thrombosis gives rise to pain and swelling of the limb, with some œdema, and the vein can usually be felt as a solid cord; there is a new access of pyrexia, especially if convalescence have already set in.

Embolism.—Embolism by plugs of fibrin deposited in the heart, and subsequently launched into the arteries, may occur in any part of the body. Hemplegia may happen from this cause in the course of typhoid fever; or occasionally, but very rarely, gangrene of part of a limb.

Parotitis.—Parotid abscess is less common in typhoid than in typhus fever; but it may occur in very severe cases, and is then an additional source of danger.

Sequelæ.—Enteric fever always leaves the patient weak, and the debility lasts long. This is due not merely to the waste of tissue by the protracted fever, but to the fact that the intestinal and mesenteric lesions interfere with absorption of nutrient material. In some cases the patient never recovers strength, but gradually becomes emaciated, and dies from asthenia or from some intercurrent attack. Occasionally the ulcerations do not heal, and they may prove fatal after the lapse of a considerable time. Phthisis, again, may be started by an attack of typhoid fever, usually, but not invariably, in an individual predisposed to the disease. Insanity is another occasional sequel; the most common form of mental derangement is melancholia, but there may be acute mania. It may come on almost immediately, the patient never appearing quite to recover his faculties after the stupor of a severe attack; or it may develop itself at an early or late stage of convalescence, or not till a still later period.

Varieties.—To complete the account of typhoid fever, some of the principal deviations from the ordinary course and type of the disease must be enumerated; and in the first place it must be understood that, both in individual cases and in entire epidemics, typhoid fever may run its course without rise of temperature, the characteristic lesions being found after death. Again, there is sometimes so little general depression of strength that the sufferer may walk about, and carry on his usual avocations up to a late period of the attack. The term *typhus ambulans*, or *ambulatorius*, has been applied to such cases. The writer has known several instances in which patients have *walked* into the London Fever Hospital with perforation.

Infantile Remittent Fever.—Infantile remittent fever is so called from the remissions often observed in typhoid fever affecting young children. No special description is necessary, the disease pursuing much the same course in children as in adults, only with greater fluctuations. Spots are less frequently seen.

Typhoid Fever with Constipation.—This really constitutes a distinct variety, the constipation persisting throughout, and not merely lasting for a few days and then giving place to diarrhœa.

Bilious Fever (*Fièvre bilieuse*).—This is recognised as a special form of typhoid fever by French observers, and deservedly so. The characteristic feature is frequent, sometimes almost incessant, vomiting of liquid containing bile, both after food and when no food has been taken. Severe headache often persists throughout the attack. The temperature does not, as a rule, rise high, and it fluctuates much; the face is pale and anxious; the pulse is frequent and very weak; the tongue is usually coated, and may be white or yellow. It is a very dangerous form of the disease, and may end fatally in ten or fourteen days by simple asthenia, without delirium or comatose symptoms.

Typhoid Fever with Meningitis.—True meningitis sometimes, though rarely, occurs at an early period of typhoid fever, and is attended with excitement, which may be maniacal in character, or violent delirium, and perhaps pain in the head.

Abortive Typhoid.—This is sometimes described as 'fourteen-day fever.' After well-marked symptoms of the attack, the temperature is not maintained, but gradually subsides. Such cases are mostly set down as common continued fever, or febricula.

Diagnosis.—A well-marked case of enteric fever at the height of the disease is easily recognised by the aspect of the patient, and by the symptoms already described: the red tip and edges of the tongue, the tumid abdomen, the enlarged spleen, the rose spots, and the character of the stools. In the early stage, however, it is often necessary to suspend the judgment for a day or two, and there may be difficulty in forming a definite opinion for a much longer period. The diseases which have most frequently been taken for typhoid fever are tubercular meningitis, acute pulmonary tuberculosis, and gastro-intestinal catarrh; typhlitis, catarrhal pneumonia and other acute affections of the lungs, glanders, pyæmia, and ulcerative endocarditis, have also from time to time been confounded with it. On the other hand, typhoid fever may possibly be taken for one of these affections, or may more easily be masked by some complication, such as pneumonia or peritonitis. What is most liable to happen is, that it may be entirely overlooked.

The insidious onset of typhoid fever is very characteristic; and, as has been said before, the thermometric chart of the first four days showing a rise day by day with the morning remissions, might of itself suggest the diagnosis. But occasionally the invasion is abrupt, or there is some pulmonary complication at the outset, which raises the initial temperature, so that it would be unsafe to rely too implicitly on the temperature. The first thing to be done in establishing a diagnosis of enteric fever is to exclude local inflammation as a cause of the febrile condition, which will be effected by physical examination and other means. It must not be forgotten during this investigation that in pneumonia the consolidation may not occur for three or four days. When there is doubt, epistaxis will be evidence in favour of, herpes labialis against, such a diagnosis, though herpes may break out when there has been a rigor. The presumption of typhoid fever arrived at by excluding local inflammation and other acute diseases will soon be strengthened by the appearance of corroborative indications which we need not again specify, or be overthrown by their continued absence.

As regards the particular diseases enumerated as those with which it is specially liable to be confounded—in tubercular meningitis the temperature is not usually so high as in typhoid fever, the pulse is at first not very frequent, and is often hesitating, while it almost always presents the condition of tension, thus contrasting with the soft short pulse of fever. There are usually, but not constantly, headache and vomiting early in the attack, the bowels are mostly confined, and the abdominal wall is retracted. Squint, inequality of the pupils, or double optic neuritis, would be unmistakable indications of meningitis. In acute pulmonary tuberculosis there is more cough; and although at first there may be only scattered sibilant sounds, such as are heard in typhoid fever, these soon become more abundant, and other physical signs of the infiltration of the lungs are added, such as impairment of the resonance, and imperfect entry of air. The temperature also is usually more sustained. Gastro-intestinal catarrh in children is sometimes attended with so much febrile disturbance as to give rise to a suspicion, or even a diagnosis, of typhoid fever, especially as the abdomen is tumid, and there may be diarrhœa; overfeeding with milk may keep up the appearance of fever for some time. There are, however, intermissions and variations which, when carefully noted, are found to be inconsistent with continued fever; the tongue is more thickly and coarsely coated; and the stools, though they may be pale from undigested milk, have not the typhoid character. In typhlitis there is more local pain and tenderness, and a lower temperature; and the symptoms set in more abruptly, vomiting being common. It is unnecessary to enter upon the distinction between typhoid fever and the other diseases mentioned; for the most part a few days will clear up any uncertainty or confusion.

As a matter of fact, errors rarely arise, when it is deliberately considered whether a given case is or is not one of typhoid fever. The danger is that the idea of fever may not be entertained at all, its symptoms being attributed to some slight local ailment. Or there is pneumonia or peritonitis as a complication, when the patient first comes under observation, which is not very uncommon among the poor or in hospital practice. The possibility, therefore, that typhoid fever may underlie an acute local affection should always be borne in mind, and when the desired crisis does not come on in pneumonia, or if in peritonitis the general symptoms are not altogether those of inflammation of the peritoneum, indications of enteric fever should be carefully looked for. When, again, a patient complaining only of some functional derangement, or of weakness and loss of appetite, has a look of illness and prostration which is disproportionate to the assigned cause, enteric fever should be suspected.

There is often great difficulty in distinguishing *infantile* remittent fever from tubercular meningitis on the one hand, and from gastric catarrh on the other. In gastric catarrh the tongue is more loaded; the temperature is less sustained and more irregular; constipation is more common than diarrhœa; and the evacuations, whether solid or liquid, have not the specific characters, but consist more of undigested food. In meningitis there will usually be purposeless vomiting, but not always; the temperature is not so high; the pulse is often slow or irregular, and the respiration shallow and sighing; the abdomen is not distended, and may be retracted; the bowels are confined. A squint would at once confirm suspicions of meningitis.

Prognosis.—It is never safe to speak confidently of the recovery of a case of typhoid fever, in view of the complications which may arise; but the prognosis is favourable or unfavourable, according to the antecedent condition of the patient, and to the severity of the attack, as estimated chiefly by the temperature. The mortality varies from 15 to 25 per cent., but there may be epidemics in which it may be throughout lower or higher than the average here stated.

Children seldom die of typhoid fever, and in the young the attack is less likely to be severe, and there is a better chance of recovery even when it is. In debilitated subjects, and especially in persons addicted to alcohol, typhoid fever is always attended with danger; even in a mild attack there may be failure of the heart, and pulmonary complications or thrombosis, which may prove fatal. Pregnancy also renders an attack dangerous. Apart from causes of anxiety in the general condition of the patient, and exception being made of cases in which the fever assumes the bilious type, attended with frequent vomiting of bile, headache, and prostration, and of the rare instances of peritonitis as an early complication, the prognosis turns mainly on the temperature. If this is not more than 102·5° F. in the evening at the end of the first week, there is very little danger; on the other hand, if the evening temperature reaches 105° F., nearly half the cases prove fatal. When the temperature ranges high, it is of great importance to ascertain whether it is so for many consecutive hours, or only for a short period; a heat of 104° F. sustained for a great part of the day is a more serious matter than a brief rise to 105° F. On this account, and also because the maximum may be attained at different periods of the day, it is desirable that the temperature should be taken in serious cases every two or three hours, or even more frequently. In typhoid fever, as in other acute diseases, a contrast between the surface-temperature and the temperature of the blood, as revealed by the thermometer, is of unfavourable significance. If with high temperature there are indications of failure either in the nervous system or in the heart, the prognosis becomes serious; a tendency to stupor or retention of urine early in the disease is a bad sign; and acute tympanites at this period, indicating, as it does, paralysis of the muscular walls of the intestine, and presumably of the sympathetic nervous system, almost invariably points to a speedily fatal termination; the later gradual distension of the abdomen ranks with the unfavourable signs, but is often met with in cases which recover.

Unusual frequency of the pulse, marked dicrotism early, and extreme weakness of the beat and compressibility of the vessel later, intimate danger, as does also an increasing frequency day by day towards the end of the third week. When the beats run into each other, and the pulse is a mere flutter, the danger is immediate and extreme. The sounds of the heart should be noted throughout the disease; the first sound, as heard at the apex, tends to become, first, short and sharp, then weak, and it may altogether cease to be audible; a good or bad first sound is of good or bad augury respectively. A systolic apex-murmur is not uncommon, and occasionally a distinct presystolic murmur is heard; these murmurs have no great significance, and usually disappear as the patient recovers.

Treatment.—The principles on which the treatment of typhoid fever should be conducted are generally accepted and well understood. Success depends greatly on their intelligent application to individual cases, and on careful attention to details at every stage of the disease.

The patient should, if possible, be placed in a large, airy, and well-ventilated room, the windows and door of which should be more or less continually open, according to the season and weather. The bed should not be too wide, and it should be approachable on both sides, so that the patient can be easily reached from either hand; it should be firm, but comfortable. A feather or flock bed is very objectionable, on account of the hollow into which the patient sinks in it. When practicable, it is a great comfort to have two beds—one for day, the other for night. The covering should be light, but sufficient to protect the patient from changes in the external temperature; eider-down quilting, or any material impervious to the insensible perspiration, should be forbidden; the under-surface of such coverings will often be found quite damp, and exhaling an offensive odour. Conscientious, skilful, and efficient nursing is of the utmost consequence; and that nothing may be overlooked, a record should be kept of the condition of the patient, of the food, stimulants, and medicines administered, and of the evacuations passed.

The patient should be sponged night and morning with tepid water, to which a little vinegar, or eau-de-Cologne, or permanganate of potassium may or may not be added. The temperature of the water may vary, the feelings of the patient being consulted, and the effects in producing sleep and quiet noted. The hands and face may be washed or bathed frequently, and the general sponging may be repeated at any time when it seems to be required by heat and restlessness.

It is useful to habituate the patient to the use of the bed-pan from the first. It is true that very often the chair or utensil is used throughout; but in severe cases, or on the occurrence of hæmorrhage, the sitting posture is dangerous, and indeed impossible, and it may be most distressing to have to pass the excretions into the bed-pan for the first time under circumstances of extreme prostration; this may, indeed, destroy the patient's chance of recovery. A disinfectant solution should be placed in the pan or other vessel into which the stools are received, and more should be added before they are thrown away.

Perhaps the most important element in the treatment of typhoid fever is the regulation of the diet. This should be exclusively liquid, and the staple constituents will be milk, and beef-tea or broths of one kind or another. It should be borne in mind that these liquids are food, and not mere drinks, and they should be given with strict regularity. Two or three pints of milk, and a pint or pint and a-half of beef-tea or some equivalent, will be about the quantity required for twenty-four hours' consumption in the first instance; and it should be so divided that milk and beef-tea are given alternately about every three hours, judgment being exercised in waking up the patient if he is sleeping when food is due, or allowing him to sleep beyond the hour. The great tendency now, on the part of the public, is to over-feed cases of fever. When the patient asks for drink, milk is offered, and if it is iced or diluted with soda or seltzer water it is sufficiently grateful in quenching thirst to be accepted in quantity altogether beyond the digestive powers; it then coagulates in masses, escapes solution by the gastric and pancreatic juices, and passes down the intestine in heavy curds, which irritate the ulcerated surfaces, besides producing other disturbances. It is in this way that milk has been discredited as an article of diet. The writer's experience is in accord with that of the late Dr. Parkes, who looked upon milk as the typical diet for enteric fever. In later stages of the disease it may be necessary to give nourishment more frequently, but the attention of the medical attendant will in most cases be required rather to moderate the amount of food given than to urge its administration; it may, however, be found necessary to take precautions against neglect in this respect during the night. In emergencies, concentrated meat-extracts may have to be given in teaspoonfuls every few minutes. The patient should, of course, be allowed to drink freely of cold water, toast-water, or any simple drink. The key to the regulation of the diet—it may almost be said to the management of the patient—is to be found in the careful inspection of the stools; the medical attendant ought to see every evacuation, or, at any rate, one motion every day, supplementing his own information by the report of a trustworthy nurse. When curds appear in the dejections, either too much milk is taken, or too much at a time, or its digestion is interfered with. If the passage of undigested milk is not remedied, there will certainly be flatulence, discomfort, and restlessness, elevation of the temperature, and in most cases diarrhœa. When, without error in the administration of the milk, curds appear in the stools, dilution with soda or seltzer water, or the addition of lime water or bi-carbonate of sodium, may prevent premature and unduly firm coagulation; or the admixture of arrowroot, barley water, or gelatine may cause the curds to be subdivided, and thus ensure their digestion. A more efficacious method, however, is to peptonise the milk. This is to be done not simply by adding a peptonising powder or liquid, but by carrying out the precise instructions given by Sir William Roberts (*see* PEPTONISED FOOD). In some cases beef-tea excites diarrhœa, and, given in excess, it will almost always have this effect.

As the fever subsides, eggs beaten up, or lightly boiled or poached, may be added to the dietary. In all cases the return to ordinary diet must be made with great caution, bearing in mind the fact that there may be intestinal ulcerations unhealed, and it should be a rule that no really solid food be given till the temperature has been normal for a week; even at the end of this time it is not uncommon for the temperature to rise one or two degrees, after a moderate amount of fish or meat with bread has been taken.

It is an unfortunate aggravation of the sufferings in typhoid fever that fruit, which is so grateful when the mouth is dry and parched, cannot be given freely, on account of its liability to excite diarrhœa; but a few grapes may be permitted, care being taken that the skins and seeds are not swallowed, and the effects being carefully watched.

The question of stimulants is an important one. Here, again, the prepossession in the public mind is in the direction of almost indiscriminate administration of alcohol, and the importunities of friends may have to be resisted. The amount of brandy or wine given must therefore be carefully checked and controlled. In a large proportion of cases no alcohol is necessary from first to last; it is scarcely ever required in the early stages of the disease, except perhaps in drunkards; and at no period should it be given as a matter of routine, or merely because the case is one of fever, but only to meet certain definite indications. These are mainly evidences of weakness of the heart, frequent, weak, and fluttering pulse, and weakness or absence of the first sound of the heart. When, as is usually the case, the tongue is also dry, and the teeth and lips are covered and the mouth lined with sordes, the indications for the use of stimulants are unmistakable. The effects should be watched; when alcohol does good the pulse becomes less frequent, and of better strength and volume, and the temperature is usually lowered; an important indication also is that the odour of spirit is not detected in the breath. When very high temperature and other unfavourable prognostic symptoms set in very early, stimulants may be given without waiting for the conditions above-mentioned. Alcohol is again often required as an adjunct to the treatment of fever by the cold bath. The safest form of stimulant is brandy or whisky; the quantity needed will vary greatly in different cases; in some two or three ounces in the twenty-four hours will be sufficient, in others ten or twelve ounces may be required. It should be given in divided doses in, or immediately after, the milk or beef-tea.

It will be convenient to say here a word on the use of opium. Its employment in certain complications—tympanites, peritonitis with or without perforation, hæmorrhage, and excessive diarrhœa—will be described later; the question now is whether it is well to give it for the relief of sleeplessness and restlessness. In the writer's opinion, when the restlessness is not so far allayed by cold or tepid sponging as to permit of sleep, it is of great advantage to the patient to give ten or fifteen minims of laudanum at night, or its equivalent in some other form. The writer has not found it to interfere with the digestion.

In a large proportion of cases no medicine need be given from first to last, but effervescing salines are usually grateful; the mineral acids, at one time very largely employed, often seem in small doses to do good; and one or two grains of quinine may frequently be given with advantage. It should be understood that medicines are of less importance than food, and that they are not to be allowed to interfere with its regular administration. A gentle aperient, calomel or grey powder followed by a mild saline draught, at the outset is often useful, but it may be blamed for subsequent diarrhœa. In Germany and America the treatment is often begun by administering six or eight grains of calomel in two doses, and at an early period of the disease this is more likely to do good than harm, though the dose is unnecessarily large.

When treatment, other than the careful watching, nursing, and feeding which are sufficient in mild cases, is required, this should not be a mere matter of routine; and it may conduce to precision in meeting the various indications presented from time to time if an attempt is made to classify and distinguish them.

We can recognise, then, in the course of typhoid fever, effects attributable (1) to the action of the poison; (2) to the intestinal lesions; (3) to protracted high temperature.

1. The entire fever-process, with all its concomitants, is of course due to the action of the specific microbe, but certain effects appear to have a more direct relation with the poison than others. The immediate agents in the production of nearly all, whether direct or indirect, is a ptomaïne secreted or formed out of disintegrated proteids by the typhoid bacillus; and an important question bearing on treatment is whether the toxic material is formed entirely in the intestinal canal or also in the blood and tissues. It is apparently on the first of these two suppositions that the employment of mercury, iodine, carbolic acid, sulpho-carbolates, salol, salicylates, and other intestinal disinfectants suggested by the theory of the bacteroid origin of typhoid fever, has been based. Good results have undoubtedly been obtained, but not such as to invalidate the long-established conclusion that it is not within the power of medicinal agencies to cut short an attack of typhoid fever, or even to effectually modify its course. Undoubtedly ptomaïnes are formed in the small intestine, and this not only by the typhoid bacillus, but by other bacteria which find a congenial soil in the albuminoid exudations poured out by the irritated mucous membrane. It has seemed to the writer that this is the explanation of the dark and peculiarly offensive stools sometimes met with in the early stage of typhoid fever accompanied by a high temperature, and of the extraordinary oppression of the nervous system and depression of the circulation occasionally seen without high temperature, or distension or tenderness of the abdomen, or diarrhœa, or other indication of a severe attack.

These are, therefore, the cases in which intestinal antiseptics are indicated; and, according to the writer's experience, mercurial preparations are the most trustworthy. When the motions are specially offensive and accompanied by much gas, the abdomen being tumid and the temperature high, from a half to one fluid drachm of the solution of perchloride of mercury, with perhaps one or two grains of quinine, may be given every four hours for two or three days with excellent effects. When the nervous system is evidently overwhelmed by poison, while the abdominal symptoms are slight, the local lesions may be disregarded, and two or three grains of calomel may be administered once or on two successive days. The entire aspect of a case threatening to prove fatal may sometimes be changed by thus clearing out and disinfecting the intestinal canal. It will be remembered that two or three grains of grey powder were formerly given three times a day throughout the early part of the attack.

The formation of ptomaïnes in the blood and tissues is little, if at all, influenced by remedies. The chief and most characteristic effect is the rise of temperature; and this, when not aggravated by adventitious causes, is not controlled by antiseptics of any kind.

2. Severity of the intestinal lesions, as indicated by marked tenderness in the right iliac region, tumidity and tension of the abdomen, and diarrhœa, may call for opiate fomentations, and, when the motions are unduly frequent, for starch and opium enemata. Careful examination of all the stools is specially necessary in case of irritation by undigested milk, and for the early detection of sloughs and blood-clots which may give warning of hæmorrhage.

3. The great source of danger in typhoid fever is the prolonged high temperature; and it is to this, together with the fever poison or process, that are due the prostration of the nervous system and the weakness of the heart which are the most frequent causes of death. To keep down, therefore, the febrile heat of the body is to diminish very greatly the danger attending this disease. It was natural and inevitable that the remarkable class of drugs which have been found to have the power of lowering the temperature —acetanilide, phenazone, phenacetin, and the like—should be eagerly employed for this purpose in typhoid fever; but while an immediate effect can be obtained, it is only fugitive, and a continued administration is

usually disastrous. The most trustworthy means of controlling the temperature is cold bathing. The cold-water treatment of fever was, as is well known, originated by Dr. James Currie, and practised with marked success by him and many other distinguished and trustworthy physicians. Notwithstanding results obviously good, it fell into disuse, till revived by Dr. Brand of Stettin. Dr. Brand's method is to place the patient in water at a temperature of 65° or 70° F. whenever the temperature of the body, as taken in the rectum, reaches 102·2°, and to keep him there for ten, fifteen, or twenty-five minutes, until the heat is reduced 2°, or at any rate until he has been shivering for some minutes. Liebermeister takes 103° as the temperature which requires the bath, and this he does not make quite so cold, that is, 75° F., while he recommends ten minutes only as the period of immersion. The bath has to be repeated three, six, or eight times a day—as often indeed as the heat of the body rises to the point named; and it must be persevered with for two or three weeks or more, as may be required. A little brandy is given before or during the bath; and when the patient is taken out of the water he is placed in bed, dried, covered up, but not too warmly, and kept at rest (*see* HYDROTHERAPEUTICS). In order that the full benefit may be obtained from this treatment, it must be begun early, in which case the temperature need never be allowed to reach an injurious height; and it is claimed that the intestinal lesions are also held in check. When thus carried out, it must be taken as established that the mortality of enteric fever is very greatly reduced by the bathing. Jürgensen's statistics show a reduction from 15·4 per cent. to 3·1; Liebermeister's from 27·3 to 8·2 (this observer, however, employing quinine largely); others show a still larger fall; and it may be safely estimated that in France and Germany the deaths have been diminished by at least one-half. Dr. Cayley has shown that like results are to be expected in this country, and the writer's own experience is corroborative of his conclusions. If, however, the remarkable success obtained by Dr. Barr of Liverpool by the continuous bath—the patient being kept in water at a regulated temperature throughout the attack—is confirmed by general experience, this method ought to supersede all other treatment. Against the advantages of cold bathing are to be set off the difficulty of carrying it out, and the labour it involves; the prejudices of the public, and the dislike and dread of some patients; the facts that some cases may be protracted (which, by the way, might otherwise end fatally); and that relapse is certainly more frequent. These are good reasons for trying whether the same end may not be attained by other means; but unless we are successful in this, the duty of the medical attendant is to insist on the uncompromising employment of the cold bath. The graduated bath, in which the initial temperature of the water is 90° F., or, as the writer has found to answer the purpose equally well, 80°, is often more acceptable to patients, the water being cooled down rapidly to 70° or 65°. If the fever be high, and the nervous prostration great, conditions in which the shock of sudden cold is of great service, the cold water added to bring down the temperature may be poured over the patient's head. The cold wet pack and Thornton's ice-cap have been tried as alternatives to the bath, but without effects adequate to the requirements of the case. It has been hoped again to prolong the effects of the bath, and so render frequent repetition unnecessary, by the administration of large doses of quinine or salicylic acid. Quinine, to keep down the temperature for any considerable time, must be given in large doses—thirty or forty grains; and even this amount will, as a rule, produce no decided impression unless the way has been cleared by a bath. It is to be given, then, shortly after a bath in two or three equal portions within the space of about half an hour, and a little laudanum may be given with, or just before the quinine, to prevent vomiting. Very frequently the temperature remains depressed for twenty-four hours afterwards, sometimes even for a longer period. The patient often suffers from severe symptoms of cinchonism, but in view of the advantage obtained this need not be seriously regarded. Sometimes, however, violent and protracted vomiting is set up, which is an absolute bar to the further employment of quinine, except hypodermically. The neutral sulphate is the most convenient form for this purpose, and it is sufficiently soluble to be given in adequate doses, that is, of five or six grains. The writer's own experience tends to the conclusion that the frequent bathing has advantages over the combination of quinine with the bath, both as regards the safety and the comfort of the patient; though he has also seen cases in which the bath alone seemed inadequate, while with the aid of quinine the fever was kept down. He has twice seen severe tetanus produced by the bath and quinine, both cases, however, recovering. Salicylic acid and the salicylates have appeared to him to have a dangerously depressing effect. Of digitalis employed in large doses as an antipyretic, he has had no experience.

Without going so far as to say that the cold or graduated bath should be employed in all cases, the writer is of opinion that many lives would be saved were cold-bathing at once put in practice, whenever a temperature of 103·5° or 104° F. in the first few days shows that the attack is to be more than average severity; and it is of the greatest importance that this should be done early, so that the pyrexia may never get the upper hand, and that the intestinal lesions may, if such a thing is possible, be modified. And no patient should be deprived of the chance which is afforded by the bath when, at any stage of the disease, life is threatened by hyperpyrexia or by consequences of high temperature, such as violent excitement, sleeplessness, restlessness, or nervous prostration. The only complications which render the bath inadmissible are hæmorrhage, peritonitis, and the advanced cardiac weakness and degeneration sometimes found late in the disease. Albuminuria or pulmonary affections do not constitute a bar to cold bathing. The writer has known albumen to disappear from the urine at once, and pulmonary congestion to clear up after a single bath.

Treatment of Complications.—We will now consider the treatment of the chief symptoms and complications. In severe and protracted cases a state of extreme prostration ensues which must be combated by special therapeutic measures. A feature of this condition is great frequency and weakness of the pulse, with loss of tension, so that the beats run into each other. Here digitalis may be of very great service, not only by diminishing the frequency and increasing the strength of the heart's action, but by giving tone to the vessels. Probably, however, the most valuable resource is the hypodermic injection of strychnine, which may undoubtedly save life. One-sixtieth to one-thirtieth of a grain may be given every three or four hours as long as necessary, the effect being carefully watched. Digitalis or ether, or both, may be combined with strychnine. Strychnine hypodermically is again the best remedy in the sudden intercurrent attacks of prostration which sometimes occur in the course of fever. The most careful watch should be kept for complications at all stages of the fever, but especially after the end of the second week. A rise of temperature must always be taken to have some definite significance requiring explanation. With increased frequency of respiration, it may be the sole indication of the accession of pneumonia or pleurisy. A fall of temperature may give warning of hæmorrhage. Retention of urine, though uncommon in typhoid as compared with typhus fever, should always be borne in mind; and unusual restlessness should at once suggest an examination of the hypogastrium. The passage of a catheter has often put an end to sleeplessness and excitement. Bed-sores ought never to occur, and it will conduce to their prevention for the medical attendant to inspect the sacral region and other parts where they are liable to be produced.

Hæmorrhage.—In the treatment of hæmorrhage the first thing to be done is to arrest the peristaltic action of the bowels by a full dose of opium; and as an immediate effect is required, one of the liquid preparations should be given—the tincture or liquid extract, and the dose may be from twenty minims to a drachm. The bleeding vessel has to be closed by a clot, and peristaltic movements will tend to disturb this, while it must be remembered that the blood poured out is a continued provocative of movements on the part of the intestine. Direct astringents which depend on local action are useless; before they could travel the whole length of the small intestine, and reach the bleeding point, they would be neutralised by combining with the intestinal contents. Physiological hæmostatics may be of more service. Ergotine hypodermically, or alternate doses every hour or every two hours of the liquid extract of ergot, ʒss to ʒj, and of turpentine ♏x–xv, have seemed to the writer to have most effect. Acetate of lead and opium or morphine, sulphuric acid and decoction of logwood, tannic acid, and all the known styptics have been recommended. An important adjunct—probably more effectual than any internal remedy except opium—is an ice-bag over the region of the cæcum; this at the same time quiets peristalsis and contracts the vessels.

Stimulants must be given if the patient is in danger of dying from syncope, but it must be borne in mind that fainting gives time for the vessels to close; and until the bleeding has stopped, this condition must not be too diligently averted. We must, in fact, sail as close to the wind as is consistent with safety. The same considerations apply to the administration of food: very little, if any, should be given by the mouth for twenty-four hours, nourishment being supplied by small nutrient enemata.

Perforation.—The only medicinal treatment likely to be of service is the administration of large doses (ʒj or more) of laudanum or the liquid extract of opium or an equivalent of morphine, hypodermically or by the mouth. This has saved life in a few cases, but in the immense majority of cases a fatal termination speedily ensues. Laparotomy may also be proposed.

Peritonitis.—Here, again, opium in repeated moderate doses is the most useful remedy; with poultices applied over the abdomen.

Tympanites.—Once more the remedy is opium, which should be given in pill three or four times a day when the distension is late and gradual; in very large doses of some liquid preparation when it is sudden. Charcoal has been recommended, but in the writer's experience it has rarely been other than hurtful.

Diarrhœa.—As long as the stools do not exceed three a day, or while they do not appear to distress or exhaust the patient, nothing special need be done to check the diarrhœa. It must always be borne in mind that beef-tea or other strong flesh-juices may excite diarrhœa; undigested curds of milk may have the same effect. As soon as undue frequency in the action of the bowels is observed, any possible cause in the diet should be eliminated; this failing, the best remedy is an opiate enema, twenty or thirty drops of laudanum in two ounces of thin starch. In most cases two or three enemata will arrest the diarrhœa; should this not happen, astringents must be given by the mouth—acetate of lead and opium or morphine, sulphuric acid, laudanum, logwood, or tannic acid.

Constipation.—This, whether intercurrent when there has been diarrhœa, or present throughout the fever, is a perplexing symptom. It is best relieved by enemata given every other day, but sometimes these are insufficient: a teaspoonful of castor oil may then be given, care being taken that any accumulation in the rectum which might give rise to difficulty of defæcation is previously removed by enema.

Bilious Vomiting.—When this is present from an early period of the attack, attended as it usually is by great prostration, it has seemed to the writer that life is endangered by the formation and absorption of some poisonous ptomaïne, and that the intestinal lesions are then of secondary consequence. Acting on this idea, calomel has been given in doses of two or three grains, in order to carry off the poison and disinfect the intestinal tract, with excellent results.

Albuminuria.—Nephritis must be treated by poultices and dry cupping over the kidneys. Albuminuria due to alteration of the blood requires no special treatment, and it is not a bar to cold bathing, but on the contrary may be among the symptoms calling for it. The disappearance of albumin from the urine, which is sometimes observed when the temperature has been reduced by bathing, seems to show that the blood-change is due to the pyrexia, and not to the poison.

Pneumonia.—When pneumonia sets in, stimulants are generally required, and the patient will derive benefit from bark or quinine, which may be given in the form of the ammoniated tincture. Turpentine in small doses, or the stimulant balsams, will often be found useful. Turpentine stupes are generally better than poultices.

Thrombosis.—Elevation of the leg on soft cushions, warmth, and gentle support by means of a flannel bandage, will be the treatment required.

W. H. Broadbent.

TYPHOID STATE (τῦφος, stupor).—Synon.: Fr. *État Typhoïde*; *État Adynamique*; Ger. *Typhöse Erscheinungen.*

Definition.—A condition which may arise in the course of any febrile disorder, when the approach of death is gradual, and the rise of temperature either excessive or long-continued. The typhoid state is, however, most frequent in typhus, enteric, yellow fever, and pernicious malarial fevers; and in such cases the tendency is often evident from the very beginning of the attack.

Description.—The symptoms of the typhoid state relate chiefly to the nervous system, and indicate depression, not excitement. There is low muttering delirium, passing into stupor, with little or no true sleep (*coma-vigil*); with derangement of the senses, and hallucinations of sight and hearing. The urine and fæces are passed unconsciously, or there may be retention of urine. The sensibility of the skin is greatly impaired; flies may creep unnoticed even over the eyelids. General muscular weakness is shown, the patient lying on his back, sunk down in the bed. The lips and gums are covered with sordes, and the tongue is dry and black. *Subsultus tendinum* is present. The pulse is frequently of a running character, so that it is difficult to distinguish and count the beats; small and weak; sometimes irregular, and easily affected by slight causes, for instance, failing distinctly during inspiration. The heart's impulse is greatly weakened; the first sound almost or quite lost at the apex. The skin is dry, if, as is often the case, the temperature is high, 104·5° F. or upwards; or it is bathed in clammy sweats, which rarely prevail at one time over the entire surface. There is lividity of, or even ecchymoses on, the under-aspect of the trunk and limbs; and in the exanthematous fevers the eruption becomes petechial. The breathing is hurried and shallow; and towards the close frequently assumes the type known as Cheyne-Stokes respiration.

Pathology.—It is unwise to attempt to attribute all these different symptoms to one single cause. The chief primary cause may be the injurious influence of a high internal temperature upon the central nervous organs, but this same temperature acts directly also upon the parenchyma of glandular organs, and upon the muscular fibre, both of the heart (Stokes) and of the voluntary muscles (Zenker); and the disorder of the nervous centres must be greatly increased by, if not sometimes directly due to, the changes in the composition of the blood, and in the forces of the circulation.

Prognosis.—The prognosis of the typhoid state is always grave, but in fevers which run a definite course recovery may take place, even when the condition is fully developed, if it be so only at or near the crisis.

Treatment.—The treatment consists in the free use of stimulants. Of these brandy is the best, and may be given in doses of half an ounce every half-hour or hour; but the quantity must be determined not by measure, but by the effects upon the patient. If no improvement follows its exhibition by the mouth, frequently repeated rectal injections of brandy with egg or strong beef-tea ought to be tried. Musk, in doses of one to three grains, has been recommended, but the writer does not attach any value to this drug in these cases. The subcutaneous injection of five to fifteen minims of ether is often so successful in increasing the vigour of the heart's action, that it well deserves a trial here, too, if other means prove ineffectual. If the temperature is excessive, the cold or tepid bath, or the cold pack, should be used; but immediately before or during the application of external cold, half an ounce of brandy at least should always be given. The salutary effects of cold are maintained and increased by full doses of sulphate of quinine, such as five or ten grains of the sulphate every hour, until twenty or thirty grains have been taken. The writer cannot advise the use of salicylic acid or its salts in the typhoid state. External stimulating applications are not without value, for example, vesication by blistering fluid, or by strong solution of ammonia to the shaven scalp, when nervous symptoms predominate, or a flying blister to the præcordial region when the heart's action is seriously impaired. Throughout the typhoid state the patient's strength must be husbanded as carefully as possible; and the great object of the nursing should be to save him from the necessity of any mental or muscular effort whatever.

James Andrew.

TYPHUS FEVER (τῦφος, stupor).—Synon.: Malignant Fever; Petechial Fever; Gaol Fever; *Typhus Exanthematicus*; Fr. *Typhus*; Ger. *Flecktyphus*; *Kriegspest*; *Lazarethfieber*.

Definition.—Perhaps no better definition has been given in modern times than that which Hildebrand formerly assigned to typhus: 'Morbus acutus, febrilis, contagiosus, exanthemate proprio ac eminenti systematis nervosi passione stipatus.'

Historical.—Before describing this disease, which has been properly designated a scourge, a historical sketch of its ravages may not be devoid of interest. It is more than probable that typhus and other analogous forms of fever have existed from the earliest times, and that, as surmised, the plague of Athens described by Thucydides was the disease under consideration. Be that as it may, it was noticed as a new disease by Frescatoro, imported into Italy in 1501 from Cyprus.

Sir John Pringle, whose opportunities for the study of the disease were extensive from 1742 to 1745, has given an excellent description of the camp fever as it prevailed in the English army at that period.

Not only has typhus raged in armies—more especially in defeated armies, often following retreating hosts like a shadow, as was witnessed in the Grand Army in the retreat from Russia—but also in prisons, as the epidemic of Toulon, and notably in English prisons before the reforms initiated by the philanthropic Howard were carried out. It was found that the overcrowding and filth of gaols generated typhus, and were the cause of epidemics marked by extreme malignancy. Ireland has been looked on as the favourite habitat of typhus fever, the *Brutstätte*, the land of fever; so it has been termed by Virchow 'das Land des Hungers, des Fleckfiebers und der Auswanderung.' It may be observed in passing that Ireland fortunately no longer answers to this disparaging description. True it is of the past, for more than a century and a half widespread and devastating epidemics have swept over the land uninfluenced by change of season. Other countries were the seat of similar visitations. In many countries it has been sporadic and epidemic—in Russia, in Poland, and in many provinces of Germany, in Rhineland, in Hanover, in Berlin, Breslau, in Holland and Belgium.

Ætiology.—Having briefly sketched the history of typhus, it now becomes necessary to inquire into its causes and modes of propagation.

All experience goes to prove that food, bad in quality and deficient in quantity, is the most potent predisposing cause of fever; the late Sir Dominic Corrigan, in his *Famine and Fever*, gives convincing proof of this fact. All the great epidemics of fever in Ireland and elsewhere have followed times of famine, owing to bad seasons and failure of the crops. It has been assumed on high authority that typhus is a hunger fever, but against this view a protest must be entered. That want and misery, and consequent mental depression, overcrowding, and dirt, render the person susceptible and a ready recipient of the poison must be admitted. But that there is a something in the air—'a contagium vivum,' a typhus miasma, which, taken into the system, produces fever—must also be admitted. Up to the present, the most ardent and able investigators have failed to discover the presence of a fever-producing parasite in typhus, such as has been found in some infective diseases. After Obermeier's discovery of the presence of spirilla in the blood of relapsing fever (*see* Micro-organisms) research was stimulated with a view of discovering a fever-producing parasite in the blood of typhus; and indeed Hallier proclaimed that he had found a micrococcus in typhus which he supposed to be specific, but Klebs and others, according to Mosler, have failed to verify this statement.

Koch, in his most important communication to the Medical Congress at Berlin, included exanthematic typhus in the group of infective diseases in which research has been fruitless of results.

The poison, whatever it may be, is present in certain localities, causing endemic disease, and under favourable conditions assuming the epidemic form.

Can it arise spontaneously, independently of infection? To this question an affirmative answer must be given, fortified by the fact that all infective diseases must have had a beginning. The origin of the disease spontaneously is doubted by Professor Mosler, who mentions many sources of contagion little suspected as carriers of disease, such as dirty paper-money, or coins. There is no disease, with the exception of small-pox and scarlatina, which is admittedly more infectious than typhus fever.

In Ireland the question has many years since been set at rest by the essay on the 'Origin and Latent Period of Fever,' by Sir Henry Marsh, published in the *Dublin Hospital Reports*, in which that eminent observer accumulated a mass of evidence which incontrovertibly proved how communicable is the disease. Cheyne's reports of the Hardwicke Hospital are also replete with facts pointing to the same conclusions. The physicians of the Hardwicke, with scarcely an exception, were seized with fever; so it was in other fever hospitals. The dispensary medical officers in many parts of Ireland during epidemics fell victims to the disease. All, or nearly all, who came frequently near the infected—physicians, students, nurses, and the women who washed the clothes, all who had not previously had the disease—were stricken down. The writer experienced it in his own person, as did many of his predecessors and colleagues in the hospital. He was in the act of examining the chest of a patient in fever when the person was suddenly seized with a fit of coughing; he was so placed at the moment that he must have inhaled the breath: the odour was intolerably offensive. He was certain he had imbibed the poison, and after a latent period of three days he exhibited the usual train of symptoms which usher in fever of the severest form. It is worthy of notice that the exposure took place when he was weakened by not having had food for many hours, and when he was not in perfect health. So it was in the case of Marsh, who gives a graphic description of his own seizure. The greater number are not conscious when they are poisoned by the typhus miasm, but the exceptions are not rare. Marsh perceived on suddenly turning down the clothes of a patient, a highly disagreeable odour; he was oppressed, and at once overwhelmed *uno ictu*, being conscious at the time of having absorbed the poison.

PRODROMAL OR LATENT PERIOD: PERIOD OF INCUBATION.—The time intervening between exposure to infection and the advent of the series of phenomena constituting fever is generally from three to seven days; but it may be shorter or more protracted. There may be no incubation—*typhus siderans*; the overt symptoms at once appearing, as it were, simultaneously with the reception of the poison. The incubation period is not generally a time of health: sleep is disturbed, there is often a malaise, an undefined sense of illness, a depression, and often a fear of some impending calamity. The patient may struggle against it, and follow his ordinary occupations, until it becomes impossible to further resist.

SYMPTOMS.—The symptom which ushers in the disease is generally a rigor, a sensation as if cold water were trickling down the back—a feeling well remembered by the writer, although many years have elapsed. There may, however, be no distinct rigor, merely a *frisson*, a chilliness; and even this may not be noticed. There may be one distinct severe rigor, or a number of slight shiverings. After the rigor a rapid rise of temperature takes place; and now, if not before, the patient is in most cases compelled to take to bed. The symptoms then are headache, giddiness, heaviness, languor, dulness, pain in back and limbs—especially the thighs, sleeplessness or disturbed sleep, thirst, inappetency, tongue loaded, white or yellowish, perhaps nausea or even vomiting.

The early symptoms are at times so slight that the affected person may be able to walk about; and in three, four, or seven days defervescence takes place, and restoration to health follows. This is termed 'febricula'—*Febris ambulatoria* of the Germans. In by far the majority, however, the symptoms become aggravated day by day; sometimes catarrhal symptoms supervene—often they are the earliest manifestations. Headache is complained of, with intense flashes of light before the eyes, or intolerance of light; the skin, at first red, assumes a dusky hue; the tongue becomes brownish and dry. On the fourth or fifth day of the fever the rash (the exanthem to which the disease *typhus exanthematicus* owes its name) appears. This rash is generally first observed on the trunk, then spreads to the extremities, rarely on the backs of the hands and face. The spots vary in size from a slight speck to three or four lines; sparse at first, they soon extend; isolated or grouped together, they have been compared to pieces of marquetry; they may be of an intense red, but generally they are pale; little papillæ are seen in some few cases. The typhus exanthem bears a close resemblance at its commencement to the rash of measles; hence it is often termed 'measly eruption.' The spots disappear on pressure. In the space of two or three days the eruption is complete; the colour gradually assumes a more or less dark hue, livid or mulberry, no longer disappearing on pressure. The usual duration of the rash is from a few days to fourteen or fifteen days. Its colour is often deeper on the back than elsewhere; and when a doubt exists as to its having appeared, it should be looked for there.

The rash does not seem to have any influence on the fever, and it may continue after the defervescence; but the more copious it is, and the deeper its colour, the more severe is the disease. This is the opinion which is held by most observers. The change of the eruption from measly to true petechiæ or cutaneous hæmorrhages is the rule. The skin in the course of the disease may be the seat of various epiphenomena—erysipelas, furuncles, sudamina, œdema, abscesses, or gangrene of the parts most exposed to pressure; and sometimes even the nose and the genitals are affected. In some epidemics icterus occurs, and its appearance has in some cases been remarkably sudden. The febrile phenomena are not mitigated with the development of the rash.

It sometimes happens that towards the end of the first week there is an amelioration of the symptoms; but this is but a lull in the storm in the greater number of cases. The temperature, which had fallen, rises again, and often exceeds the former record. The pulse attains a frequency of 100 in the morning, and 112 to 120 in the evening, and in the severest cases far exceeds this. In the early stages it is fairly full, but it may become weak, compressible, and fluttering; or, which is perhaps a more evil omen than great frequency, slowness is observed, owing to the diminished power of the ventricle to make every contraction felt at the wrist. The patient lies on his back and in a state of great prostration; there is a tendency to slip downwards; the headache of the early days has been succeeded by delirium, the character of which varies much. At first, chiefly at night or on awaking from disturbed sleep, he is confused and unable to answer questions correctly; at the end of the first or beginning of the second week the delirium becomes more pronounced—noisy, restless, or apathetic—and often the strangest phantasies arise. A fixed idea may take possession of the mind; muttering delirium, coma vigil, sopor, suddenly furious mania alternating with sopor; difficulty of restraining the patient in bed; hence necessity of closest watching, especially at night. The tongue is dry, contracted, and black, covered with fuliginous deposit—parrot tongue—as are also the gums. Retention occurs from paralysis of the detrusor vesicæ, or involuntary discharge of urine; and the bladder should be examined frequently, as the discharge is sometimes merely an overflow; for days it may be necessary to employ the catheter; the urine is high coloured, scanty, and often albuminous. Such are the symptoms of typhus in its severe form.

Towards the fifteenth or twenty-first day, in, fortunately, the great majority of cases, a favourable change takes place. There is no disease in which the change may be so sudden from a state of extreme danger. The patient, who had been violently delirious, or lying in a torpid state of low muttering delirium with subsultus tendinum, falls into a tranquil and profound sleep which may last for many hours—so long that it is necessary to awaken him for nourishment; and on awakening the temperature may be normal or below it, the tongue moist, the pulse—which had been rapid, thready, and tremulous—firm and moderate in frequency, and intelligence to a great extent restored, with returning desire for food and drink. This change—crisis by sleep—is the most favourable event. The skin, which was burning hot—*calor mordax*—may become moist, bedewed with a gentle sweat; and this seems in some instances critical, altogether different from the copious sweat which, occurring at an earlier stage, is almost always indicative of danger. A change, too, occurs in the urine which has been considered critical: it has been high-coloured and albuminous, or even bloody, and now the secretion is abundant, of normal colour, or even paler than natural, with a copious deposit of the lithates and phosphates. To this change in the urine the term 'crisis by urine' has been given.

COMPLICATIONS.—Many are the dangers and difficulties from complications which threaten the patient in the course of typhus, and prolong the disease; one of the most common is implication of the respiratory organs. In some epidemics so frequent is *bronchitis*, that the disease has received the name of 'broncho-typhus.' From the onset there may be a bronchial affection unmarked by the ordinary symptoms, even in advanced stages—no expectoration, perhaps not much acceleration of breathing; it may involve the whole extent of the bronchi (bronchiolitis), even producing atelectasis; its presence being only discoverable by auscultation. It is noteworthy that secondary affections in typhus are more or less latent. Broncho-pneumonia, hypostatic *congestion*, diffuse *pneumonia*, are among the most formidable complications in fever, and often indicate a lethal termination. Multiple *abscesses*, or *gangrene* in various situations not confined to the parts exposed to pressure, may occur. *Convulsions* may usher in a fatal termination. Sudden death has occurred when all seemed to progress favourably.

Diagnosis. There are cases of typhus the course of which is normal, and which present no difficulties to the experienced physician in arriving at the diagnosis, and hence it is said the disease is easy of diagnosis; but he will meet with others, in which, to say the least, it is doubtful, nay, impossible. It is well to realise these difficulties, which are met not only in the slighter cases, but also towards the fatal termination of others, when even the necropsy throws no light upon the nature of the disease, the results being absolutely negative.

The poison which is so potent in its effect to destroy life, may leave no trace behind which is characteristic and pathognomonic, distinguishing it from other acute diseases, as enteric fever, malignant measles, encephalitis, meningitis, pneumonia, puerperal fever, icterus gravis, or pyæmia, and even from some chronic diseases which towards the end exhibit symptoms closely resembling those of typhus, and consequently are termed *typhoid.* Wunderlich strongly emphasises this: 'In dem Gange des Flecktyphus tritt nicht eine einzige Erscheinung auf, welche nicht auch in manchen andern Krankheiten vorkommen könnte, und die tödliche Katastrophe zeigt nichts was dem Flecktyphus allein zukommt.'

Recognising these facts, it is satisfactory to know that such cases are not frequent, and that typhus pursuing its ordinary course is easy of recognition.

The fevers with which it is most likely to be confounded are enteric and relapsing fever, both of which are found to exist in company with typhus in many epidemics of the latter. Cases of enteric fever may be wanting in the characteristic changes in the intestinal canal and the glands; and, again, typhus may exhibit changes resembling those of enteric fever, and so the two may, as it were, shade into each other. The knowledge of the exposure to either disease will assist very much, for typhus never gives rise to enteric nor enteric to typhus. Important aid also in the diagnosis may be obtained by observation of the temperature: marked elevation of temperature is noted in typhus from the onset, and the rapidity of the rise and the shortness of its duration exclude the idea of enteric. The typhus course resembles relapsing fever in the first days. In both of these diseases the temperature is high; but it is higher in relapsing fever, and on the fifth or seventh day defervescence takes place, and the patient is for the time fever-free, to be followed by a new access of fever. Other febrile diseases seldom maintain so high a temperature as typhus for so long a period, for either the severity of the disease kills, or a fall takes place. The return of the temperature to the normal from fever-height in typhus is often very rapid, the defervescence, as before mentioned, taking place in one night.

Comparing typhus with enteric fever, the defervescence is extremely rare at so early a period in the latter, or at so late in an acute exanthem or in relapsing fever. These observations on the temperature, which are so valuable and trustworthy, are due to the researches of Wunderlich. The rapid fall of the temperature in typhus, as compared with the gradual decreasing fall in enteric, is also a distinguishing feature. The profuse petechial rash contrasts strongly with the sparse and rosy spots of enteric fever, usually coming out in successive crops, and elevated. The absence of epistaxis and intestinal lesion, also of hæmorrhage and of marked splenic enlargement; as a rule, absence of diarrhœa of the peculiar character, which is almost pathognomonic of enteric fever; the absence, too, of ileo-cæcal tenderness and gurgling; and the rarity comparatively of meteorism, all are to be taken into consideration. In both the respiratory and circulatory organs are liable to be implicated, and so are the kidneys.

It has been affirmed that no single symptom proclaims the presence of typhus; but the order in which the symptoms are presented, the congress of symptoms, and the disturbance of the nervous system, powerfully aid in arriving at the diagnosis.

Prognosis.—In forming a prognosis of typhus fever, the character of the epidemic, and the rate of mortality, may first be taken into account. Some epidemics are peculiarly mild and benign, others are malignant in the extreme. The period of the epidemic is also important, as the earliest cases are generally most fatal. Then the condition of the infected, if previously in broken-down health, ill fed, ill clothed, ill housed—such fall ready victims to the pestilence; perhaps nothing renders the prognosis more unfavourable than habits of intemperance. As for the upper ranks of life—persons who have lived in comfort, and who have been regular in their habits, and previously in fair health—the following are circumstances which tend to cause the disease to fall heavily upon them: if engaged in anxious business transactions, if the mind is on the stretch, and the nervous system is early engaged; such cases have received the popular name of 'brain fever.' Sex-mortality is also to be noted, being greater in adult men than in women. The symptoms indicative of danger are the early existence of delirium alternating with stupor, the peculiar affection denominated 'coma vigil,' subsultus tendinum, and other low nervous phenomena.

Very high or very low temp[illegible]

extreme rapidity of pulse, always proclaim the severity of the disease and consequent danger. It has been observed, however, that in no disease is high temperature so well borne as in typhus. The character of the pulse is one of the most reliable indications of danger. To rapidity may be added irregularity, feebleness, compressibility. The opposite state, however (slowness) is also of evil augury; for the first sound of the heart may be absent, and the impulse diminished in force or absent – conditions of the heart indicating the need of wine and other stimulants, as first pointed out by Stokes. Great tympanitic distension is another indication of danger; and the presence of rash of the deepest hue.

Other conditions which add to the danger in typhus fever are weakness or paralysis of various parts; hypostatic congestion, which may end in gangrene of the lung; strabismus; and contraction of the pupil; spasm, convulsion, stiffness of neck, utter unconsciousness, automatic movements; and, above all, advanced age.

The prognosis in uncomplicated typhus is favourable; in early life the mortality is moderate. It is not so great in women, unless when they are pregnant. Danger increases after passing the meridian of life; a quarter and even half of the cases between fifty and sixty years of age succumb. In some epidemics the enormous mortality of 40 or 50 per cent. has been reached, contrasting remarkably with the low rate of others – of 5, 6, or 7 per cent.

Anatomical Characters.—It is admitted by all who have had the most extensive opportunities of investigating the disease, that there are no anatomical changes which can be considered pathognomonic of typhus. Lebert asserts with truth: ‘Kein Organ ist jedoch der besondere und Hauptablagerungsherd der Krankheit.’

If death takes place early the body is little emaciated; the petechiæ which are caused by blood-extravasations are visible, and, as in life, most marked on the back. Almost all the organs of the body are the seat of change in structure, congestions, and fatty degenerations. The liver, spleen, and kidneys are the seat of more or less degeneration. The mucous membrane of the intestinal tract is infiltrated, and shows traces of catarrh, and in exceptional cases even superficial ulceration, but there is nothing constant. The brain and membranes in the early stages are hyperæmic; if death occurs late in the disease they may be anæmic, with serous effusions. The heart-walls are softened, and the seat of granular fatty change; there is fluid blood in the ventricles. The lungs are the seat of hypostatic congestion, the blood being profoundly altered—dark, almost black. The veins and arteries have been found to be the seats of thromboses and emboli. In the event of complications already alluded to, numerous are the lesions from which they arise.

Treatment.—Impressed with the communicability of typhus, it is the duty of the physician to insist, if possible, on the isolation of the sick from the healthy. The neglect of this precaution has often been followed by lamentable consequences. On the first approach of fever the patient should be ordered to bed. Every exertion, mental or bodily, at the commencement of the disease should be forbidden. The transport of the sick of typhus in war has been known to intensify the symptoms; so it is, too, in civil life. Therefore removal from the locality where first attacked, when the disease has made any progress, should be avoided, unless under the stress of absolute necessity.

In the management of typhus cases, in hospital or private practice, an abundant supply of air should be afforded. From the chamber all unnecessary furniture should be removed; the covering of the bed should not be too heavy. In summer the windows should be open, and in winter the windows of adjoining rooms, with open door between. The temperature of the apartment should not be under 59° F. nor over 65° F. During the height of the fever, when the temperature is high, exposure to cold does not act injuriously; but not so once defervescence has taken place. The patient should not be permitted to change from the prone position for any purpose—an order often difficult to be enforced during the early period of the illness. The strictest injunction should be issued against noise, or even whispering, in the room. Light should be modified, but not excluded. The patient will sleep better if the room is not darkened during the day. A marked difference should be made between day and night; this has been strongly insisted on by Corrigan in his admirable lectures on fever. No one should be admitted to the room except the necessary attendants.

The disease having been established, can it be cut short by any means? It is not possible when the poison has been taken into the system. For long it was supposed that bleeding, emetics, and cold affusion were potent factors in suddenly arresting the progress of the disease; purgatives have also been a popular remedy, and the administration of an active purge at the onset of fever has often had an unfavourable influence on the whole progress of the case. The idea of arresting typhus fever by such means is now altogether abandoned.

The disease in uncomplicated cases, when of moderate severity, runs a certain course, tending towards a favourable termination, and then the treatment is absolutely expectant. Nevertheless the watchful care of the physician can do much in steering the ship through troubled waters into a haven of safety, avoiding the rocks and shoals which threaten to submerge it. The regulation of the diet is of paramount importance. Thirst is constantly felt, and the craving should be satisfied, and the fancies of the sick, when possible, be indulged. Cold water or some mineral water will generally be found to be most acceptable; when the tongue is dry, iced water or ice may be permitted. If the patient's sensibilities are so blunted that he cannot give expression to his wants and wishes, care must be taken that at regular intervals drink and nourishment be given; no more suitable drink than milk and water or soda-water, can be given, thus supplying nourishment at the same time that the thirst is assuaged No longer is the fever patient destined to be kept on *diète absolue—Fieberdiät.* It is now universally recognised that the waste must be supplied by suitable nourishment. In Great Britain and Ireland the example was set, which has since been followed in France and Germany, clinical physicians in the foremost rank in these countries admitting frankly that there was ground for the charge made against them of starving their patients. So speak Niemeyer and Trousseau. Broths of different kinds are now freely allowed, and, when there is great debility and manifest failure of strength, more concentrated nourishment, as essence of meat, or eggs. The administration of wine and stronger alcoholics is one of the points in the treatment of fever demanding the most careful consideration on the part of the physician, for upon it may depend the issues of life or death; but some patients do not require wine. In most cases, unless in those stamped by malignancy from the commencement, it may be postponed to the end of the first or beginning or even the middle of the second week, and then cautiously, tentatively given, marking its effects. The selection of the stimulant should depend upon the age and previous habits of the patient: the young or previously temperate require wine in small quantities, and diluted; the aged or intemperate a liberal allowance of strong wine or even brandy. Without reference to the day of the fever, if there be prostration, a tendency to sinking of the vital powers, stimulants must be freely given; and thus it may be that the threatened paralysis of the heart is warded off. Medicinal agents, such as ammonia, ether, musk, and camphor are often advisable.

When wine agrees, it will be found that the pulse, which was weak and shaky, acquires strength and falls in frequency, and the delirium is mitigated, for stimulants often exercise a calmative influence inducing sleep. The heart, which, from its weakness or paralysis, calls for the most strenuous efforts to sustain its flagging force to bridge over the danger which is so imminent, may recover its natural force. The cerebral symptoms—headache and delirium—are frequently relieved by the application of ice or, what is sometimes more effectual, cold or tepid affusion. Care should be taken, when the ice-bladder is employed, that it should not remain too long on the head, as it seems to have a depressing effect. When insomnia is present, and the temperature is high, tepid affusion often has the effect of inducing sleep; so has the abstraction of a small quantity of blood from the temples, sleep often coming on while the blood is flowing. The practice of general bleeding in fever followed by Sydenham and by Pringle even in gaol fever, and in a modified manner by many eminent physicians of wide experience, as Cheyne and others, in the epidemics of the early years of the present century and even later, has fallen into disuse; but the withdrawal of a little blood locally (two or three leeches on each temple) is not only unobjectionable, but is a remedial measure of the greatest value. In conditions of a comatose nature blisters should be employed—straps of blisters on the vertex, and not to the nucha, the part usually selected, but which should be avoided. If insomnia continues, the use of the bromides may be resorted to, and often with advantage; but when they fail, as they may, then opium or morphine must be administered. Dr. Hall has found sulphonal a remedy of much value, but it often has a depressing effect.

The application of water to the head has been spoken of, but in all cases it is also essential for the whole body. The most scrupulous cleanliness is to be observed, and sponging with cold or tepid water may be used when the antipyretic treatment by cold baths has not been fully carried out—a practice now so generally followed in Germany in the treatment of enteric fever, and for which are claimed by its advocates, Liebermeister and others, such satisfactory results. This treatment is now being adopted in typhus also, in which, as in other cognate diseases, the danger of high temperature is universally admitted in combating the very essence of fever, which Galen termed 'calor præter naturam.' The practice, although it originated in England, has not hitherto in this country been adopted to the same extent as on the Continent and in India. The importance of the reduction of the temperature which is menacing life cannot be over-estimated.

Quinine has been looked on by some as a specific, not only in malarious, but in continued fever, and has been used extensively since first recommended as an antipyretic by Vogt. Liebermeister recommends it in colossal doses, and says he has known no serious case of typhus without it. Quinine is used as an adjunct to the cold bath in the antipyretic treatment of fever; it may be the sole antipyretic when the cold bath is contraindicated. Mosler, who had the experience of two epidemics of typhus, attributes the low mortality of the second to the fact of the antipyretic treatment having been by him more energetically carried out in that epidemic than in the first.

It has been stated, in contrasting maculated typhus with enteric fever, that in the former the bowels are generally confined; the best means of removing this state is by warm or cold water enemata, which never cause over-action, which even mild aperients by the mouth often do. One of the most dangerous complications in fever is meteorism, and the best means of combating it is by the internal and external use of turpentine. Another is bed-sore, which in low forms of fever, despite all efforts to guard against it, will sometimes appear. The back should be examined daily, and the surface, which has become red, should be bathed with brandy or camphorated spirit; the position of the patient should be changed, and air or water cushions placed under the back, or a water bed employed. In all cases it is most desirable to have two beds; a change can be effected without difficulty or danger, and the comfort and advantage of a day and night bed are incalculable. It is most difficult at times to limit the ravages of bed-sores, the nates have literally sloughed away, but even in such a case recovery has taken place.

The local applications which answer best are carrot poultices with charcoal, or stimulating poultices calculated to promote the throwing off of the gangrenous parts. Dry gangrene may be allowed to remain undisturbed, as it is a protection to the subjacent parts. The danger of hypostasis has been alluded to, and this may be averted by altering the position of the patient, and also by the free administration of wine or brandy to stimulate the heart's action.

The use of quinine as an antipyretic has been mentioned; and it may be added that it is the most reliable remedy in some of the complications of fever—above all in typhoid pneumonia, as recommended by the writer's distinguished colleague, Dr. Gordon. Independently of its effect in pneumonia, quinine seems to have almost a specific influence on the muscular tissue of the heart, for it has been often found that under its influence the weak, irregular, and fluttering heart has become regular.

The physician must be always on the watch for complications, for their approach is generally insidious, and wanting in the symptoms which in ordinary cases appertain to them; they may be truly termed latent. The restoration to health after ordinary typhus is rapid; but typhus protracted beyond its ordinary duration leaves the patient's bodily strength at a very low ebb, and sometimes the brain does not speedily recover from the shock it has received. Mania may be a sequel, but the form of cerebral disturbance is more frequently characterised by mental weakness, with inability to fix the attention and follow any train of thought. The prognosis is generally favourable, for usually in time the mind recovers its wonted vigour. JOHN BANKS.

TYROSIN (*τυρός*, cheese). — SYNON.: Fr. *Tyrosine.*—Tyrosin, or para-oxyphenyl-*a*-amidopropionic acid, is, like leucin, with which it is generally associated, a decomposition-product resulting from the prolonged action of the pancreatic secretion on the complex proteid molecules. Its chemical composition is represented by the formula $C_9H_{11}NO_3$.

CHARACTERS.—Tyrosin crystals are soluble in acids and alkalis, but very sparingly soluble in cold water, much more soluble in hot water, and practically may be considered insoluble in ether and strong alcohol.

Microscopically, tyrosin crystals are usually seen in the form of very fine needles, either separate, or occurring in feathery or wheatsheaf bundles (*see* fig. 103).

Chemically, tyrosin may be obtained from the urine by the method described under LEUCIN, but the residue of this, insoluble in boiling alcohol, is treated with boiling water, and allowed to crystallise. The most reliable and delicate reactions for tyrosin are the two following:

Piria's Reaction.—Warm on a water bath for about five minutes a watch-glass containing tyrosin moistened with concentrated sulphuric acid; a pink colour is produced. Dilute with water, warm, neutralise with barium or calcium carbonate; filter whilst hot. Add to the filtrate a few drops, carefully avoiding an excess, of a weak solution of the perchloride of iron. A violet coloration is indicative of the presence of tyrosin.

Hoffmann's Reaction.—If to a heated solution of tyrosin a little Millon's reagent be added, the fluid assumes a rose-red or crimson colour; and if tyrosin be present in quantity, a precipitate of a similar colour will be thrown down.

PATHOLOGICAL SIGNIFICANCE. — Tyrosin, according to Kühne, is never present in healthy livers; it, however, is probably normally present in very small amount in the pancreas and the secretion of this gland, and in the spleen. It is never a normal constituent of the urine; but its presence in this excretion along with leucin is of value diagnostically in certain morbid states of the liver, especially acute yellow atrophy, in which the secreting cells are quickly disintegrated. It has also been detected in the urine in cases of acute poisoning by phosphorus. *See* LEUCIN; LIVER, Atrophy of, Acute Yellow; and MICROSCOPE IN MEDICINE.

JOHN HAROLD.

U

ULCER and ULCERATION (ἕλκος, *ulcus*, a sore).—SYNON.: Sore; Fr. *Ulcère*; Ger. *Geschwür*.

DEFINITION.—A solution of continuity on an epithelial or endothelial surface, secreting pus.

ÆTIOLOGY.—A breach of surface may arise from external causes, such as mechanical violence, chemical irritation, heat and cold, continued pressure, and the like; on the other hand, changes may commence within the tissues themselves, owing to some general or constitutional cause, and a breach of surface, dependent upon acute or chronic inflammation or defective nutrition, be the result.

ANATOMICAL CHARACTERS.—The parts of a healing ulcer are—the *surface*; the thin blue epidermic *pellicle*; the *edges*; the *surroundings*; the *discharge*. When an ulcer departs from the healing type, every possible variety of appearance occurs in the surface, edges, surroundings, and discharge, and in the character and intensity of the accompanying pain.

When a section of an ulcer is examined microscopically, the following parts are made out: A layer of free leucocytes or pus-corpuscles on the surface; projecting up into the pus are fine points, consisting of loops of blood-vessels, coated over with living white corpuscles, constituting granulations; beneath this, a zone of inflammatory tissue, consisting of fine connective or dense fibrous tissue, varying according to the age and character of the affection. Marginally there is a zone of hyperæmia, fading away into healthy tissue beyond, where the blood-capillaries are very numerous, and the white blood-corpuscles are in excess.

Should the whole of the affected part be seen on a vertical section, it would appear depressed in the centre; and each zone, from the surface downwards, would appear as an arc of a greater circle than the previous.

The history of the commencement of an ulcer will evidently vary, according as it originates (1) from *external*, or (2) from *constitutional* causes.

1. When a *wound* does not heal by primary union, by scabbing, or by first intention, it begins in a few hours to show signs of active hyperæmia. The surface exudes first serum, then white blood-corpuscles, fibrinous and albuminous matters; the surroundings become congested; by-and-by granulations appear in the bottom of the wound, and an ulcer is thus established.

2. When the changes commence *within* the tissues, the general affection finds expression in some local irritation, causing a determination of blood to the part. The irritation may be a varicose vein, a gumma, a strumous gland, or a malignant tumour. The blood-vessels at first exude serum, which infiltrates the neighbouring tissues, causing them to swell. White blood-corpuscles and fibrinous matters after a time escape from the capillary walls, and the irritated spot becomes permeated by an embryonic connective tissue. The tissue thus formed passes, as the result of chronic irritation, to a higher state of development, becoming fine fibrous tissue, and as it becomes more dense contracting upon the structures passing through it. The consequences of such a change as this in any part are, first, an increased activity of its normal functions; and, secondly, a perversity and a gradual cessation of these functions, followed by destruction of the tissue from the arrest of nutrition.

A section of the part in this condition would show the irritating spot in the centre, then a zone of indurated fibrous tissue, and around all a zone of hyperæmia. When the skin becomes involved it changes colour, the epidermis is shed rapidly, serum oozes out through cracks and fissures, and finally may collect on the surface to form a scab. When the scab falls off, a raw surface, consisting of the papillary layer of the skin, is seen, and from this a discharge flows away, becoming thicker and more purulent. The surface is now an open sore, secreting matter, and exists as an ulcer.

PATHOLOGY.—**Ulceration.**—The ulcerative process is so intimately associated with inflammation, suppuration, gangrene, phagedæna, granulation, and cicatrisation, that it is impossible to detach it from any one of these, and call it a separate definite process. Few writers agree in their descriptions of the extent of the process, some looking upon the ulcerative process as implying destruction of the tissues only; others, as signifying both destruction and repair. In its widest sense, the ulcerative process is the process whereby ulcers are formed, spread, arrested, maintained, and healed. The actual formation of an ulcer has been discussed; and when the ulcer is once established, the ulcerative process is seen to be a liquefaction and dissolution of the tissues and exuded elements, and the formation of granulations and discharge. This process goes on from the beginning to the end of the history of an ulcer, so that it is impossible to say that it ends before healing takes place.

In the immediate neighbourhood of any ulcer, vascular changes take place, which have to be followed closely before the ulcerative process can be understood aright. In the first place, the capillaries in the neighbourhood of the irritated spot are in a state of tension, from increased blood-pressure, and they tend to relieve themselves by the transudation, first, of serum, and then of white blood-corpuscles and fibrinous material. These products behave differently, according as they escape into the *surrounding tissues*, or reach the *surface*.

(*a*) When the cells and fibrinous materials escape into the *surrounding tissues*, they infiltrate the immediate neighbourhood of the ulcer, causing a surcharge and œdema of the connective tissues. The consequent pressure on the blood-vessels leads to interference with the circulation, and, as a result, to a deficiency of the nutrition of the surrounding tissues. The cellular elements of these tissues swell, undergo degeneration, liquefy and are absorbed, or remain in the tissues. According to the intensity of the irritation and the condition of the patient, so the area of infiltration and of liquefaction extends, and the degenerative process continues; or, on the other hand, along with the infiltration, induration occurs, and stays the processes of destruction. The arrest of the extension of infiltration, by the formation of a moderately firm barrier of indurated tissue, is necessary before repair sufficient to heal the ulcer is induced.

(*b*) The portion of the cellular transudation that reaches the *surface* consists of two parts. The part for which sufficient nutrition cannot be obtained flows away as pus, whilst the part that is retained in close proximity to the blood-vessels becomes formed into a layer of embryonic connective tissue. This layer, as the irritation declines in intensity, increases in thickness, becomes vascularised, and rises into small protuberances constituting granulations. The vascularisation of the embryonic connective tissue keeps pace with the continued addition of new cells on the surface, and so the reparative action is kept going. The deeper layer of first-formed cells now become spindle-shaped, with their long axis parallel to the blood-vessels. Along with the blood-vessels, lymphatics and sympathetic nerves find their way into the granulations. The spindle-shaped cells gradually form a denser tissue, and, owing to their shrinking, the granulations diminish in size, the purulent secretion grows more scanty, and by-and-by the whole surface is involved in cicatricial tissue, and glossed over by an epithelial pellicle (*see* CICATRISATION). The details of this process will vary according as the destructive or the reparative process predominates; the predominance of the former will cause ulcers to spread, forming inflamed and phagedænic ulcers; whilst the predominance of the latter will tend towards the healing of ulcers.

That an ulcer heals by the building up of new tissue is much to be doubted. The ulcer comes to the same level as the surroundings, not so much, if at all, by the growth of its granulations, as by the subsidence of the swelling and induration in the edges and surroundings themselves. Before it can heal, these must be restored to a normal state; and it is only when this takes place, and the same level is reached, that the epidermis advances and glosses over the fibrous tissues of the cicatrix.

VARIETIES.—No better classification of the varieties of ulcers than Syme's can be given. All writers on surgery, since his time, follow the spirit, if not the letter, of his classification, and it is proposed to adopt this system here, noticing in order the following varieties of ulcers: (1) The *healing* or *healthy*; (2) *those that do not heal from defect of action*; (3) *those that do not heal from excess of action*; and (4) *those that do not heal from peculiarity of action.*

1. The healing or healthy ulcer.

The surface is covered by granulations, which are small and sensitive, and bleed when smartly touched. There is a thin, blue, epidermic pellicle, consisting of the epidermis advancing from the edges and over the surface. The edges are on a level with the surface, of a pink tint, and free from induration. The surroundings are free from induration, and normal in appearance. The discharge consists of healthy laudable pus. The pain is inconsiderable.

TREATMENT.—The treatment consists in helping the healing process by local and constitutional means. The local means consist, first, in rest, by position, or by splints or bandages: and, secondly, in the application of a piece of lint dipped in water or slightly stimulating lotion to absorb discharge and protect the surface; over this a piece of oiled silk slightly larger than the piece of lint, to prevent evaporation; and then a bandage or piece of strapping over all, to fix the dressing and support the part. Should the healing of the ulcer flag, stimulating lotions are required to restore the tone. If the ulcer has involved a large amount of skin, the process of skin-grafting hastens the cure, and is an efficient means of helping the cicatrisation. The patient's general health must be attended to, and the appearance of any retrograde change in the part will serve as a guide to such treatment.

2. Ulcers that do not heal from defect of action.

(*a*) *Weak ulcer.*—The cause of this form is generally the prolonged use of emollient applications. The characters are: The granulations become flabby, watery, gelatinous masses, and rise above the level of the surroundings, constituting 'proud flesh.' The edges are overlapped by the granulations. The surroundings are normal. The discharge is thin and watery. There is little or no pain.

Treatment.—It is necessary to get rid of the exuberant granulations by caustics, such as nitrate of silver or pure nitric acid. Afterwards we must employ astringent lotions, or powdered substances, such as oxide of zinc, oxide of zinc and starch, tannic acid, or nitrate of lead, with firm bandaging. When at the same time the patient's health is lowered in tone, tonics and bitter astringents must be given freely.

(*b*) *Indolent, callous, or chronic ulcer.*—This sub-variety occurs when, from chronic irritation, the fibrous-tissue induration is excessive, the blood-vessels reach the surface of the ulcer in too minute quantities to build up healthy granulations, and so the ulcer is perpetuated.

The surface is sunk below the level of its surroundings, is destitute of granulations, and looks glazed. The edges are raised, hard, and irregular. The surroundings are indurated, raised, and the veins in them frequently become varicose. The discharge is thin, serous, and small in quantity. The pain at times is very great, especially at night.

Treatment.—The induration is got rid of by strapping tightly and evenly with soap or resin, or a mixture of soap and resin, plaster; holes must be made in the plaster to allow the discharge to escape, and the strapping should be re-applied every forty-eight hours. At each removal, the surface may be touched with caustics, or washed with a strongly stimulating lotion, as of carbolic acid 1 to 20, or chloride of zinc 20 grains to the ounce. When the induration is gone and granulations appear, the ordinary treatment for a healthy ulcer is all that is required. Another method is to blister the surface of the ulcer with plaster or solution of cantharides; to apply a poultice over all, allowing it to remain for six hours; and on removal of the poultice, to wash the part with carbolic acid lotion 1 to 20, and apply antiseptic dressings (*see* Antiseptic Treatment). Still another method of treatment is by the elastic bandage; this is used for the lower extremity only. The part is first washed with carbolic acid 1 to 20, and the limb bandaged firmly and evenly with Martin's elastic bandage, from the toes upwards, covering over the ulcer. No dressing is placed over the ulcer. The bandage by continued pressure causes softening, liquefaction, and absorption of the hard surroundings; and the surface of the ulcer is bathed in the natural secretion of the part. The bandage is removed nightly, washed with carbolic acid, hung up to dry at a distance from the fire, and re-applied in the morning. During the night a simple dressing is worn. For old-standing ulcers multiple concentric incisions through the dense tissues about them are of much value. The incisions are made parallel to the margins, but not sufficiently near to cut the blood-vessels going directly towards them. The incisions are to be kept open by strips of linen, when it will be found that the infiltrating serum escapes, affording relief of tension.

3. Ulcers that do not heal from excess of action.

(*a*) *Irritable ulcers.*—These are met with on the legs of nervous and anæmic women. The surface is uneven, covered often with a grey slough. The edges are irregular. The surroundings are red and glazed, but not thickened. The discharge is a thin sanious pus. The pain is excessive, of an aching kind.

Treatment.—In the treatment of irritable ulcer it is necessary, first of all, to relieve pain by giving opium hypodermically or internally, and applying opiate or lead lotions externally. At the same time an endeavour is made to restore the patient's health and tone. When the pain has ceased, the ulcer is treated by some one of the above methods.

(*b*) *Inflamed ulcers.*—Any form of ulcer may become inflamed. This sub-variety usually arises during the course of an indolent ulcer, from derangement of the patient's health, and local irritation.

The surface is covered with a greenish-grey slough. The edges are swollen, everted, red, and angry. The surroundings are red, swollen, and hot. The discharge is ichorous, offensive, often bloody, and causing irritation wherever it touches. The pain is of a throbbing kind.

Treatment.—The inflamed ulcer should be treated by rest, with bread-poultices properly applied; by three or four leeches, around the sore; or by scarification of the edges, which will allay the inflammation. After this the ordinary treatment previously recommended is to be followed.

4. Ulcers that do not heal from peculiarity of action.

(*a*) *Phagedænic and sloughing ulcers.*—When an inflamed ulcer commences to spread, the edges liquefy and rapidly break down. The process may take place with extraordinary rapidity, as in chancre, when it is called phagedæna; or as in hospital gangrene, when it spreads chiefly by sloughing. The patient in either case is usually in a cachectic state; the ulcerated part is dusky red, angry-looking, hot, and painful. The surface is covered by a grey or black slough, and the edges are sharply cut and undermined. *See* Bubo, Venereal; Gangrene; and Venereal Sore.

Treatment.—Rest, opiates internally, and externally in the form of lotions, and careful dieting are necessary to subdue the spread of the inflammatory action. Prolonged immersion in water, which is kept constantly renewed, is an excellent method of treatment. Should these methods not control the action, the application of strong nitric acid will often succeed. Fresh air and disinfectants are required; and opium to relieve pain.

(*b*) *Varicose ulcers.*—The points to be observed about a varicose ulcer are that it follows the chronic irritation of a varicose vein; that when formed it may become indolent, inflamed, irritable, &c.; and that it frequently bleeds, from the ulcerative action extending towards and thinning the wall of a vein. *See* Veins, Diseases of.

Treatment.—Varicose ulcer itself is to be treated by the ordinary methods, but the varicose vein must be supported by an elastic stocking, or, what is better, when the ulcer is in a healthy state, by a Martin's elastic bandage.

(*c*) *Hæmorrhagic ulcers.*—Hæmorrhagic ulcers occur in persons suffering from amenorrhœa, scurvy, chronic jaundice, or hæmophilia. They possess the characters of irritable ulcers, but in addition have a special tendency to ooze blood from the surface. The blood is of a capillary-venous character, and flows freely at times.

Treatment.—In the hæmorrhagic subvariety we have to attend to the diathesis with which this special form of ulceration is associated, and treat the ulcer by any one of the usual methods.

(*d*) *Syphilitic*, *lupoid*, *rodent*, *scorbutic*, *endothelial*, and *mucous* ulcerations.—These are described in separate articles.

One form of ulcer possesses so much interest to the practitioner that it calls for special consideration.

Bed-sore.—Synon.: Fr. *Décubitus*; Ger. *Decubitus*; *Wundliegen.*

Definition.—A form of ulcer caused by continued pressure, consequent on the recumbent position.

Ætiology.—Bed-sores are dependent either on a low condition of the nutrition of the tissues of the patient, on bad nursing, or on a combination of the two. In patients suffering from fractured spine, especially if the spinal cord be torn; in those paralysed from other causes; in cases of fractures of the lower extremity; in angular curvature of the spine; in patients suffering from hip-joint diseases; in the acute specific fevers; and in the aged—in fact, in any disease or condition necessitating long confinement to bed, and rest in one position—bed-sores may be developed. When, in addition to the illness, the nursing is badly conducted, as shown by urine, pus, blood, or any discharge whatever being allowed to remain on the part where the patient lies, a strong determining cause is set up, which will in all probability originate a bed-sore. Other strongly predisposing causes are the use of a feather bed, and the presence of a blanket between the mattress and the under-sheet, into which the perspiration from the patient's body soaks, causing the blanket to act like a poultice. Hence it will be seen that paralysis and an enfeebled state of the circulation, combined with pressure and inattention to strict rules of cleanliness, are the main elements present in the production of a bed-sore.

The various sites on which bed-sores form are arranged here in the order of frequency with which they are met—the sacrum, the heel, the buttocks, over the trochanters, between the shoulders, on the middle of the back from the shoulders to the sacrum, on the malleoli, on the elbows, and on the calf of the leg. On the heel the usual cause is the pressure of a splint; on the elbow bed-sores frequently supervene in such cases as hip-joint disease, owing to the tendency patients have to support themselves on one or both elbows.

Anatomical Characters.—A bed-sore is only one of the many forms of the evil results of pressure. The passage of blood through a part where pressure is great becomes mechanically difficult. Exudation from the blood-vessels takes place, causing the cuticle to be first raised, then to peel off, and finally a moist catarrhal surface results. By-and-by stagnation of the blood in the blood-vessels occurs, and as a consequence the part becomes practically dead. In the surrounding parts the blood-vessels become engorged; and, the presence of the slough acting as a foreign body, the irritation causes inflammation, and an exudation of inflammatory products occurs between the living and dead parts. This takes place all around and beneath the slough, but is first apparent as a furrow on the skin. This furrow gets gradually deeper and deeper, and, the process of separation extending beneath the slough, it becomes detached and finally thrown off. An ulcerating surface now results, the further history of which will vary with the patient's health, and according as the illness, which rendered confinement to bed necessary, is of a curable or an incurable nature.

Symptoms.—The premonitory symptoms of bed-sore may be either subjective or objective. Subjectively the patient complains that the bed feels hard, that there is a crease in the sheet, that there are crumbs of bread or salt in the bed; along with these generally imaginary troubles, a pricking numbing sensation is felt at the point of pressure; but on examination of the part complained of, no change may be apparent. Or, again, the complaints may be *nil*, as in the paralysed, and yet the effects of pressure may be far advanced. The objective symptoms, that is, the changes apparent in the part, may be, as in the paralysed, the first indication of the effects of pressure. These are alteration in the colour of the skin, a roughening of the cuticle, and a variable amount of pain on pressure with the finger. Any of these is sufficient indication that preventive measures must be immediately undertaken, otherwise a bed-sore will develop. As the symptoms advance, the discoloration becomes deeper, passing from red to livid red, from purple to black. The pain, except in the paralysed, becomes for a time severe, and then finally disappears, as all nervous connexions are severed. The circulation through the part being completely stayed, a dark slough is formed, and a line of demarcation between the living and dead tissue is set up. A foul discharge runs from the part; the tissues around become red and congested; the edges are undermined; and a feeble attempt is made to throw off the central slough. Should the slough be thrown off, the muscles, fasciæ, and even the bone of the damaged part may be exposed. The general symptoms associated with bed-sores are chiefly those of the disease in the course of which this complication has supervened. In some instances a form of pyrexia may, however, be induced by the discharging ulcer itself—a condition which constitutes one form of 'bed-fever.'

Diagnosis.—The appearances described in the skin, at the point or points of pressure, are unmistakable evidence either of the likelihood of a bed-sore developing, or of its actual presence.

Progress and Prognosis.—Should the patient recover from the illness for which confinement to bed had become necessary, the bed-sore will in all probability heal. Bed-sores, however, can scarcely be healed in those patients whose maladies do not improve, or in whom recovery does not take place. At times pyæmia supervenes; or the exhaustion, consequent on a long-continued and profuse discharge from the sore, proves too great a drain on the patient. The prognosis in regard to bed sores developing in any individual case will depend on the disease, the age of the patient, and the care taken in nursing. The patients in whom a bad prognosis might be given, in regard to the appearance of a bed-sore, would be the old, and the partially paralysed, especially when bad nursing is superadded.

Treatment.—It is necessary to consider this subject under the heads of (1) the *preventive* measures; (2) the treatment *when abrasions have taken place*; and (3) the treatment or cure of the *sore when formed*.

1. The *preventive measures* have, in paralysed patients, and in patients suffering from incontinence of urine, to be commenced at the beginning of the illness, and signs of changes in the skin are not to be waited for. The part must be thoroughly cleaned, the circulation stimulated, the skin hardened, and pressure removed from the parts where it is greatest. The best means by which to gain these ends are as follows. First, the part is to be washed with soap and water, and then thoroughly dried. Secondly, a piece of cotton wool dipped in spirits of wine, eau-de-Cologne, or brandy, must be applied to the part with gentle rubbing, until it has become thoroughly dry; and this process must be repeated three or four times at each dressing. Thirdly, to keep the skin supple, a very small quantity of oxide of zinc ointment or simple ointment must be rubbed into the part, until all greasy feel has disappeared. Fourthly, a draw-sheet must be placed beneath the patient, and oxide of zinc powder sprinkled on the part on which the patient is to lie; the sheet must be changed the moment it becomes wet, whether from urine, blood, pus, or sweat. Pressure must be removed by frequent changes of position, and by suitable pads, air-cushions, water-pillows, or water-beds. The part where the edges of the cushion press is to be treated by the same preventive measures, and to be dressed two or three times a day. Lastly, we must avoid a feather-bed, and a blanket beneath the under-sheet. In many cases bed-sores are caused by careless nursing, but in others the best nursing possible cannot prevent badly nourished tissues from falling into decay.

2. When *abrasion* or roughening of the cuticle occurs, the same precautions in regard to pressure, moisture, and the use of the draw-sheet have to be observed; and, in addition, some specific applications are used. Sometimes the part is greased over with zinc or simple ointment; this is useful in certain cases, preventing urine or other irritating fluid from touching the tender parts. Over an abraded portion, soap plaster spread on amadou or linen is applied; at other times collodion or flexible collodion may be used. The best fluid applications are rectified spirit, or camphorated spirit, with one-third water; it is necessary to add water owing to the pain caused by pure spirit. The surface may also be mopped over with a solution of two grains of perchloride of mercury in one ounce of spirit; or with one consisting of five grains of nitrate of silver to an ounce of water.

3. The treatment of the *bed-sore itself* consists in keeping the part sweet; in aiding the removal of the slough; in applying some one of the many stimulant and antiseptic lotions in use; and in preventing the neighbouring tissues from breaking down. To clean the parts, and hasten the removal of the slough, apply a bread-and-water poultice, or a compress of wet salicylic or boric acid wool. When the discharge is foul, the

part should be washed with Condy's fluid or perchloride of mercury lotion (1–2000) between each application of the poultice. Poulticing may be unadvisable, as the heat and moisture tend to soften and weaken the parts, and permit of their rapidly breaking down.

Stimulating and antiseptic dressings are employed in one or other of the following methods. Cut a piece of lint the exact size of the sore; soak it in some stimulant and antiseptic lotion, such as carbolic acid, 1 in 40, or the red lotion, or the compound tincture of benzoin, the balsam of Peru, or the tincture of myrrh or of catechu; and apply it exactly within the edge of the sore. Over this place a piece of oiled silk or guttapercha tissue, a fraction larger than the lint used; and over this again three or four large folds of lint or amadou, with a hole cut in the centre corresponding to the sore.

In place of the folds of lint and amadou, circular pads or water-cushions might be used to take the pressure off. When the slough is large, lotions and poultices should not be applied directly to it, as the moisture only favours putrefaction. To prevent this, dry the sloughing surface with absorbent wool; dust it over with iodoform, iodol, or ordinary dusting powder; place a piece of oiled silk or guttapercha tissue exactly over the powdered slough; and the lint, dipped in one of the above-mentioned lotions, when applied over it, can only touch the sore at the ulcerating furrow between the living and dead tissue. All dressings should be fixed by diachylon plaster, and not by a bandage, owing to the heat and moisture engendered by use of the latter.

The neighbouring tissues must be treated with the preventive measures already mentioned.

When the slough has separated, an attempt is to be made to heal the part by improving the patient's general health, provided the existing malady permits. The usual precautions have to be taken with the surrounding parts; and the ulcer treated by one of the methods recommended under the head of Ulcers that do not heal from Defect of Nutrition. James Cantlie.

UMBILICAL REGION.—This is the central region of the abdomen, corresponding to the umbilicus and its vicinity. The principal structures which normally lie underneath it are the great omentum, and part of the transverse colon and small intestines, with the deep structures situated in front of the spine. The stomach may reach the umbilical region when distended after a meal.

Clinical Investigation.—There is nothing special to be said on this point, the ordinary methods of abdominal examination being applicable in the investigation of the umbilical region. The following points may be noticed with regard to the abnormal conditions met with in this region.

1. When the stomach is diseased, it is often so distended as to reach the umbilical region. The liver also, either when enlarged or displaced downwards, frequently extends to this region. More exceptionally the spleen or kidney may attain such a size as to encroach upon it. Enlarged organs or tumours may also ascend thus far from below, as in the case of the uterus and ovaries; and even a distended bladder may rise to this height.

2. In general enlargement of the abdomen the umbilicus and its vicinity often give useful information in determining its cause. Thus, when the enlargement is due to fluid in the peritoneum, the umbilicus tends to become stretched, everted, obliterated, or pouched out, which is not the case in other forms. In some instances of portal obstruction it not only projects, but has a peculiar appearance and feel, due to the presence of enlarged and thickened veins. Moreover, the percussion sound in this region remains tympanitic, and sometimes even excessively so, when the rest of the abdomen is universally dull. On the other hand, when the enlargement is due to an organ or tumour, this is not observed, and the umbilical region is often dull when the flanks are resonant. An important element in the diagnosis of ovarian tumour is often thus afforded.

3. Should a very small quantity of fluid be present in the abdominal cavity, this may be detected by placing the patient on his hands and knees, when the fluid gravitates towards the umbilical region, and can be discovered there by percussion.

4. The umbilicus itself may be the seat of disease, such as inflammation, eczema, or gangrene. These conditions are most important in infants, and soon after birth peritonitis may be set up by the extension of irritation from the umbilicus inwards. It, with the adjacent portion of the abdominal wall, is also sometimes involved in tubercular or malignant disease of the peritoneum, which spreads along the remains of the umbilical cord, causing thickening, hardness, redness, and other changes in the umbilicus. The region may likewise become fixed to the underlying great omentum, so that it cannot be moved.

5. Umbilical hernia is an important form of hernia. It may attain a very large size. Moreover, in connexion with this condition, much thickening and induration may be met with about the umbilicus, as the result of a chronic inflammation.

Frederick T. Roberts.

UNCONSCIOUSNESS. — Loss of mental perception or consciousness. *See* Consciousness, Disorders of.

UNDERCLIFF, on the South Coast of the Isle of Wight.—Extends from Bonchurch to Niton. A mild, tonic climate. *See* VENTNOR; and CLIMATE, Treatment of Disease by.

UNILATERAL FACIAL ATROPHY.—SYNON.: Progressive Facial Hemiatrophy; Neurotic Facial Atrophy: Fr. *Aplasie Lamineuse Progressive*; Ger. *Prosopodysmorphie*.

In this very rare affection the whole or part of one side of the face becomes notably smaller than its fellow, owing to an atrophic condition of the subcutaneous tissues and of the skin, together with atrophy of the muscles (though occasionally these escape) and of the bones on the affected side of the face. It is generally unassociated with pain or any alteration of sensibility in the affected region. The skin becomes thin, and pale from absorption of pigment, and hair either fails to develop or drops out. A remarkable and characteristic appearance is produced. The affection is to be distinguished from a congenital inequality of the two sides of the face which sometimes occurs, though to a minor extent. It commonly begins in childhood, and nearly always before the twentieth year, gradually spreading from some limited area in the cheek or other part. It may progress slowly but steadily for several years, and then remain stationary during the rest of the patient's life, which it does not tend to cut short in any way.

The pathology of this rare progressive atrophy of one side of the face has given rise to much discussion. It has been regarded by some as an 'essential atrophy;' by others, as a result of disease in certain vaso-motor and 'trophic' nerves; as an effect of persistent irritation acting upon the cervical sympathetic, especially in its upper and middle ganglia; and by others, with much more probability, as a result of irritation acting upon the fifth nerve, or at least upon some of its fibres. This last view is powerfully supported by the fact that, whilst the atrophy is generally limited to the territory of the fifth nerve, in some cases it has even been restricted to one or other of its divisions. Thus, it has been known to be limited to the parts supplied by the two lower divisions of the fifth nerve; whilst Lovell Gulland has described a case of hemiatrophy of the face confined to the area of distribution of the first division of the fifth nerve. Then, again, in some few cases the atrophy has been associated with pain in the corresponding regions of the face, such as might be caused by neuritis.

This last view of the pathology of the affection has been confirmed by Mendel (*Berlin. klin. Wochenschrift*, May 7, 1888), who, at a necropsy on one of these cases, found a proliferative neuritis of the branches of the fifth nerve, especially of the second division, corresponding to the area of the greatest intensity of facial atrophy. With these changes there was also atrophy of the descending nucleus, though other parts of the nucleus and the roots of the fifth were healthy.

The opposite state—that of *unilateral hypertrophy of the face*, also occurs as a very rare event, mostly as a congenital condition. D. W. Montgomery of California has recently recorded (*Med. News*, July 15, 1893) an interesting example in which the deformity commenced in a boy, without apparent cause, at about the tenth year. He gives references also to nine other cases of this peculiar affection.

Treatment of unilateral facial atrophy, as well as of its opposite, has hitherto proved of little or no avail.

H. CHARLTON BASTIAN.

UNILATERAL HYPERIDROSIS. Excessive perspiration on one half of the body occurs more or less habitually, or only after exercise. It may be limited to one side of the face and head, or the neck and arm may be included; or it may implicate the whole of one half of the body. It has sometimes, and especially when limited to the face and neck, seemed to be one of the symptoms due to paralysis of the cervical sympathetic nerve. In other cases no such relation has been ascertained to exist. It has been met with principally in association with various nervous diseases, such as hemicrania, diabetes mellitus, locomotor ataxy, dementia paralytica, and Graves's disease. *See* SYMPATHETIC SYSTEM, Disorders of.

TREATMENT.—In the absence of definite information as to the pathology of this affection, it is not possible to indicate any rational principles of treatment. Empirically some of the remedies used for checking perspiration, such as zinc, belladonna, and quinine, may be tried, in combination with nervine tonics such as arsenic and strychnine. *See* SUDORIPAROUS GLANDS, Disorders of.

H. CHARLTON BASTIAN.

URÆMIA (*οὖρον*, urine; and *αἷμα*, the blood).—SYNON.: Fr. *Urémie*; Ger. *Urämie*.

DEFINITION.—This term is applied to a group of nervous symptoms, which occasionally occur in the course of acute or chronic Bright's disease, as well as in other maladies which prevent the secretion or the discharge of the urine.

ÆTIOLOGY AND PATHOLOGY.—The circumstances in which uræmia arises are pretty well ascertained, but the connexion between these circumstances and the symptoms is still obscure. It occurs when there is interference with the secretion or the discharge of urine. It is thus met with in all the forms of Bright's disease; in cystic, tubercular, and cancerous disease of the kidney; in suppurative nephritis; and in cases of anuria, either of obstructive or of non-obstructive origin. But some of these conditions frequently exist for long periods without uræmia being developed, and it is sometimes developed unexpectedly without apparent alteration of the patient's state. The attack is, however, precipitated frequently by pregnancy and parturition; by indulgence in alcohol; sometimes by the recurrence of the menstrual period; and probably by intercurrent disease. But the occurrence of these conditions does not in all cases suffice to induce it, for many women suffering from Bright's disease pass through pregnancy and labour without manifesting uræmic symptoms, and so with other inducing causes.

Of the exact nature of the uræmic process we are unable to speak at present with certainty. Two sets of explanations have been suggested—namely, the *mechanical* and the *chemical*. Dr. Owen Rees in this country, and Professor Traube in Germany, have been among the chief exponents of the mechanical explanations. The former dwelt upon the wateriness of the brain in many cases of uræmia. The latter suggested processes by which that œdema might arise. Sudden increase of blood-pressure, and sudden increase of the proportion of water in the blood, might, he thought, suffice to account for the condition. Rosenstein and others have lent the weight of their authority to these views. Monck has sought to demonstrate by experiment that cerebral œdema from increased pressure may produce the result; but even if these experiments had been correct, which is doubted by many, it cannot be denied that there are many well-marked cases of uræmia in which there is no encephalic œdema. The observation of Popoff, which refers the changes to accumulation of altered corpuscles within the cerebral capillaries, may prove important, if it should be confirmed by other authorities.

Among the chemical theories, one of the earliest was that which referred the process to retention of urea; but many difficulties arise in connexion with this. The very ingenious theory of Frerichs, which referred the process to decomposition of retained urea by the action of a ferment, must now be held to be disproved, in consequence of evidences discovered, both of a negative and of a positive kind. The evidence at present before us seems to point to the probability of the process being due to retention of some excrementitious material or materials. Feltz and Ritter believed that the potassium salts are the only really toxic constituents of healthy urine, and that their accumulation is the cause of the uræmic symptoms. Bouchard believes that, while the potassium salts and other mineral substances are of some importance, other poisonous substances, such as urea, and certain materials including colouring-matters, are of much greater moment, while ammonia and its compounds occupy also a very minor position. Probably also the animal alkaloids play a very notable part in the production of these symptoms. Substances such as the xanthocreatinin of Gautier belong to this category. Landois has made out by experiments on animals that if creatin or creatinin be applied over the motor areas of the cerebrum, convulsions result; and certain other substances often met with in the urine exert a like influence. Such observations make it probable that the precise causation of the group of symptoms may soon be made out. While it is clear that chemical processes account for many of them, it must not be forgotten that microscopic organic changes are doubtless accountable for some.

SYMPTOMS.—All the functions of the nervous system are occasionally involved in uræmia. Among the disorders of the sensory function the most common are pain, especially in the head, sometimes very intense and persistent; dimness of sight, or actual blindness of one or both eyes, sometimes attended by no change in the retinæ, at others by retinitis albuminurica; ringing in the ears; and sometimes deafness. Among the motor changes, the most striking are the general convulsions or twitching of muscles; the tendency to vomiting; and sometimes extreme dyspnœa. Among cerebral and mental derangements, drowsiness, torpor, coma, and delirium are the chief.

The forms of uræmia generally recognised are the *chronic* and the *acute*.

1. **Chronic Uræmia.**—This comes on gradually, and may at first scarcely attract attention; the habitual listlessness and indifference of manner observable in cases of Bright's disease becomes increased. Movements are slow, and speech is somewhat indistinct. There is often dimness of sight, ringing in the ears, uneasiness in the head, or violent and persistent headache. The condition of the patient varies; the symptoms occasionally pass away, but they constantly recur, and become by degrees more intense. The drowsiness passes into torpor. If the patient is roused to speak, his articulation is thick and indistinct. It soon becomes impossible to elicit any answer; lethargy deepens into coma; the breathing becomes stertorous, or rather hissing in character, the air being driven against the teeth or hard palate; and death supervenes. Sometimes, instead of silence, a rather noisy delirium comes on, in which wild prolonged howls alternate with muttering, and occasionally with paroxysms of excitement. Sometimes, again, there is a low prolonged muttering, with a repetition of the same expression time after time. Subsultus tendinum and twitching of the facial muscles are commonly seen throughout. Convulsions, vomiting, and diarrhœa are

frequent symptoms; epistaxis also occurs, but more rarely. This form of uræmia is a common mode of fatal termination in cases of chronic Bright's disease. It sometimes occurs—but much more rarely—in the early stage of the inflammatory form.

2. **Acute Uræmia.**—This includes all the varieties in which the symptoms are suddenly developed. There are three common forms—the comatose, convulsive, and mixed; and several less common, namely, the delirious, dyspnœtic, ocular, and articular. In the acute *comatose* form, after headache, giddiness, affection of sight, vomiting, or delirious excitement, coma is rapidly developed; or it may supervene without such premonitory symptoms. The face is usually pale; the pupils are dilated or unaltered, and react slowly to light; or, on the other hand, there may be a red spot on the cheek, injected conjunctivæ, and contracted pupils. There is a peculiar stertor—not the deep snoring of hæmorrhagic apoplexy, but a sharper, more hissing sound, produced by the rush of expired air on the hard palate or teeth. The coma may rapidly deepen, and death ensue within a few hours; or, on the other hand, the patient may rally and continue free from the symptoms permanently; or sooner or later uræmia recurs in one or other of its forms, and issues in death. Acute uræmic coma occurs in all of the forms of Bright's disease, but is most frequent in the inflammatory and cirrhotic varieties.

The second acute type is the *convulsive*, which may almost exactly simulate epilepsy; or be unattended by loss of consciousness; or may affect certain groups of muscles, and simulate tetanus. The attack comes on suddenly, with or without warning. It may be single and solitary; or attacks may occur in rapid succession, five or six, or even more, in the course of twelve hours. They may be recovered from; or they may prove rapidly fatal, either during the paroxysm, or in the coma which succeeds it. They occur in all the forms of Bright's disease, but most frequently in the cirrhotic and in the inflammatory varieties. The existence of cirrhosis of the kidney is not infrequently first revealed by the occurrence of convulsions.

The other types of uræmia, namely, the *mixed*, in which sudden coma occurs with convulsions; the *delirious*, in which the ordinary symptoms are replaced by restless delirium; the *dyspnœic*, in which there are sudden and often most distressing attacks of breathlessness, without corresponding change in the physical signs of the lungs or heart; the *tetanic*; the uræmic *blindness*; the *disturbances of hearing*; the *itching* or *burning sensation* in the skin; the *vomiting*; the *diarrhœa*; and the *articular* uræmia, which Jaccoud has described as presenting many features in common with acute rheumatism, need not be particularly described here.

Diagnosis.—There is little difficulty in distinguishing the chronic form of uræmia when fairly established. The most important evidence is, of course, afforded by examination of the urine. Uræmia sometimes resembles fever or meningitis; but the history of the illness, the state of the urine, the temperature, and the mode of breathing, suffice to distinguish it from these conditions.

The acute form of coma may closely resemble cerebral hæmorrhage with loss of consciousness, but differs in the absence of paralysis of one side, and also in the character of the breathing, while the condition of the urine also affords important indications.

The convulsive type may resemble epilepsy, but it has rarely the initial cry, the corpselike pallor, the predominance of convulsions on one side, the turning in of the thumbs on the palms, and the loss of reflex irritability. The chief reliance is to be placed on the analysis of the urine, because, although after true epilepsy albumen may be present, and urea may perhaps be diminished for a time, the secretion soon returns to its natural condition, while in uræmia it is always distinctly albuminous. From opium-poisoning or belladonna-poisoning it is distinguished by the condition of the pupils, and the examination of the secretion.

Prognosis.—The occurrence of uræmia in a case of Bright's disease is always grave; the chronic form is hopeless, and when it occurs the duration of life cannot be long. The acute forms are often recovered from; they sometimes subside spontaneously, but when they are due to chronic renal disease, death cannot, as a rule, be regarded as far off. When they result from acute disease, they are not so hopeless, because the conditions on which they depend are frequently removed by treatment. Puerperal cases, although involving great immediate danger, are very frequently recovered from, probably because they owe their origin to a combination of circumstances which do not long persist.

Treatment.—The first indication is to seek to re-establish the suppressed secretion of the kidneys. For this purpose, dry cupping, wet cupping, leeching, or poulticing over the loins, and the administration of digitalis and other non-irritating diuretics, are indicated. Frequently the blood must be relieved more rapidly than the action of the diuretics can accomplish. Venesection to the amount of eight, ten, or more ounces, may be of use, especially in the puerperal forms, and the acute inflammatory cases. Dilution of the poisoned blood may also be tried, as has been urged by Dr. William Carter in his admirable *Bradshaw Lecture*. Purging with hydragogue cathartics, such as elaterin, or compound powder of jalap, or jalap and scammony; diaphoretics, such as nitrate of pilocarpine subcutaneously or by the mouth; and the hot pack—any of these methods may often relieve the system until there is time for the diuretics to act. Above all, the nitrate of pilocarpine and the hot-air bath are to be recommended. When the convulsions are severe, sedatives, such as bromide of potassium—or still better of sodium—and hydrate of chloral, are useful. Chloroform is of great value. It quiets the nervous system, and checks the convulsions more rapidly than anything else; but the tendency to coma in the individual case must be carefully kept in view during administration. Tonic remedies, and articles of diet such as milk (at once nourishing and powerfully diuretic, and supplying little excrementitious matter), should be given, to ward off a return of the symptoms when the uræmia has disappeared, as well as during its continuance. In puerperal cases an obvious and important indication is to complete the labour with as little delay as possible.

In the related condition of diabetic coma treatment is unavailing; but intravenous injection of saline fluid may be attempted, and general stimulants given. *See* TRANSFUSION OF SALINE FLUIDS.

T. GRAINGER STEWART.

URETERS, Diseases of.—SYNON.: Fr. *Maladies des Uretères*; Ger. *Krankheiten der Harnleiter.* — Morbid conditions of the ureters are so generally parts of, or associated with, diseases of the bladder or kidney, and so naturally come to be described in the articles treating of these several diseases, that a separate account or distinct classification of them is perhaps scarcely called for; and a brief description of the most important will be sufficient for all practical purposes.

1. **Congenital Malformations.** — A double ureter is the most frequent malformation, the division sometimes reaching as far as the bladder. In very rare cases a triple ureter has been found. Congenital malformations leading to more or less complete obstruction of the ureter are found most often near the pelvis of the kidney. If the obstruction is complete, it gives rise to hydronephrosis (*see* HYDRONEPHROSIS). If incomplete, a slighter degree of the same condition results, the pelvis and calyces becoming dilated, and the kidney-substance atrophied and indurated. The chief congenital obstructions are—(1) Total obliteration of the ureter as it leaves the pelvis. (2) Valvular opening from the pelvis into the ureter. This becomes gradually more complete as the dilatation of the pelvis increases. (3) A spiral arrangement of the ureter. (4) An abnormal renal artery pressing on the ureter as it leaves the pelvis. The incomplete obstructions frequently give way at intervals, when there will be a copious flow of urine, usually of low specific gravity and pale colour.

2. **Acquired Obstruction.**—*Complete* obstructions which are not congenital may arise: First, from impaction of a renal calculus; this may take place at any point, the most frequent being at the brim of the pelvis or the vesical orifice. Secondly, from external pressure, as from uterine cancer, pelvic tumours, fibrous bands, enlarged glands, or fæcal accumulations, in which case the condition would at first be incomplete. *Incomplete* obstruction arises most frequently from impediments to the discharge of urine, existing in the prostate or urethra. In the former case, the bladder being in a state of constant over-distension, the valved opening of the ureter is closed with unnatural force. In the latter the hypertrophy of the bladder increases the length of the portion of ureter lying in the bladder-walls, and the bundles of muscular fibres more or less constrict the orifice. Any cause giving rise to hypertrophy of the bladder will therefore tend to obstruct the orifice of the ureter, as is seen in chronic cystitis, stone in the bladder, and other conditions. The opening is still further narrowed by swelling of the mucous membrane, the result of subacute or chronic inflammation. Occasionally the orifice may be partially obliterated by a villous growth in the bladder. *Stricture* of the ureter is found in rare cases, apparently the result of previous inflammation and ulceration. Slight obstruction may occur during pregnancy, from the pressure of the gravid uterus.

3. **Dilatation.**—The part of the ureter above any obstruction is always found more or less dilated, according to the degree and the duration of the impediment. If the condition be acute and complete, little or no hypertrophy of the coats of the ureter will be found; but if chronic and incomplete, its walls will be thickened, both by fibroid change and by hypertrophy of the muscular coat. The dilated ureter is always tortuous, being increased in length as well as in diameter, and may even resemble a portion of small gut. The mucous membrane is always opaque and somewhat thickened, occasionally red and injected, and frequently pigmented from previous attacks of inflammation. A largely dilated ureter may sometimes be felt through the abdominal wall. There will probably be some degree of pain or uneasiness in the course of the canal, or in the loin; and a tendency to sickness.

4. **Inflammation.**—*Simple* inflammation of the ureter is frequently found, as an extension either from the bladder or from the pelvis of the kidney. *Septic* inflammation accompanies septic pyelitis, due to extension of decomposition from the bladder to the pelvis of the kidney (*see* SURGICAL KIDNEY). *Scrofulous* or *tubercular* inflammation

almost invariably accompanies a similar condition of the bladder or kidney.

5. **Malignant Disease.**—Cancer may extend from neighbouring organs into the ureter, but there is no reason to believe it ever primarily takes origin there.

Neither the diagnosis nor the treatment of an affection of the ureter can be separated from that of the disease to which it is secondary.

MARCUS BECK.

URETHRA, Diseases of.—SYNON.: Fr. *Maladies de l'Urèthre*; Ger. *Krankheiten der Harnröhre*.—The affections of this canal comprise urethritis with its various consequences, such as gleet, warts, periurethral abscess, inflamed follicles, and stricture; syphilis and soft chancre may also affect the urethra. For descriptions of most of these affections, the reader is referred to the articles GONORRHŒA; GLEET; SYPHILIS; and VENEREAL SORE. Some forms of (1) Urethritis, (2) Neuralgia, (3) Stricture, and (4) Foreign Bodies, remain for consideration here.

1. **Urethritis.**—The origin of urethritis is not exclusively due to inoculation with gonorrhœal pus, a fact of great medico-legal importance. Inflammation of the urethra, usually running a less severe course than the gonorrhœal form, may be set up by leucorrhœal, menstrual, and other discharges from the vagina. Traumatic irritation of the urethra may be excited by the passage of instruments or a calculus, or by the introduction of foreign bodies by the patient; in such cases soreness and scalding attend the first subsequent micturition, and swelling and discharge follow within twenty-four hours.

Asparagus, beer, arsenic, and other substances, have the power of producing urethritis in some persons; highly acid urine and oxaluria may also occasion slight urethral irritation. A very mild form of urethritis is an occasional concomitant of early syphilis; it is, however, always very limited in extent, and subsides spontaneously. In gouty urethritis the inflammation may be as severe as in well-marked gonorrhœa, and attended by the complications met with in that disease, and affecting the testes, bladder, eye, or joints. The leading distinctions of gouty urethritis are the milkiness of the discharge, and the absence or small amount of swelling of the fore part of the urethra; while scalding in the perinæum, and irritability of the bladder are severe and prominent symptoms.

Tubercle sometimes affects the urethral passage; it is always a very indolent affection, being due to the slow degeneration and ulceration of tubercular deposits in the deeper portions of the canal, and usually associated with similar disease in the prostate or bladder.

In such cases the irritability and inflammation of the bladder are always more urgent than the urethritis, while the evidence of tubercular disease in other parts of the body is usually sufficient for diagnosis.

2. **Neuralgia. Pain in the Urethra.** The causes of pain felt in the urethra may be found in some diseased condition of the tube; or it may be independent of any local morbid action. Gouty irritation is a frequent cause, and a nervous condition produced by prolonged debauchery of various kinds is not uncommon. The gouty state is relieved by the treatment of the diathesis; the nervous irritation by suitable general treatment, to which may be added local applications which have the effect of dulling the sensibility of the urethra, such as the passage of sounds, and the use of astringent or (in obstinate cases) of caustic injections to the deeper portions of the urethra. In some cases instrumentation of the urethra excites severe pain; this is best avoided by first injecting about thirty minims of a 10 per cent. solution of cocaine. Oxaluria and a highly acid state of the urine may sometimes produce considerable smarting at the time of micturition; the exhibition of alkalis and suitable dietary will usually suffice to relieve this, which is often a source of considerable annoyance to the patient.

3. **Stricture.**—The average distensile capacity of the urethra has a diameter of ten, or a circumference of thirty, millimetres. This measurement varies in different portions, being widest behind the triangular ligament (the anterior layer of the deep perinæal fascia), slightly less in the bulbous portion, and least of all at the meatus. The meatus varies very much in size, between a mere pinhole and a diameter of fourteen or fifteen millimetres, the most common size being a circumference of twenty-five millimetres. In different persons the general distensile capacity of the urethra ranges between twenty and forty millimetres.

Strictures are abrupt abnormal contractions of the urethra at any given point of its course. Such contractions may be either (*a*) of a temporary nature; or (*b*) permanent.

(*a*) *Temporary Contractions. Spastic and Inflammatory Strictures.* Spastic strictures are due to temporary contraction of the muscular fibres surrounding the urethra; inflammatory strictures to swelling and congestion of some part of the canal, the condition being usually associated with more or less muscular spasm. These temporary contractions of the urethral passage, being due to transient causes, involve no permanent lesions. Spasm and congestion may, however, occur at the seat of an organic stricture.

Muscular spasm may arise from reflex irritation, especially the existence of inflammatory swelling and congestion; it may also occur in consequence of the passage of instruments along the canal, or of a calculus. Again, the presence of an organic stricture near the meatus will frequently excite reflex spasm of the deep perinæal muscles. Operations about the rectum may produce a similar effect. Inflammatory swelling, causing narrowing of the canal, is not an infrequent complication of gonorrhœa, and often occurs in cases of enlarged prostate.

Treatment.—The treatment of these conditions should be directed to the removal of the cause. Irritation must be avoided, and congestion allayed by saline purgatives, warm baths, and morphine suppositories. If retention of urine be present, a flexible catheter should be passed (No. 5 or 6 English).

(*b*) *Permanent Contraction. Organic Stricture.*—In the great majority of instances organic stricture is the result of long-continued inflammation following gonorrhœa, leading to exudation into the submucous tissue. This exudate subsequently organises into a low form of fibrous cicatricial tissue, the contraction of which leads to the permanent narrowing. A similar result may also follow on injury of the urethra (*traumatic stricture*), and is then more severe, the new tissue being very dense. The cicatrix left by the healing of a urethral chancre may likewise cause stricture. Congenital narrowing of the meatus is common, and congenital strictures are sometimes met with within the second inch from the meatus.

Organic strictures may be situated at any part of the urethra except the prostatic, being numerically most common in the first inch from the meatus. Burckhart asserts that he has met with strictures in the prostatic urethra, but the writers have not seen such a condition.

The tightest and toughest strictures are generally found near the junction of the bulbous and membranous portions of the urethra; that is, about five inches from the meatus. The membranous portion is only affected when there is a large amount of cicatricial tissue spreading backwards from the bulb. The new fibrous tissue is developed in various forms; thus it may be present as a membranous fold stretching across (*bridle stricture*), or occasionally encircling (*annular stricture*) the canal. There may be only one bridle or several.

Superficial scars of healed ulcers and warts may give rise to patches of tough tissue. Indurated areas and fibroid nodules in the submucous tissue, standing forwards on the surface of the canal, cause irregular projections as well as unyielding indurated patches. These twist the course of the canal and impede the passage of bougies. In other cases, instead of being in limited patches, the indurated tissue may extend evenly along the canal for some distance, making it smooth and gristly, and diminishing its calibre.

The indurated new tissue may form only a thin layer of fibres beneath the mucous membrane, or may extend more deeply, infiltrating the whole thickness of the corpus spongiosum, or even extending beyond it into the tissues of the perinæum, rendering them dense and unyielding. The degree of narrowing of the passage depends in great measure upon the age of the stricture, being greater as time goes on; it may be temporarily increased by muscular spasm or inflammatory congestion. The canal never becomes obliterated, as the term 'impermeable stricture' would seem to imply. Strictures are always permeable to urine, but may not be so to the passage of an instrument. Strictures vary in behaviour: some yield easily to dilatation and slowly recontract; others are rigid, and can be dilated only to a small extent (*indurated strictures*). Lastly, some dilate quickly, but as quickly shrink back to their previous size (*resilient strictures*).

Secondary Effects of Organic Stricture.—The urethra in front of a stricture may be quite healthy, but if the condition has existed for some time the mucous membrane between the meatus and narrowest contraction is often puckered and indurated, or is excoriated or ulcerated. Sometimes just in front of the stricture artificial openings are found; these are the mouths of false passages which have been made by inexpert instrumentation. False passages may, after passing outside the urethra in front of the stricture, run for some distance, ending as *cul-de-sacs*; or they may re-open into the urethra behind the stricture; less often they extend up for some distance between the bladder and rectum, or open into the latter. At the seat of stricture the mucous membrane is often roughened, puckered, and of a dull white opaque colour; behind it the urethra is dilated, pouched, pigmented, and even ulcerated; the mucous membrane may be coated with muco-pus, sometimes mixed with phosphates. The pouches, formed by distension of the follicles, may be the starting-point of perinæal abscess, which may burst into the urethra or on to the surface of the perinæum; or, lastly, may burrow upwards between the bladder and rectum and round the prostate. If a perinæal abscess bursts into the urethra and on to the surface of the perinæum, fistulous tracts are formed, which ultimately become very dense and unyielding. Such fistulæ are often multiple, and may open in various situations. The bladder, ureters, and kidneys will, in neglected cases, show evidence of secondary mischief. The changes induced are partly dependent upon the obstruction to the free flow of urine, and partly inflammatory as the result of decomposition of the retained urine. Thus the bladder-walls hypertrophy in order to overcome the obstruction; but if the compensation is insufficient, dilatation and sacculation will ensue. The ureters dilate, and the walls hypertrophy; the pelvis dilates, and the pyramids of the kidney-substance become flattened, crescentic, and subsequently wasted; the remaining renal substance is stretched and sclerosed, and the condition known as hydronephrosis results. If the urine should decompose, acute cystitis, becoming chronic, will follow, and the micro-organisms will find their way to the ureter and pelvis of the kidney, exciting pyelitis, and in severe cases acute nephritis with numerous points of suppuration—the so-called 'surgical kidney' (*see* SURGICAL KIDNEY). These results only occur in cases which have not been treated at all, or only imperfectly.

SYMPTOMS AND DIAGNOSIS OF ORGANIC STRICTURE.—The symptoms of organic stricture of the urethra are more evident in the case of an old and narrow stricture. Few symptoms attract observation before the stricture is well advanced. The most common and the earliest is a scanty muco-purulent discharge. This sign is indeed very often the indication of the chronic inflammation of limited areas of the passage which ends in stricture. When the stricture is developed the symptoms are more definite, namely, slight dribbling of urine after micturition has apparently ceased; small size of the stream, which may be forked and twisted; and gradual increasing difficulty, with straining and pain, in micturition, which is more frequent than normal. Any or all of these symptoms may be absent, even when the canal has lost as much as two-thirds of its distensibility. Usually to these troubles are added occasional attacks of complete retention of urine from temporary spasm or congestion. There may also be the signs caused by the various secondary complications.

Examination of the urethra by means of a steel sound or gum-elastic bougie will reveal the number and situation of the strictures present. The distensile capacity of the various parts of the passage can be determined by the urethrameter.

TREATMENT.—The treatment of organic stricture consists, first, in removing from the habits and diet of the patient all causes of functional disorder.

Temperance in alcoholic drinks, in stimulating or highly seasoned foods, in sexual indulgence, and in some forms of exercise, such as horse and bicycle riding, must be enforced. Due attention to the condition of the skin and bowels, and sufficient bodily exercise, are requisite. Although attention to these matters will not in any way remedy the existing condition of a stricture, yet they will prevent congestion and spasm, and so obviate the temporary and often dangerous aggravation of the sufferings caused by this condition.

Locally the passage must be restored to, and maintained at such calibre as, on the one hand, will enable the bladder to empty itself completely by each act of micturition; and, on the other, will allow a sufficient margin to prevent stoppage of the flow of urine during occasions of temporary swelling or spasm. Such an expansibility would seem for most persons to be about one inch or three-quarters of an inch in circumference—that is, about No. 10 English; though in practice it is advisable to dilate somewhat further (No. 12 English) than this, to allow sufficient margin for neglect on the part of the patient. In all organic strictures there is a tendency to contract again; hence, when sufficient expansibility has been established, it must be maintained by the frequent passage of a bougie. In most cases the patient should be taught to do this for himself.

Various methods, neither of which is applicable to all cases, are employed for dilating the strictured part of the passage. Some methods, such as the use of caustics, or the cautery and forcible dilatation, have fallen into desuetude; those in modern use are (*a*) gradual interrupted dilatation; (*b*) gradual continuous dilatation; (*c*) internal urethrotomy; (*d*) external urethrotomy.

(*a*) *Gradual interrupted dilatation* is attained by passing metal sounds or flexible bougies (preferably the latter) through the stricture. At the first sitting that size which will just pass through the stricture should be used; subsequently larger sizes must be used, until No. 12 or 13 English can be passed. It is probable that in most if not all cases the stricture is partly stretched and partly torn in this method of treatment. The instruments may usually be passed at intervals of two or three days.

(*b*) *Gradual continuous dilatation.*—In this method a flexible catheter is passed through the stricture and tied in. As the stricture yields the instrument must be removed, and a larger one introduced from time to time, lest, being loose, the catheter escape from the urethra. A week or ten days usually suffice to dilate the stricture to the requisite dimensions. The nature of the process appears similar to that of a seton in ordinary sinuses or cellular tissue: the fibrous tissue becomes loose and succulent, and its fibres permeated by leucocytes; superficial ulceration with destruction of the cicatricial tissue also occurs in some cases.

(*c*) *Internal urethrotomy* is accomplished by means of a concealed knife conducted to the stricture by running in a split sound which passes through it into the bladder. As the knife is pushed on it is made to project and divide any resisting tissue met with. A full-sized catheter is then passed, and the bladder emptied. At the end of ten days instrumentation should be commenced in order that the passage may be kept properly dilated.

(*d*) *External urethrotomy.*—When attacked from without, the situation of the stricture is indicated by a staff passed down to or through it. In the former case the cicatrix is divided from before back, and in the latter from behind forwards. Cutting from before back is the more common operation, since if the staff can be passed through the stricture internal urethrotomy can usually be done. If the urethra is laid open in front of the stricture the orifice must be sought for—too frequently a long and tedious process—and the contraction then slit up along a fine director which has been passed into the bladder.

Various instruments have been devised and are employed for carrying out the methods shortly described here; some more suited than others to particular cases.

Comparison of the different methods.—Gradual interrupted dilatation is applicable in a larger number of cases than is any of the other methods described. It is least attended by evil consequences, and is most effectual in strictures of recent formation situate near the bulb. Objections to this method are the rapidity with which recontraction takes place if the passage of bougies be neglected by the patient, and the impossibility in some cases of dilating the stricture beyond a certain calibre without exciting shivering, pain, pyrexia, or even local inflammation and abscess. Epididymitis is sometimes set up by the passage of the instruments. Indurated strictures are sometimes so tough and dense that they cannot be sufficiently dilated.

Gradual continuous dilatation is easy and rapid, but is liable to be followed by speedy recontraction. It is useful in cases in which it is necessary to obtain a rapid dilatation of a very narrow stricture, in consequence of advanced vesical or renal disease. In these the bladder must be given rest without delay, yet the condition of the kidneys is most unfavourable to any operation. If there is great difficulty in passing an instrument into the bladder, it is advisable, when it is passed, to tie it in. The objections to continuous dilatation are that it confines the patient to bed, and in some cases excites local irritation and constitutional fever sufficiently severe to require its abandonment.

Internal urethrotomy is applicable with best results in young patients, in whom renal changes are absent or only slight. It is also preferable for those patients who prove intolerant of interrupted or continuous dilatation, since serious disturbance rarely follows incisions made in strictures between the meatus and the bulb. The locality of stricture has much to do with deciding upon the adoption of internal division. The shallow constrictions, so-called 'bridle strictures,' and the elastic rapidly yielding and as rapidly contracting resilient strictures, are always situate in the penile portion of the urethra, and are specially amenable to incision, while they are very little affected by the passage of bougies.

The great thickness and toughness of certain strictures of the bulb render their division the only mode of securing even moderate duration of their dilatability. The recontraction of a stricture after it has been divided would seem to follow less speedily than after it has been treated by gradual dilatation.

External urethrotomy is needed in comparatively few cases. It is advisable when the perinæum is hardened and beset with fistulæ; or in those still more rare cases in which no instrument can be introduced into the bladder. Under such circumstances it is requisite to attack the stricture from the surface.

4. **Foreign Bodies impacted in the Urethra.**—Foreign bodies of various kinds may be introduced into the urethra, and may lodge in the canal, impeding the free flow of urine, or even arresting it, and eventually exciting inflammation and abscess. Calculi passing from the bladder may lodge behind a stricture, or close to the meatus. Portions of a bougie or catheter may be broken off in attempts to pass a stricture.

The symptoms pointing to the presence of a foreign body are usually pronounced. There is pain, with difficulty in passing water, and perhaps complete retention; while the foreign body can usually be felt in the canal, and can be seen through the endoscopic tube.

TREATMENT.—The foreign body must be removed by means of appropriate forceps introduced through the largest-sized endoscopic tube which can be passed. If this is found to be impracticable, the urethra must be opened from without.

BERKELEY HILL.
CHARLES STONHAM.

URIAGE, in Isère, France.

Thermal muriated sulphur waters. *See* MINERAL WATERS.

URIC ACID DIATHESIS: URIC ACID CALCULUS.

—SYNON.: Lithuria; Lithiasis; Nephrolithiasis; Fr. *Diathèse Urique*: *Calcul Urique*; Ger. *Stein aus Harnsäure*.

ÆTIOLOGY.—Uric acid is probably the outcome of the metabolism of the proteid tissues of the body. It is allied to urea, and takes its place in the urine of birds and most reptiles. It is not, however, to be considered as a less oxidised antecedent of urea, but as a distinct product of metabolism of nitrogenous material, either of food or of tissue waste. By some physiologists it is considered that the liver is chiefly concerned in the production of uric acid, and this theory is grounded on these facts—that urea is produced in the liver; that urea and uric acid are nearly allied; and that in so-called liver-disorders there is frequently a deposit of uric acid in the urine. On the other hand, the liver contains but the merest trace of uric acid; and the blood in the hepatic vein has no more in it than that in the portal vein. Uric acid is found in decided amount and always in the spleen; and as all the blood from this organ passes through the liver, so the uric acid which escapes from the liver may have come to it from the spleen with the blood-stream. In what relation does the kidney stand to the formation of uric acid? On this point, also, authorities differ. Many hold that the kidney merely picks it out of the blood by the agency of the epithelial cells of the uriniferous tubules; but there is good reason to believe that, whereas the water and saline constituents of the urine are excreted by simple diffusion through the blood-vessels of the glomeruli, and are therefore influenced as to excess or deficiency by greater or less blood-pressure, the urea, uric acid, pigments, and other constituents, are, in part at least, the result of a true secreting power of the renal cells. However formed, uric acid exists in normal urine in combination with bases in the form of quadriurates; this was demonstrated by Bence-Jones, and lately confirmed by Sir William Roberts (*Med.-Chir. Trans.*, vol. lxxiii. p. 245). The uric acid in healthy urine will separate and be deposited after cooling and standing for some time, and this process of spontaneous liberation is favoured or retarded by the various urinary ingredients: thus, the water of the urine leads to the splitting up of the quadriurates and the liberation of uric acid, but the salines and the pigments tend to retard its separation. When these ingredients are present in normal amount no precipitation of uric acid takes place within the urinary passages; if, however, they are deficient from any cause, gravel or calculus may result. The frequency of stone in the children of the poor is thus explained by Sir William Roberts: They are fed chiefly on farinaceous and starchy food, which contains but little mineral matter as compared with milk or meat; consequently the urine is deficient in saline ingredients, and precipitation of uric acid is apt to occur. This poverty of salines in the diet of the rice-eating classes of India may probably explain their proclivity to calculus. On the other hand, the immunity enjoyed by seafaring men may be chiefly due to the full amount of salt which they consume, and which retards the precipitation of free uric acid in the body.

Characters.—Pure uric acid is colourless, but clinically it is always associated with the urinary pigments, which give it the well-known red or brownish-red colour. It is so slightly soluble in water that it is readily precipitated when the amount of urine is scanty; it is dissolved by alkalis, and consequently is never deposited in alkaline urine. Under the microscope, pure uric acid assumes the form of rhombic crystals, stars, bundles, tablets, and prisms. When combined with bases in the form of brick-dust sediment, amorphous granules are seen.

Calculi or concretions composed of pure uric acid vary in size from the finest red sand up to masses of several ounces in weight. They are of a red colour, very dense and hard, indistinctly stratified, usually of a flattened oval shape, of a rough tuberous exterior when single and smooth, and faceted when multiple. To this, however, some exception must be made, for it is not uncommon when only two or three co-exist in the bladder, to find them rough and mammillated, as if there had been no contact or rubbing between them. When the uric acid is combined with other ingredients in a calculus, the colour is paler, the lamination more distinct, and the texture more friable. Pure uric acid calculi, when broken by the lithotrite, form sharp angular fragments; the urate concretions, on the other hand, break more readily and form flaky laminated *débris*.

The quantity of uric acid secreted daily is very small and variable—so small that physiologically it deserves no more notice than kreatin and other organic bodies which are occasionally present in human urine. Its sparing solubility, and its readiness to form deposits in the body as biurate of sodium in gout, and as gravel and calculus in the urinary tract, render it of the greatest importance as a pathological factor. The amount excreted does not appear to depend greatly on the nature of the food taken. The vegetable feeder is as liable to its deposit as one who lives largely on animal food. Alcoholic drinks, taken even in limited quantity, certainly, in very many, are apt to lead to the precipitation of uric acid or urates. The tendency to uric acid gravel and calculus varies greatly in different countries, and in different parts of the same country. In England it prevails much more in the eastern and south-eastern than in the western and north-western districts. Uric acid forms the nucleus of nearly all the calculi in the adult of the eastern counties; but if such a person, having such a stone in his bladder, should become a resident in the west or north-west, the deposit of uric acid will commonly change to one of oxalate of lime; and should he return to the east, the accretion to the stone will again become uric acid. This contrast—which seems so great—is not so in reality, because uric acid is known, under certain reagents, to split up into urea and a compound of oxalic acid.

Symptoms.—The deposit of uric acid or urates, even in large amount, frequently takes place without any disturbance of health. Sometimes, however, it is accompanied by local irritation of the kidneys and bladder, characterised by frequent micturition, with a sense of heat and even pain during the act; and often, too, by flatulence, heartburn, and other signs of indigestion. There is, however, no habit of body, and no recognised symptoms of a definite kind, which are so plainly due to, or so constantly accompanied by, an excess of uric acid, as to warrant the continued use of the term 'uric acid diathesis.' Uric acid and its salts are found in excess in many organic diseases; in maladies of the heart and lungs in which oxidation of the blood is so frequently deficient; in organic diseases of the liver; in pernicious anæmia; in almost all febrile diseases; and sometimes associated with diabetes mellitus, chorea, and certain skin-diseases. They are deficient or absent in advanced disease of the kidney, in general anæmia, and in some exhausting non-febrile diseases. The relation of uric acid and the urates to the gouty state is interesting and important, and has recently been re-investigated by Sir William Roberts (*Med.-Chir. Trans.*, vol. lxxiii. p. 339). *See* Gout.

Treatment.—It will be apparent that the general treatment of uric acid in excess must be comprised in that of the various diseases in connexion with which it occurs. For that condition of indigestion and urinary irritation in which the chief feature is the copious deposit of uric acid and the urates, alkaline remedies, such as bicarbonate of sodium, or the bicarbonate, citrate, and acetate of potassium in twenty or thirty grain doses, dissolved in three or four ounces of water, and given three or four times a day, afford the best and quickest relief; they produce an alkaline condition of the urine, and a complete solution of the deposit for the time. Salts of lithium have a similar effect. Lately, piperazine, a new remedy, has attracted considerable attention; it has a strong alkaline reaction, and a minute quantity added to fresh acid urine will render it alkaline; it does not, however, have this effect on the urine when taken internally. It is unquestionably a powerful solvent of uric acid; it combines with it to form a urate of piperazine, and this urate is far more soluble than the urate of the metallic bases. Its precise value has yet to be ascertained, but there is abundant evidence to show that, when taken to the extent of fifteen to twenty grains daily in aërated water, it has a marked effect in eliminating uric acid by the kidneys, and it is also beneficial in the gouty state. When hepatic congestion and general sluggishness of all the secretions are present, saline aperients combined with alkaline remedies are indicated, such as the mineral waters of Carlsbad, Friedrichshall, Contrexeville, and Vichy, all of which seem to have the power of exciting all the alimentary glands to healthy and increased action. Free libation of hot water alone is of infinite value, and it may be doubted whether the benefit of some of the natural mineral waters just named be not due as much to the amount of water taken as to their saline ingredients. A well chosen, simple diet is above all things important—the avoidance of rich, sweet, or highly seasoned food, and the very sparing use of wine and all alcoholic drinks.

William Cadge.

URINARY CALCULUS.—A calculus formed in any part of the urinary apparatus. *See* Calculus; and Renal Calculus.

URINARY FEVER.—Synon.: Urethral Fever; Catheter Fever.

Definition and Varieties.—The above terms have been applied by different writers to various conditions traceable to mechanical irritation of the urethra. The resulting symptoms vary, according to circumstances, in their nature, mode of onset, severity, and prognosis. At the present time considerable confusion exists on the subject of urinary fever, and this is doubtless partly due to the fact that the ill-effects consequent on instrumentation of the urethra have not been sufficiently differentiated. These injurious consequences may be conveniently grouped as follows:—

1. Shock, slight or severe in nature, appearing immediately after the passage of the instrument, transient in duration, and ending in recovery.

2. An acute febrile attack, occurring some time after instrumentation (usually following the first act of micturition), transient in nature, but of some severity while it lasts, and ending in recovery. *Acute transient urethral fever*; *urinary sepsis.*

3. Acute recurrent attacks, similar in nature to that just mentioned. *Acute recurrent urethral fever*; *recurrent urinary sepsis.*

4. Acute septic infection, with definite pyæmic lesions, and secondary centres of inflammation.

5. An insidious attack, without any well-defined symptoms, but marked by gradual loss of health and strength, often with an ultimately fatal termination.

Ætiology.—Any form of mechanical irritation of the urethra may lead to one of the conditions just mentioned. There is no doubt that unfavourable symptoms are most likely to occur if the disease rendering instrumentation necessary is situated in the membrano-prostatic portion of the urethra. Urinary fever, using the term in its broad signification, may occur alike in those who have been subjected to instrumentation before, and in those on whom a catheter has been passed for the first time. In the case of patients accustomed to catheterism, an attack of urinary fever may be determined by the use of an instrument of larger size than customary. In many cases of the more severe forms of urinary fever there is evidence of disease of the kidneys, but in others these organs are apparently healthy, or the disease is so slight, as shown by *post mortem* examination, that it seems inadequate *per se* to account for death. It would appear from the researches of Sir Joseph Fayrer that malarial subjects are especially prone to resent instrumentation of the urethra. Some people undoubtedly suffer more than others, this intolerance increasing with advancing years, and with any general derangement of the health.

Pathology.—Considerable difference of opinion exists as to the nature of urinary fever, and the elucidation of the matter has no doubt been rendered more difficult in consequence of endeavouring to account for most, if not all, of the ill-effects of urethral irritation by the same explanation. Two separate theories have been advanced, and each of them has its advocates and opponents. After carefully considering the facts and opinions on both sides, the writer believes that both these theories are applicable for the rational pathological explanation of the five conditions above mentioned.

1. *Neurotic Theory.*—It is contended by the supporters of this view that urinary fever is directly traceable to reflex congestion and inflammation of the kidneys, resulting from the irritation of the sympathetic and cerebrospinal nerves of the urethra. That the nervous excitability of the urethra is very great is undoubted, and is fully proved by numerous observations. It has already been stated that irritation of the membrano-prostatic urethra is more likely to be followed by untoward results than is that of the penile portion, and it is worthy of note that it is precisely in this part that the nervous supply is most abundant. That irritation of the nerves of the urethra may produce reflex effects upon the kidneys excites no surprise, when it is remembered that the sympathetic nerves of the urethra are derived from the abdominal sympathetic, and are therefore in direct anatomical continuity with the nerves of the renal plexus. Irritation of the urethral nerves might thus induce extreme congestion of the kidneys, associated with suppression of urine, followed by hæmaturia. If such a condition were excited in kidneys previously healthy it would be transient in nature, and would, under ordinary circumstances, speedily terminate in recovery; on the other hand, if the kidneys were already the seat of some inflammatory mischief, it is by no means improbable that the fresh irritation might cause congestion and inflammation of already damaged organs, checking the function of those parts which are alone able to carry on excretion, and thus destroying the patient by the gradual accumulation in his blood of the obscure antecedent products of urea. In more rapidly fatal cases the access of new inflammatory mischief might determine the occurrence of suppuration in the kidney, the patient succumbing to acute interstitial nephritis with scattered points of suppuration. *See* Surgical Kidney.

It is perfectly well known that an involuntary shudder often accompanies the end of the act of micturition in healthy men. The state of shock which occasionally follows the introduction of a catheter is no doubt largely explained by this physiological phenomenon. It shows that in some men a nervous system exists so sensitive as to be seriously impressed by even a normal act; much more so, then, by so rude a measure as the passage of a catheter. Irritation of the sympathetic nerves of the urethra might reflexly induce engorgement of the abdominal vessels, and thus induce the temporary faintness and shock not infrequently met with as the result of catheterism.

2. *Septic Theory.*—Although some of the conditions arising from mechanical irritation of the urethra are, and others may be, due to nervous influences, yet in the majority of cases of acute febrile attacks there is little doubt that the ill effects are dependent upon sepsis. Acute septic intoxication and septic infection may occur through a wound in the urethral mucous membrane or in the bladder, as they may do in the case of a wound of any other part. But while this is fully recognised and conceded, it is asserted by some that, irrespective of the undoubtedly septic and infected cases, so-called urinary fever (excluding shock) is dependent upon the absorption of toxic matters from the urine as it passes over the wound made in the urethra by instrumentation. It is highly probable that this view is correct in the majority of cases. Traumatism is a constant accompaniment of acute urinary fever, a few drops of blood following the withdrawal of the instrument. In support of this septic theory it must be borne in mind that the temperature remains normal until *after* the first act of micturition succeeding instrumentation: the urine charged with pyogenic material is thus brought in contact with the wounded surface; the septic matter is absorbed, and the febrile symptoms follow. If the urine be in a healthy condition, and antiseptic precautions be taken, urinary sepsis is much less likely to occur. Mr. Reginald Harrison asserts, moreover, that if a perinæal opening

be first made, and thus *free* drainage be afforded, urethral operations for stricture are not followed by urinary fever.

In most cases of stricture and of enlargement of the prostate with residual urine there is an ample supply of septic material, which, under suitable circumstances, would be readily absorbed. In the recurrent form of urinary fever it is almost certain that each attack of fever occurs in response to the absorption of a fresh dose of poison, for it is difficult to suppose (unless we are prepared to admit that the mere passage of the urine, without absorption, can produce a febrile attack) that the nervous system is responsible for repeated attacks at intervals of time during which no fresh irritant has been applied.

Some cases, perhaps, are of a complex nature, due in part to reflex congestion with inflammation of the kidneys, and in part to some form of septic absorption.

Symptoms, Prognosis, and Treatment of the Various Forms. — (1) *Urethral shock.*—In certain persons, especially those of a neurotic temperament, the passage of an instrument, even when used with the greatest dexterity and gentleness, produces symptoms of more or less severe shock. In the slightest, and fortunately by far the most frequent, cases, the patient, although not experiencing pain, becomes pale, breaks into a profuse cold sweat, feels dizzy, and not infrequently faints. Occasionally the state of insensibility is accompanied by convulsive movements of the whole body. These symptoms are more likely to occur when an instrument is passed for the first time, or if the surgeon uses one of a larger size than that to which the patient has been accustomed. Recovery ensues in a few moments, and the patient experiences no further ill-effects. Fresh air, the recumbent position, and a dose of sal volatile is the only *treatment* necessary at the time; but the patient should be directed to keep quiet for the remainder of the day.

In rare cases this condition of shock is very much more serious, and may terminate fatally within twenty-four hours. In such there is total suppression of urine; and *post mortem* the kidneys are found to be intensely congested, although they are often otherwise healthy; it is probable that the fatal termination is due to cessation of the excretion of urea. *Treatment* is of little avail. Free purging by croton oil or elaterin, hot stupes to the loins, warm diluent drinks, the hypodermic injection of pilocarpine, and the warm vapour bath offer the best chances of success.

(2) *Acute transient urinary fever. Acute urinary sepsis.*—The symptoms characterising this condition come on soon after the first act of micturition following instrumentation. In most cases it will have been noticed that there was perhaps some slight resistance to the onward passage of the instrument—resistance, it may be, so slight that moderate pressure easily overcame it; on withdrawing the instrument a drop or two of blood was observed to follow it, indicating the infliction of a wound.

No symptoms occur immediately, but after micturition the patient is seized with a severe rigor, and experiences pain in the loins and back, often severe in nature. The temperature rises, and may reach 105°; the pulse is accelerated; headache and nausea are fairly constant; and vomiting and diarrhœa are occasional accompaniments of the condition. The urine is diminished in quantity and may be bloody. The cold stage is quickly succeeded by profuse sweating, and a feeling of great heat. The temperature falls, the pains diminish and ultimately disappear, the urine loses its bloody tint and is secreted in larger quantity, and the patient quickly recovers and experiences no ill after-effects.

Such an attack lasts usually from twenty-four to thirty-six hours. No doubt it may attack alike those whose kidneys are known to be diseased, and those in whom these organs are apparently healthy. In some cases the patient may remain febrile for a longer period than above stated—a matter for anxiety, as it may indicate the supervention of acute nephritis. Subsequent instrumental attempts may induce other attacks, but by no means necessarily. That this form of urinary fever is of septic origin there can be little doubt, and for its prevention the surgeon should endeavour to avoid injury to the urethra, and should adopt antiseptic precautions. Those who believe in the neurotic origin of this form of fever advise the administration of quinine and opium for some days before any instrumentation is resorted to, but this treatment is of little or no value.

The *treatment* of the patient during the attack is conducted on ordinary principles. During the cold stage the patient should be wrapped in blankets, and hot bottles applied; hot drinks may be freely taken, but alcohol should be avoided. The sweating stage hardly calls for treatment; it is in itself a sign of recovery. The bowels should be opened by croton oil placed on the back of the tongue, and hot fomentations may be applied to the loins if there be much pain. Complete rest for some days is advisable, and all irritation of the urethra must be avoided.

(3) *Recurrent urinary sepsis.*—In some cases recurrent febrile attacks similar to that just described may occur at intervals of two or three days, quite independently of any fresh urethral irritation. During the interval between successive attacks the patient is apparently quite well. Such cases appear to be analogous to chronic septic intoxication as met with in wounds elsewhere. The *treatment* is conducted on the same lines as above indicated; the bowels should be kept open

freely, and diuretics with diaphoretics may be useful. In malarial subjects quinine may prove beneficial.

(4) *Acute septic infection and pyæmia* may occur after instrumentation with wound of the urethra as in wounds elsewhere. Secondary centres of inflammation in the viscera and distant parts, suppuration of the joints, with repeated rigors, high temperature, and the usual symptoms attendant on infective processes, serve to distinguish the case from one of acute urinary sepsis.

(5) *Persistent urinary fever.* In some instances, especially in cases of enlarged prostate with residual urine necessitating the daily employment of the catheter, the patient falls into a general state of ill-health, insidious in its onset and progress, and sometimes ending fatally.

In such cases it will be found that there is old standing disease of the kidneys. The irritation of the urethra appears to light up fresh mischief—mischief in many cases added to by the concomitant absorption of septic material. In the cases of enlarged prostate with residual urine, there is unfortunately in many cases an ample source of septicity in the decomposing urine present in the bladder.

The symptoms may date from the first passing of the catheter. There is very rarely any decided rigor, and the symptoms, unless distinctly septicæmic in nature, may be at first indefinite. The patient complains of general malaise, loss of appetite, and perhaps a feeling of chilliness. Fever may be entirely absent, and is never very marked. The urine is not diminished in quantity as a rule, nor is there any noticeable alteration in the excretion of urea. Perhaps the symptoms of this condition are best explained by the statement often made by the patient himself—'he is not the same man that he was before using the catheter,' and yet he is unable to state definitely from what he suffers.

In the later stages of a fatal case the condition of languor so commonly met with becomes more marked, the patient becomes drowsy and apathetic, and may wander a little at night. Sometimes there may be temporary improvement, only to be followed by a relapse. Death may occur in from six weeks to as many months. Fortunately many cases after some few weeks gradually recover.

In all cases in which the surgeon deems it necessary to employ the habitual use of the catheter, it is most important that every care should be taken to avoid urinary fever. The patient should be confined to his room, which should be kept at an equable temperature; the bowels should be regulated, and the action of the skin and kidneys promoted; the diet should be light, nutritious, and non-stimulating. If the amount of residual urine is considerable, it should on no account be all drawn off at once, but the bladder must be gradually emptied in the course of a few days. Attention to these fundamental points will do much to ward off serious effects. Should they, however, in spite of all precautions, manifest themselves, the patient must be kept quiet in an equable temperature, instrumentation must be carried out as carefully and seldom as is consistent with the exigencies of the case, and the general excretory system requires attention. If rest is broken, opium or some other form of narcotic must be given; but the use of opium requires prudence and supervision in view of the renal imperfection. Stimulants are frequently necessary.

C. STONHAM.

URINARY ORGANS, Diseases of.

SYNON.: Fr. *Maladies des Voies Urinaires*; Ger. *Krankheiten des Harnapparates*.

In accordance with the plan adopted in other corresponding articles, it is intended here merely to discuss briefly the diseases of the urinary organs from a general point of view. These organs include: (1) The kidneys, with their infundibula and pelves. (2) The ureters. (3) The bladder. (4) The urethra. The particular diseases of each part of the urinary apparatus will be found treated of under these several headings, and in certain special articles, to which the reader is referred.

SUMMARY OF DISEASES. The primary division of diseases into *functional* and *organic* must be recognised in connexion with the urinary organs.

I. **Functional.**—The following disorders may be included under this group: (1) The excretory function of the kidneys is influenced and often disturbed by various conditions, physiological or pathological, quite independent of any obvious local morbid change. Hence the urine is modified in different ways and degrees, as regards its quantity or quality. This may depend, for instance, upon some general condition, such as fever or gout; upon causes originating in the nervous system; upon digestive disorders; or upon special diseases, such as diabetes. (2) The muscular structures in certain parts of the urinary apparatus are liable to be affected, and this applies practically to the bladder and urethra. The bladder is subject to undue irritability, spasm, or paralysis, the last being especially important in connexion with disease of the spinal cord. The urethra is not uncommonly the seat of spasm, giving rise to more or less spasmodic stricture, and consequent retention of urine. (3) It is believed by some authorities that the kidneys or bladder may be affected with neuralgic pains, there being no local mischief to account for them.

II. **Organic.**—The numerous affections of the urinary apparatus belonging to this division may be thus classified:—

(1) *Injuries* of different kinds, under which would be included not only those of traumatic origin, but also ruptures or perforations due to disease.

(2) Conditions affecting the *circulation*, namely, (*a*) Acute or chronic congestion. (*b*) Embolism. (*c*) Hæmorrhage. The first two are only met with in the kidneys, but hæmorrhage may occur from any part of the urinary apparatus.

(3) *Acute Inflammatory Diseases.*—These are of different kinds, and comprise the following subdivisions: (*a*) Acute Bright's disease, involving the kidney-substance. (*b*) Suppurative inflammation of the kidney, usually terminating in renal abscess. (*c*) Inflammation of the lining mucous membrane. The urinary mucous tract may be involved throughout, but usually only a limited portion is affected, and thus we have the different complaints known as *pyelitis*, or inflammation of the pelvis of the kidney; inflammation of the ureter, rarely existing alone; *cystitis*, or inflammation of the bladder; and *urethritis*, or inflammation of the urethra, the common form of which is gonorrhœa. This mucous inflammation often leads to a purulent discharge, and may terminate in ulceration or gangrene. (*d*) Inflammation around the kidney—*perinephritis*; or around the bladder—*pericystitis*.

(4) *Chronic Inflammatory Diseases.*—These may remain after the acute forms, or they are chronic from the outset. Practically they include only certain forms of Bright's disease; chronic abscesses; and mucous inflammations.

(5) *Malpositions and Malformations.*—These abnormal conditions may be of considerable importance in connexion with the urinary organs, being either congenital or acquired, and varying in their nature. 'Movable kidney' is a form of displacement always to be borne in mind, especially in females. *See* Kidneys, Diseases of: 25. Malpositions of.

(6) *Hypertrophy and Atrophy.*—The morbid changes of this kind belong to two main classes, according as they affect the kidney-substance, or the walls of the duct or bladder. Atrophy of the kidney is either acute or chronic, the latter being in almost all cases a form of chronic Bright's disease, but it may be congenital or due to compression.

(7) *Obstruction, Dilatation, and Accumulations.*—Obstruction may be due to different causes, and localised at either of the orifices, or at any point in the course of the ureter or urethra. As a consequence of such obstruction, and occasionally from other causes, dilatation occurs, affecting either the pelvis and infundibula of the kidney, the ureter, the bladder, or the urethra, according to its seat; the entire tract may be thus implicated. Accumulations also follow, either of urine, pus, or other materials, and these may become very serious. Hydronephrosis and pyonephrosis are well-known forms of disease, in which urine or pus, or a mixture of both, thus accumulates in the pelvis of the kidney. Retention of urine in the bladder is of common occurrence, arising from various causes. Cystic disease of the kidney may be mentioned under this head, as in some instances, at any rate, it probably arises from limited dilatations of the renal tubules.

(8) *New-Growths and Degenerations.*—Cancer may involve any or every part of the urinary apparatus. Non-malignant growths are met with in exceptional cases. Tubercular disease is an important and serious malady in connexion with the urinary organs. The kidneys are liable to albuminoid disease, and to fatty degeneration. Syphilitic growths may also be found in them.

(9) *Gravel, Calculi, and Foreign Bodies.* The formation of gravel, and of calculi of different kinds, with the morbid conditions resulting therefrom, are of peculiar importance in relation to the urinary organs, and a large proportion of cases in actual practice belong to this group. It may also be mentioned here that foreign bodies are sometimes found in the bladder or urethra, introduced from without either intentionally or accidentally.

(10) *Parasites.*—Certain parasites are particularly associated with the urinary organs, especially the Bilharzia hæmatobia. Hydatid-disease is met with in rare instances. The filaria sanguinis hominis is probably related to chyluria; and bacteria occasionally occur in the bladder. *See* Chyluria; and Entozoa.

Ætiology and Pathology.—It would be quite out of place here to attempt to discuss the ætiology and pathology of some of the morbid conditions that have been mentioned, such as urinary calculus, or cystic disease of the kidney, which are fully considered in special articles. All that can be done is to point out in a general way the principal morbific causes which act upon the urinary organs, and the modes in which their diseases originate. (1) These organs are much more liable to injury than most others. This may not only come directly from without, but may also be inflicted by articles introduced into the urethra or bladder, by surgical operations, or by calculi. (2) Certain morbid conditions are congenital, being the result of imperfect development, or of intra-uterine disease. (3) Exposure to cold or wet undoubtedly originates serious renal disease in some cases—for instance, acute Bright's disease; and it is also supposed to give rise in other instances to less serious complaints in connexion with the urinary organs, such as congestion, or some form of mucous inflammation. This cause probably acts by interfering with the cutaneous excretion, and inducing internal congestion. It may also be remarked that want of cleanliness and other conditions of the skin may help in developing renal disease. (4) Affections of the urinary organs are of frequent occurrence in connexion with certain acute febrile diseases, either as essential parts of these diseases, or as complications or sequelæ. Scarlatina and pyæmia demand special mention in this connexion. (5) Abnormal conditions of the urine when first excreted, or the presence of certain materials in the kidney which this organ cannot properly get rid of, are prolific causes of urinary affections. These abnormal conditions and materials may originate in a variety of remote causes, and they are well exemplified by the effects of certain medicines, alcohol, excessive acidity of the urine, diabetic urine, and gout. Such causes may induce congestion, inflammation, chronic renal changes, or calculi. (6) The urinary organs may be implicated as part of some general or constitutional disease, as in cancer, tuberculosis, or albuminoid disease. (7) Certain parasites specially lodge in these organs, as has been already mentioned. (8) The urinary apparatus may be affected as a consequence of some neighbouring disease. For instance, a tumour may compress the ureter or bladder, or obstruct the renal vein; or different structures may be involved by extension. (9) Cardiac diseases which impede the venous circulation, not only cause venous congestion of the renal organs, but in time give rise to serious organic changes. (10) The cause of urinary disease may be in the nervous system. Thus may arise a form of acute congestion of the kidneys; and the paralysis of the bladder, which spinal disease so often produces, is liable to be followed by cystitis and its consequences. (11) One specific disease is associated with the urethra, namely, gonorrhœa; and its effects often extend to the bladder, or even higher up along the urinary tract. Syphilis may also originate its own specific lesions in connexion with the urinary apparatus. (12) It is important to notice that the different parts of this apparatus have an intimate relation to each other from an ætiological point of view. For instance, undoubtedly one kidney may become hypertrophied, if the other should be destroyed by disease. Or a morbid condition may extend directly from one part of the urinary organs to another. Again, urine which undergoes certain changes after its formation is liable to cause mischief. Other relations which probably exist between the different portions of the urinary apparatus are discussed elsewhere. *See* SURGICAL KIDNEY; and URINARY FEVER.

CLINICAL INVESTIGATION AND SIGNS.

Without entering into details, the symptoms and signs which may be associated with urinary diseases can be summarised in the following way, and this summary will indicate the course to be adopted in their investigation. (1) Painful sensations, with or without tenderness, may be referred to the region of the kidneys, perhaps to the ureter, to the bladder, or to the urethra, when these are respectively the seat of mischief. Moreover, disease in one part may be accompanied with sympathetic or referred sensations in some other part; or in certain conditions there may be pain along the spermatic cord to the testis, with retraction of this organ. Other sensations are complained of in many instances, such as itching or tickling at the end of the penis, heat or burning along the urethra, heaviness and weight in the lumbar region, or fulness of the bladder. These feelings are often modified by various causes. (2) The sensations connected with micturition are of special significance, such as a frequent inclination to pass water, a sudden and urgent desire, or strangury. (3) The act of micturition itself is often affected. It may be too frequent or infrequent; difficult, even to complete retention—*dysuria*; irritable, there being a difficulty in retaining the urine; or the urine escapes involuntarily — *incontinence*. The stream of urine is altered in size or shape in some conditions (*see* MICTURITION, Disorders of). (4) The urine itself affords signs of great importance in relation to diseases of the urinary apparatus, in regard to its quantity, physical characters, chemical composition, and microscopic appearances. Indeed, it very often happens that the urine alone affords any reliable clinical evidence of urinary disease. At the same time it must, of course, be borne in mind that this excretion is modified by many other conditions, the urinary organs being quite healthy. This subject is fully treated of elsewhere (*see* URINE, Morbid Conditions of). (5) Urinary diseases often produce important effects upon the blood or general system, as well as upon other organs. Hence arise renal dropsy; the phenomena of uræmia, septicæmia, or the typhoid condition in some forms of disease; collapse sometimes; and morbid conditions affecting the heart and vessels, or certain structures in the eye. These morbid changes may be evidenced by more or less marked symptoms. Moreover, enlargement of the kidney may affect neighbouring structures. (6) Physical examination is of essential value in the investigation of many urinary affections, and in carrying this out the aid of a skilful surgeon is often of the first consequence. The local examination is directed to the determination and investigation of displacements, enlargements, or tumours of the kidneys; conditions of the bladder, especially retention of urine, and the presence of calculi or growths; and morbid states affecting the urethra, such as enlarged prostate, stricture, or the lodgment of a calculus. Physical examination also reveals the changes in other structures already alluded to.

These are the main points which can be usefully discussed from a general point of view with reference to urinary diseases. For their diagnosis, prognosis, and treatment, as well as for more complete details on the various matters alluded to, reference must be made to the different appropriate articles, especially to those which deal with the affections of the several parts of the urinary apparatus. *See* BLADDER, Diseases of; BRIGHT'S DISEASE; KIDNEYS, Diseases of; RENAL CALCULUS; SURGICAL KIDNEY; URETERS, Diseases of; URINARY FEVER; URINE, Morbid Conditions of, &c.

FREDERICK T. ROBERTS.

URINE, Incontinence of.—The involuntary discharge of urine from the bladder, the patient being either unable to retain it, or unaware of its escape. *See* MICTURITION, Disorders of; and SPINAL CORD, Diseases of.

URINE, Morbid Conditions of.—SYNON.: Fr. *Etats Morbides de l'Urine*; Ger. *Pathologische Harnveränderungen.*

INTRODUCTION.—The urine is the excretion by which the products of nitrogenous waste are eliminated from the body. Alterations in its characters give valuable information regarding tissue-change in the body, and may indicate the presence of disease which would otherwise remain undetected. They therefore require detailed attention. Before entering, however, upon the discussion of the morbid conditions of the urine, it will be well to describe briefly its characters and mode of secretion in health.

In reptiles and birds the waste nitrogenous products of the body are excreted as uric acid and urates; and the urine is solid. In amphibia and mammals they are chiefly excreted as urea, and the urine is liquid. In man a certain amount of uric acid is always present, though very small in proportion to that of urea, the ratio in health being about 1 to 33. It occurs either free or in combination as urates.

Human urine is a clear liquid, of a yellow colour, acid reaction, peculiar odour, and saline taste. It consists essentially of a watery solution of urea, extractive and colouring matters, and salts. Its average specific gravity is about 1,020, but this varies according to the proportion of solids it contains.

Secretion of Urine.—Until lately, the theory of Ludwig regarding the secretion of urine was the prevalent one. He believed it to be a process of filtration of water and salts from the vessels in the glomeruli, and that these were partly reabsorbed in the tubules by the cells lining them. But it has been shown by Heidenhain that the cells of the tubules also play an active part in excreting, inasmuch as sulphate of indigo injected into the blood does not colour the glomeruli, but colours the cells of the tubules. The original theory of Bowman has thus been revived, and the process of secretion of urine may be looked upon as consisting of two parts—first, the filtration of water, and probably of a small quantity of salts, which takes place under pressure from the vessels of the glomeruli; and secondly, the excretion of urea and other solid constituents by the epithelial lining of the tubules. The water which exudes from the glomeruli dissolves and removes the substances excreted by the tubules, and is very possibly also to some extent reabsorbed in its passage. The greater the difference is between the tension of the blood in the glomeruli and that of the fluid in the tubules, the more rapid is the secretion of urine. But it is not the mere rise in blood-pressure which increases the rapidity of urinary secretion. It is really the increased rapidity of the flow of blood through the renal vessels which is the true cause; and if the pressure of blood in the veins be high, as in cases of mitral regurgitation, the flow of blood will be slow and the secretion scanty, although the pressure be high in the arteries. The conditions for a free secretion of urine thus are—(*a*) a quick flow of blood through the renal vessels, and (*b*) slight resistance in the urinary tubules and passages. The secretion may therefore be increased either by raising the pressure in the renal arteries, or by diminishing that in the tubules and veins; and, *vice versâ*, it may be diminished by lessening the blood-pressure in the glomeruli, or by raising the pressure of blood in the renal veins or of the urine in the tubules. The blood-pressure may be raised either generally throughout the body, or locally by dilatation of the renal arteries. These arteries have considerable power of contraction, so much so that they can lessen the pressure in the glomeruli even when it is raised throughout the body generally. The blood-pressure may be raised in the body generally by the contraction of the arterioles from exposure to cold, by mental excitement, by the influence of food, or by the action of certain drugs, such as digitalis. It may be lowered by shock, by exposure to external warmth, or by rise of the bodily temperature, as in fever. It seems probable, from experiments made by the writer and Mr. Power, that the arterial tension in the glomeruli may be locally diminished, even when the general blood-pressure is increased, by the action of digitalis, which, while causing contraction of the vessels generally, affects those of the kidney more especially, and thus, by their contraction, lessens the blood-supply to these organs. The vessels of the kidney are controlled by the medulla oblongata; and when this is stimulated, either directly by a galvanic current or by asphyxial blood, or reflexly by irritation of a sensory nerve, the renal vessels contract. Dr. Roy has shown that they are also very sensitive to slight changes in the chemical constitution of the blood, water or urea causing slight contraction, followed by greater and longer dilatation. Digitalis does so also; but the contraction is much longer. Common salt, nitrate of sodium, and acetate of potassium cause dilatation without previous contraction. They act upon the vessels even when the nerves are cut, and therefore they must affect them either directly, or through some local vaso-motor nervous apparatus.

By experiments on the kidneys of amphibia, which have a separate vascular supply to the glomeruli and tubules, Nussbaum has found that sugar, peptones, and albumin are excreted through the glomeruli; but that urea is passed out through the epithelium of the tubules, and in passing out causes increased secretion of water from them.

Characters of Urine.—1. **Transparency.**—Healthy urine is clear when passed, but after standing some time a light flocculent precipitate falls. This consists of mucus and epithelial cells from the urinary passages. A hummocky, white, and sharply defined upper surface indicates the presence of crystals of oxalate of calcium in the cloud. Small white flocculi of this size and shape, looking somewhat like small worms, may occur suspended in the freshly passed urine of persons who have suffered from gonorrhœa or prostatitis some time previously. On microscopic examination they are found to consist of aggregations of leucocytes. The writer has found the presence of these flocculi useful in diagnosing gonorrhœal rheumatism where no history of gonorrhœa was given by the patient.

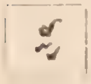

Fig. 176.

Urine which is clear when passed may afterwards deposit sediments of urates or phosphates. These are distinguished from each other by warming the urine. The urates dissolve and the urine becomes clear; but the phosphates are not dissolved, and the urine is rendered more turbid by the heat. On the addition of a few drops of acid the phosphates dissolve readily, and the urine becomes clear. When the urine is concentrated and contains a large quantity of urates, it may become turbid almost immediately from their deposition, if it is passed into a cold vessel.

Turbidity of the urine as it is passed is generally, however, due to earthy phosphates, mucus, pus, or blood. The whitish or light colour of the turbidity due to the first three causes distinguishes it from turbidity due to blood. The addition of a few drops of acetic acid causes the turbidity due to phosphates to disappear, while it does not remove that due to mucus or pus. Turbidity due to pus is distinguished from that due to mucus by the presence of albumin. The albumin may be recognised by adding a drop or two of a clear solution of ferrocyanide of potassium to the urine previously acidulated by acetic acid. If the turbidity is not increased it is due to mucus. If it is increased it may be due to pus, or to mucus in albuminous urine. In this case, let the urine stand until the sediment has deposited, pour off the supernatant liquid, add a small piece of caustic potash to the sediment, and stir it for some minutes with a glass rod. If it is due to pus it will become more transparent and tough, forming a thick mucilaginous fluid which flows with difficulty when the quantity of pus is small. When there is much pus it will form a thick, glassy, coherent lump. If due to mucus it will not become thick and coherent. If due to blood the addition of a drop of simple tincture of guaiacum and twenty drops or more of ozonic ether will give a blue colour.

2. **Colour.**—The colour of urine varies from an almost imperceptible yellow to a dark brown or almost a black. Four degrees are usually distinguished—*pale*, *normal*, *high-coloured*, and *dark*. It is usually understood that the description applies to urine seen in a white chamber-pot, from one-third to one-half filled, or more exactly, as suggested by Vogel, in a cylindrical glass about three and a-half or four inches in diameter. *Pale* urines are those which under such circumstances vary from an almost complete absence of colour, so that they are indistinguishable from water, except when seen in thick layers, up to a straw-yellow colour. *Normal* urines are those which have a golden yellow up to an orange-yellow colour. *High-coloured* have a reddish-yellow to a red colour; and *dark* urines have a deep red-brown or blackish colour.

These variations in the colour of urine are to a great extent due to the proportion of water in which the urinary pigments are dissolved. Watery urine is pale, and concentrated urine is high-coloured. It is probable that they also depend on variations in the nature of the pigments chiefly present. Sometimes they are due to an admixture of foreign colouring-matter, such as bile or blood, or to substances taken internally and excreted in the urine, such as rhubarb.

Clinical Import.—Pale urine occurs when secretion is rapid, and the urine is consequently dilute, as after copious draughts of liquid, or exposure to cold. It is found also in cases of granular kidney, anæmia, chlorosis, diabetes mellitus and insipidus, and after hysterical fits, asthma, or other forms of nervous excitement.

High-coloured urine occurs when the secretion is diminished by profuse perspiration; and also in disorders of the liver, and febrile conditions, or from lessened circulation through the kidney in cardiac disease. The colour of the urine is generally deeper after food, and the urine may be high-coloured after a large meal in healthy persons.

In cases of albuminuria the urine is generally pale when the disease is of renal origin; high-coloured when it is of cardiac origin.

Dark urine generally owes its colour to bile, hæmoglobin or blood. Bile gives it various tints of brown or green; hæmoglobin or blood imparts a smoky, blood-red, or coffee colour. When blood is mixed with much pus in a strongly alkaline urine, the colour may be greenish-brown. Rhubarb gives a reddish colour to alkaline urine. This colour disappears on acidulating. The writer has known compound rhubarb powder render the urine so red as to lead to the belief that the patient was suffering from hæmaturia, the magnesia having rendered the urine alkaline, and thus brought out the red colour of the rhubarb. This is at once distinguished by adding acetic acid, when the colour of the rhubarb disappears. Carbolic acid or creasote extensively used, either externally or internally, renders the urine blackish or black. In cases of melanotic cancer the urine, although of a normal colour when voided, may become black after standing; and this darkening is much accelerated by the addition of nitric acid or other oxidising agents.

3. **Quantity**.—The quantity of urine passed in twenty-four hours varies very greatly. The average may be roughly stated to be about fifty ounces, and the ordinary variation is about one-fifth of the quantity above or below the normal. The quantity is usually increased by anything which raises, and lessened by anything which diminishes, the arterial tension. Thus, cold and nervous excitement will increase it, while warmth and quiet usually diminish it. The quantity passed during the waking hours is much greater than during the hours of sleep; and the fact that a person has to rise during the night one or more times to pass water awakens suspicion of renal disease, or of excessive secretion.

According to Dr. Haig, excess of uric acid in the blood and urine lessens secretion, while diminution of this acid increases the urinary flow. The quantity is lessened by acute inflammation of the kidney; by weakness of the circulation—as in cases of feeble heart or mitral disease; by febrile conditions; and by removal of water from the blood through other channels, as by copious purgation or diarrhœa, profuse perspiration, or the occurrence of œdema or effusion into serous cavities

Although temporary conditions may cause the amount of urine passed in one day to differ much from that of another, yet in healthy people it usually equalises itself in two or three days, unless there be constant disturbing influences, such as persistent cold.

Clinical Import.—(*a*) A persistent *increase* in the quantity of urine may indicate diabetes mellitus, polyuria, waxy kidney, or granular kidney. These are diagnosed by the presence of sugar in diabetes; by the entire absence of both sugar and albumin in polyuria; by the presence of considerable albumin in waxy kidney; and by the presence of albumin (though only in small quantity), and of high arterial tension, in granular kidney. The conditions in which temporary increase in the quantity of urine occurs are exposure to cold, nervous excitement, hysterical fits, copious drinking, the use of diuretic medicines or articles of food containing tartrates or citrates, and the consumption of certain forms of wine and alcohol, as hock and gin.

(*b*) A quantity of urine *below the average* may be due to habit, leading the individual to drink little fluid; or to habitual exposure to heat, leading to excessive perspiration. A diminution in quantity also occurs in acute inflammation of the renal glomeruli or tubules; in subacute exacerbations of chronic inflammatory conditions; in weakness of the circulation; and in certain disordered states of the nervous system. It also occurs in cases of granular kidney approaching a fatal termination, and is then a sign of grave import.

4. **Specific Gravity**.—This is most easily ascertained by the form of areometer which is called a *urinometer.* In using this instrument care should be taken that it is clean and dry before it is put into the urine, and that it does not touch the sides of the vessel. The surface of the fluid forms a meniscus, and the graduation on the stem of the instrument should be read off at the lower edge of the meniscus with the eye on a level with it. When there is not sufficient urine to take the specific gravity, it should be diluted with one, two, or as many times as may be necessary, volumes of water, and the specific gravity taken. The decimal figures of the specific gravity thus found are then multiplied by the number of times the urine has been diluted, in order to get the true specific gravity. Thus, if the urine has been diluted by adding four times its own volume of water to it, its bulk is increased to five times that of the original urine. If the specific gravity of the diluted urine is 1002, the specific gravity of the original urine is $1{\cdot}000 + ({\cdot}002 \times 5) = 1{\cdot}010$. The urinometers give the specific gravity at 60° F.; and at any temperatures above this they indicate a lower specific gravity, and at temperatures below a higher specific gravity, than the true one.

The specific gravity of the urine depends on the proportion of solid matters which it holds in solution. The amount of water in the urine fluctuates much more than the solids, and therefore the specific gravity varies also. It is less when the urine is watery, and greater when it is concentrated. The average specific gravity is about 1020, but it may vary in health between 1010 and 1025, or even beyond these limits. In some persons the writer has seen it as high as 1038 without either sugar or albumin being present. Such high specific gravity is met with most frequently either in persons of a gouty habit who drink little water, or in women who abstain from liquid in order to diminish the frequency of micturition under circumstances where it might be inconvenient to evacuate the bladder. It varies in the same person at different times of the day, and in different portions of urine passed at the same time. As the urine is secreted and accumulates gradually in the bladder, it becomes arranged in layers according to its specific gravity, the heaviest layers being lowest. If the person remains quiet, so as not to mix the layers, and passes the urine in successive portions into different glasses, their specific gravity may be found to differ.

The specific gravity is diminished during fasting, but is increased after meals, on account of the greater excretion of solids which then occurs. It is diminished when the secretion is quickened, or rendered more abundant and watery by drinking copiously of fluids, by exposure to cold, by mental excitement, or by the use of diuretics. It is increased when the urine is concentrated by abstinence from fluids; by profuse perspiration, which carries off much water by the skin; and by long retention in the bladder, which allows some of the water to be reabsorbed. The variations in specific gravity due to the causes just mentioned are transitory, and are generally succeeded by variations in an opposite direction; so that the specific gravity of the entire urine passed during twenty-four hours may be little altered.

Clinical Import.—A persistently high specific gravity generally indicates diabetes mellitus, or azoturia. It also occurs at the beginning of acute febrile diseases; and in acute nephritis with hæmaturia.

The specific gravity is increased by the presence of albumin alone, as well as by blood. It is sometimes thought that the mere presence of albumin diminishes the specific gravity of the urine, but this is an error. It is quite true that in certain cases of albuminuria the specific gravity is diminished, but this is due to the absence of other ingredients, and not to the presence of albumin. The writer has found experimentally that the addition of serum albumin to the urine increases its specific gravity.

An abnormally low specific gravity, if persistent, may indicate contracted or amyloid kidney, diabetes insipidus, or hysteria, but a very low specific gravity may occur temporarily from mental agitation, such as from consulting a doctor, or from exposure to cold, such as occurs from going out on a cold morning, especially if it be damp at the same time, or if it occur after previous warm weather.

5. **Reaction.**—Fresh normal urine is generally acid, but when passed after a meal it may be neutral or even alkaline, and sometimes, though rarely, the mixed urine of twenty-four hours may present a similar reaction. Sometimes the reaction is amphoteric or amphogenous, that is, red litmus paper is rendered blue, and blue litmus paper is turned red. The acidity of the urine is chiefly due to acid phosphates, and in part also to free organic acids, such as lactic and hippuric. The amphoteric reaction is probably due to the presence of basic and acid phosphates together. The acidity is less when acid is being secreted by the stomach or skin during digestion or profuse perspiration. It is diminished by vegetable diet, and by alkalis or their salts with vegetable acids. It is diminished in anæmia and chlorosis; and in melancholia or paralysis the reaction may be neutral or alkaline from potassium or sodium carbonates. It is increased by a flesh or a milk diet, by muscular exercise, by drinking, and by acids; and also in fever and diabetes mellitus.

When urine is passed with proper precautions into a vessel which has been previously heated so as to destroy all germs, it may be kept unchanged for years.

Usually it becomes altered quickly, its reaction becoming, first, more strongly acid, then less acid, and finally alkaline. These changes are due to fermentation, which leads first to the formation of acid phosphates, and of lactic and acetic acids, from the extractive matters of the urine, with deposition of uric acid. This increase of acidity is not constant, and deposition of uric acid may occur simply from chemical reaction between urates and acid phosphates. After a varying period the urea becomes decomposed, and carbonate of ammonium is formed, which gives to the urine an ammoniacal odour and alkaline reaction, and causes the precipitation of urate of ammonium, ammonio-magnesium phosphate, calcium phosphate, and calcium carbonate.

The acid fermentation, when present, is probably due to an organism similar to yeast. The alkaline fermentation is probably caused in great measure by bacteria, but it may be induced also by a non-organised ferment, which has been isolated from ammoniacal urine. This ferment appears to be generally produced by bacteria, but it may be produced also, under certain circumstances, by the mucus-corpuscles and epithelial cells in the bladder. Fresh urine inoculated with bacteria from decomposing urine undergoes very rapid change, and the same is the case with the urine inside the bladder when it is inoculated by means of dirty catheters. But similar changes may occur in the bladder in cases of cystitis, even when no instruments have been introduced, and the ferment in these cases appears to be formed by the mucus or epithelium. In order to distinguish whether the alkalinity of the urine depends on ammonia or on fixed alkalis, the red litmus paper must be dried after being dipped in it. If the alkalinity is due to ammonia the blueness of the paper which it produced will disappear, and the paper return to its original red colour; but the blue will remain if the alkalinity is due to fixed alkalis.

Solid Constituents.—The solid constituents of the urine are the ashes of the body, and their quantity varies with the amount of food consumed, and the amount of waste in the tissues of the body itself. Their quality depends on the nature of the nutritive processes and of the tissue-change going on in the body; and it thus forms a useful indication of the healthy or diseased nature of the tissue-change and nutritive processes. Some solids are constantly present, although in varying quantities, in healthy urine; others are only occasionally present; and others again never occur in health, so that their presence is a sign of disease. Those present in health are (1) *nitrogenous substances*—urea, uric acid, allantoin, oxaluric acid, xanthin, kreatinin, sulphocyanic acid, Baumstark's body, and perhaps guanin; (2) *ferments*—pepsin, nephrozymose or ptyalin, and trypsin; (3) *salts*—chiefly chlorides, sulphates, and phosphates of sodium, potassium, ammonium, calcium, and magnesium, sodium chloride being the most abundant; (4) *acids*—oxalic, lactic, and glycerophosphoric acids, possibly present in combination, or partly free; sulphuric acid in two forms—simply combined with bases as sulphates, or united with other substances so as to form ether-sulphuric acids of phenol, kresol, pyrocatechin, indoxyl, skatoxyl, &c.; and (5) *pigments*, and pigment-yielding bodies or chromogens.

Abnormal constituents include albumins, albumoses, peptones, blood, hæmoglobin, methæmoglobin, bile-pigments, bile-acids, grape and milk sugar, leucin and tyrosin, lecithin, cystin, fat, and other substances.

The *quantity* of solid constituents is determined exactly by weighing the dried residue of a given quantity of urine. It may also be ascertained approximately by multiplying the last two figures of the specific gravity by 2·33. This gives the amount per thousand, and from this the total quantity is reckoned. Thus, if a man passes 1,560 c.c. of urine daily, which when mixed has a specific gravity of 1,022, then 22 × 2·33 = 51·26; and 1000 : 1560 : : 51·26 : 79·96 grammes of solids *per diem*.

The most important constituents must now be described.

1. **Urea** (CON_2H_4).—This is by far the largest and most important of the organic constituents of urine, as 70 or 80 per cent. of the entire nitrogen excreted appears as urea. The quantity of urea passed *per diem* by a healthy man is on an average 33·18 grammes or 512·4 grains. Urea may be regarded as the ash of the nitrogenous substances, whether food or tissues, which have undergone combustion in the body, and therefore its quantity fluctuates greatly according to the amount of nitrogenous food consumed, and also according to the rapidity of tissue-change. The variations due to the food are so great, however, that unless the amount of nitrogen in the food consumed be kept rigidly the same from day to day, or food be altogether withheld, they mask the variations due to tissue-change. Hence most of the earlier experiments on the influence of drugs, exercise, &c., on tissue-change, as determined from the excretion of urea, are untrustworthy.

The quantity of urea varies with age, sex, country, and other circumstances; but most of these variations are easily accounted for by the proportion of nitrogenous food taken by children and adults, men and women, English, French, or Germans respectively. Muscular exercise up to a certain point does not increase it, but when excessive it appears to do so; the explanation probably being that in ordinary exercise no destruction of the nitrogenous constituents of the muscle occurs, the energy being supplied by their non-nitrogenous elements, but that when the exercise is too severe and prolonged the albuminous constituents of the muscles themselves become partially destroyed.

Nitrogenous food, such as meat of all sorts, eggs, and gelatin, or substances which yield it, increase the excretion of urea in proportion to the quantity of this sort of food taken. There seems to be a limit, however, beyond which the excretory powers of the kidney will not go; and when this limit is reached, nature saves the organism by diarrhœa, which carries off the excess of nitrogenous food. The addition of fat alone to an abundant diet of meat rather increases the excretion of urea; but when farinaceous food is added to such a diet, the urea is rather diminished. Farinaceous food and fats given to an animal deprived altogether of nitrogenous food, cause it to excrete less urea than if it were totally deprived of food. The addition of farinaceous food and fat therefore appears to lessen the destruction of the nitrogenous tissues themselves.

When much water is drunk, the absolute amount of urea excreted in twenty-four hours is considerably increased, although, the urine being so much more abundant, the percentage of urea is lessened. The increase in urea is said to be greater when the water is drunk during the meal than when it is drunk after digestion has taken place.

Table and other salts increase the quantity of urea, even when no more water is drunk, and also increase the quantity of water, probably by causing part of the water to be eliminated through the kidneys which would otherwise have passed off through the lungs or skin.

Moderate warmth appears to diminish the excretion of urea, probably by increasing the secretion of sweat; but when an animal is kept for a length of time at a high temperature, a condition of fever appears, and the excretion of urea is greatly increased.

Quantitative Estimation.—Formerly urea was usually estimated by Liebig's method of titration with nitrate of mercury; but the mode now usually adopted, as being at once accurate and easy, is the hypobromite process. This method is due to Dr. E. W. Davy, who used hypochlorite of sodium, and this was afterwards modified by Hüfner, who introduced the hypobromite in place of hypochlorite. It depends on the fact that urea, in contact with alkaline hypochlorites (Davy's method) or hypobromites (Hüfner's method) is decomposed, and gives off nitrogen, from the amount of which the quantity of urea decomposed can be readily estimated. Various modifications in the method of applying the process have been introduced, one in common use being that of Russell and West, which consists of a tube in which the urine is allowed to mix with a hypobromite solution, and a pneumatic trough, with a measuring tube, in which to collect the evolved gas. The measuring tube is graduated to give the percentage of urea. Another apparatus is that of Dupré, in which the urine and hypobromite solution are mixed in a bottle connected with the measuring tube by an india-rubber tube. Both of these are well adapted for clinical use. In each of them 5 c.c. of urine is mixed with four or five times its bulk of the hypobromite solution. This solution is prepared by dissolving 100 parts of caustic soda in 250 of water, and adding, when cold, 25 parts of bromine. The solution does not keep, and is best made by having the soda solution of a proper strength, and adding the required quantity of bromine at each analysis.

The readiness with which crystals of nitrate of urea form on the addition of nitric acid to a solution containing it, affords a means of estimating roughly the quantity of urea present in urine. These crystals do not form in normal urine on the simple addition of nitric acid, but do so in urine containing great excess of urea. Thus, if equal parts of strong nitric acid and such urine—say, half a drachm of each—be mixed in a test-tube, and this be placed in cold water, the crystals will soon make their appearance. Another form of test is easily applied on an object glass. One end of a small piece of thread is put into a drop of urine on the glass; the drop, and the half of the thread, are then protected by a thin covering-glass; and the other end of the thread is moistened with nitric acid. The whole is then put under the microscope, and hexagonal plates of nitrate of urea are seen forming at each side of the thread when there is great excess of urea. If the urine contains the normal, or less than the normal, amount of urea, it must be more or less evaporated by gently heating over a spirit-lamp before the crystals form; and from the extent to which this is necessary a rough estimate of the deficiency of urea may be formed.

Clinical Import.—When the proportion of urea is much above 2 per cent. it generally indicates that the patient is either feverish, or has been perspiring profusely, or that the quantity of water he drinks is too small to ensure the ready elimination of the products of nitrogenous waste. In such cases, if the thermometer does not indicate the presence of fever, or if the patient has not been perspiring profusely, he should be advised to drink more water, in order to prevent the possible occurrence of rheumatic or gouty affections. A small percentage of urea is of much graver significance. It may be due to copious drinking, exposure to cold, or to mental excitement; but when it occurs independently of these causes in elderly persons, it very commonly indicates the presence of contracting kidney.

The name *azoturia* has been given to a condition in which the excretion of urea is excessive, in proportion to the weight of the body. In some persons excessive excretion of urea is associated with increased secretion of water, so that the proportion of urea remains normal. In others the water is not increased, and therefore the urea excreted is not only increased in absolute quantity *per diem*, but its proportion in the urine is greater than normal, so that such urine at once gives crystals of nitrate of urea on the addition of nitric acid. Excessive excretion of urea, both absolute and relative to the amount of urine, may occur for a time in perfectly healthy persons, without any abnormal symptom whatever. In others, however, such an excess of urea is associated with gastro-intestinal derangement and nervous symptoms, the patient complaining of acidity and flatulence, but not of thirst or excessive appetite. There is languor, fatigue after slight exertion, bodily or mental, nervousness, restlessness at night, dull pain in the back, and sometimes irritation at the neck of the bladder, with constant desire to pass water. It is probable that in some individuals the nitrogenous tissue-change goes on more rapidly than in others, and that they consequently require a larger proportion of nitrogenous constituents in their food, to enable them to do the same amount of work; and that when indigestion occurs in such persons, the nitrogenous products of imperfect digestion or tissue-waste, acting as nervous and muscular poisons, lead to the symptoms of which they complain. In diabetes mellitus there is increased excretion of urea, from the greater amount of food taken by the patients; and it has been supposed by Prout that cases of azoturia might pass into diabetes mellitus. *See* LIVER, Functional Disorders of.

The *treatment* consists in ordering nutritious diet, with a large proportion of farinaceous constituents; moderate exercise; avoidance of fatigue, mental or bodily; purgatives; alteratives; and opium.

2. **Uric Acid** ($C_5H_4N_4O_3$).—When pure, uric acid forms white crystals, very sparingly soluble in water. It does not exist free in the healthy urine, but is combined with potassium, sodium, and ammonium. From these it may be separated by the addition of an acid, or by acid fermentation in the urine after it has been passed, as already described.

The absolute quantity of uric acid in healthy urine varies considerably, like that of urea, according to the diet and other circumstances, but its proportion to the urea is tolerably constant—in health being usually about 1 to 33.

As deposited from the urine, uric acid is nearly always coloured. It may be deposited in scattered brown specks, or as a dense deposit of red sand, resembling red pepper in appearance; or it may form a thin film on the surface of the urine. The crystalline character of the deposit can generally, though not always, be recognised by the naked eye. On microscopic examination the crystals usually present a somewhat lozenge-shaped form. This form is modified by rounding and by aggregation. When the angles are rounded off, spindle-shaped, ovoid, and barrel-shaped forms are produced. Sometimes they are elongated, so as to produce a rod; and the aggregation of the lozenge, ovoid, and rod-like forms produces stars and spikes, varying considerably in appearance. Sometimes, also, they appear like dumb-bells (*see* MICROSCOPE IN MEDICINE). The crystals of uric acid are distinguished by their reddish or brown colour, as well as by their peculiar appearance. They dissolve readily in caustic soda or potash, and separate again on the addition of hydrochloric acid. The chemical test for uric acid is generally known by the name of the murexide test. It distinguishes uric acid and urates from other urinary sediments, but it will not distinguish free uric acid from uric acid in combination. The mode of applying it is to warm the sediment in a porcelain capsule, with a few drops of nitric acid and a little water, and to evaporate it carefully, almost to dryness. It is then moistened by a glass rod with diluted ammonia, when a fine purple red colour appears, which, on the addition of a drop of caustic potash, passes into a purplish blue.

Quantitative Estimation.—Uric acid is estimated quantitatively by mixing the urine with one-twentieth of its bulk of hydrochloric acid, and setting it aside in a cool place for twenty-four hours. The deposit of uric acid is then collected on a filter, washed with the least possible quantity of water, dried, and weighed; the weight of the filter having been previously ascertained. As the weighing is troublesome and difficult, the quantity of uric acid may be ascertained by carefully washing it off the filter, and boiling it with peroxide of lead in a little water, so as to convert it into carbolic and oxalic acids, allantoin, and urea. The amount of nitrogen in this solution is then estimated by the hypobromite method already described. Uric acid contains one-third of its weight of nitrogen, so that by multiplying the weight of nitrogen evolved by 3, one obtains the quantity of uric acid. Besides this, ·0045 gramme is to be added for each 100 c.c. of the urine employed.

A method much in use now is Haycraft's. It depends on the fact that in the presence of neutral salts or of an ammoniacal solution of a magnesian salt, uric acid is almost completely precipitated by an ammoniacal solution of silver as an insoluble double salt. The insoluble precipitate is collected on a filter, dissolved in dilute nitric acid, and titrated with a solution of sulphocyanide of potassium (Haycraft, *Brit. Med. Journ.* Dec. 12, 1885). When boiled with solution of potash and cupric sulphate, uric acid reduces the latter to cuprous oxide. The writer has seen a case in which the reduction was so great as to lead the patient, who was a medical man, to think that he was suffering from diabetes mellitus, and to put himself on an animal diet, by which his condition was of course made worse. Such cases can be easily diagnosed from diabetes mellitus by boiling the urine with liquor potassæ, when it will become brown if sugar is present, but not if uric acid alone is present.

2*a*. **Urates.**—Uric acid occurs in combination with potassium, sodium, ammonium, and calcium; the urate of sodium being the most common. The urates, being readily soluble at the temperature of the body, are only deposited on cooling; so that the urine, which was clear when passed, becomes muddy, and a sediment forms, which is commonly coloured like brick-dust, varying in shade, being sometimes almost white and sometimes red. Pale white urates are readily distinguished from phosphates by quickly clearing up when the urine is warmed, while the phosphates do not. Microscopically, the urates of sodium and calcium are usually amorphous; but sometimes the urate of sodium forms globules with projecting spikes, which have caused them to be compared to hedgehogs. The urate of ammonium forms opaque globules, or slender dumb-bells, which are either single or aggregated, so as to form a cross or rosette.

Clinical Import.—Deposit of urates occurs readily after any violent exertion or perspiration, or after errors in eating or drinking. People are often frightened by such deposits, but they are of no importance unless they should persist for a length of time. Persistent deposits occur in febrile conditions or deep-seated organic disease. In cirrhosis the urine is sometimes heavily loaded. *See* Uric Acid Diathesis: Uric Acid Calculus.

3. **Oxalate of Lime.**—Oxalate of lime is recognised by the white, hummocky appearance of the top of the mucous cloud in the urine. On microscopical examination, octahedral crystals are seen, presenting the appearance of a folded envelope. It also occurs in colourless dumb-bells. It is distinguished from uric acid by being colourless, and insoluble in alkalis; and from phosphates by being insoluble in acetic acid.

Clinical Import.—The occasional occurrence of oxalates is of slight importance, and is usually connected with diet. In hospital practice the writer has noticed that when the patients ate cabbage for dinner, a large proportion of them had oxalates in the urine next morning. Persistent presence of oxalates in the urine has been supposed to be connected with a peculiar diathesis (the oxalic acid diathesis), the symptoms of which are languor, depression, and melancholia. It is most probable that both this and the presence of oxalates in the urine are simply due to imperfect digestion, more especially as they often disappear readily on treatment by nitrohydrochloric acid. *See* Oxalic Acid Diathesis: Oxalate of Lime Calculus.

4. **Phosphates.**—Two kinds of phosphates are found in the urine—phosphate of calcium, and ammonio-magnesium or triple phosphate. They are always deposited when the urine becomes alkaline through fermentation; and when feebly acid urine is heated, so that the carbonic acid is driven off, phosphates are precipitated in the form of a cloud, which might be mistaken for albumin, but clears up at once on the addition of a drop of acid. Under the microscope, phosphate of calcium is amorphous. The ammonio-magnesium phosphate occurs in rhombic prisms, which are distinguished from oxalate of lime by dissolving readily in acetic acid.

Quantitative Estimation.—A rough quantitative estimation of phosphates is made by rendering some urine alkaline with ammonia, and adding an ammonio-magnesium solution to it. A precipitate of ammonio-magnesium phosphate at once occurs if the amount in the urine be normal, but is delayed when the quantity is below normal.

Clinical Import.—In persons having little exercise and a good deal of brain-work, the urine may be turbid when passed, from phosphates present in it, especially during the period of gastric digestion, when much acid has been secreted into the stomach, and the urine is neutral or faintly alkaline. This usually passes away when they get more exercise. It may continue for months, and is of importance only in so far as it renders the patient liable to phosphatic calculus. Such deposits do not indicate increased quantity of phosphates in the urine, but are simply due to diminished acidity. The writer has found the actual quantity of phosphates present in such turbid urines less than in specimens of clear urine from the same individual. Such deposits frequently occur in cases of dilated stomach, where the acid secreted into the stomach during digestion is not reabsorbed. The occurrence of stellar crystals of phosphate of lime in quantity in the urine is, according to Sir William Roberts, of grave import, indicating serious disease of some kind or other, although a few such crystals may occur in normal urine. The triple phosphate almost invariably occurs in ammoniacal urine, and generally appears after urine, alkaline from any cause, has stood for some time. *See* Phosphaturia.

The quantity of phosphates is increased in febrile disorders, and in diseases of the nerve centres and bones; it is diminished in Bright's disease, and sometimes in dyspepsia, as well as after the disappearance of febrile conditions.

5. **Sulphates.**—Sulphur appears in the urine, (1) as sulphuric acid, combined with inorganic bases to form sulphates; (2) in conjunction with organic radicals, forming ethereal sulphates; (3) as oxidisable sulphur compounds, for example, taurine; and (4) as sulphur compounds oxidisable with difficulty. Amongst the most important sulphur compounds in the urine are indican (indoxyl-sulphuric acid) and skatoxyl-sulphuric acid (*see* Section 7). The presence of sulphuric acid in simple combination with bases is tested by adding barium chloride and hydrochloric acid or excess of acetic acid to the urine, when a white precipitate takes place. The ethereal sulphuric acids are not precipitated at once by this method, but give a precipitate with barium chloride after they have been decomposed by boiling with a mineral acid.

Quantitative Estimation.—Sulphuric acid is estimated quantitatively by means of barium or strontium, but for the details of the process the reader is referred to text-books. The oxidisable sulphur is estimated by boiling with nitric acid and chlorate of potassium, and then determining the quantity of sulphuric acid present, and deducting from the amount thus found the quantity obtained by the first method. The sulphur oxidisable with difficulty is determined by evaporating a measured quantity of urine to dryness, calcining with nitrate of potassium, estimating the sulphuric acid, and deducting from these the quantity found by the second method.

To ascertain the relative proportions of sulphates and ethereal sulphates, acidulate 10 c.c. of the urine with acetic acid, precipitate with 20 c.c. of a 10 per cent. solution of barium chloride, and filter. The precipitate contains the sulphates, the filtrate the ethereal sulphates with excess of barium. Boil the filtrate with strong hydrochloric acid to decompose the ethereal sulphates, and the bulk of the precipitate which then falls will indicate the quantity of them present. The relative proportion of ordinary sulphates and of ethereal sulphates is important. In healthy urine the former are more abundant, but in abnormal conditions the latter. Many substances of the aromatic series are excreted in combination with sulphuric acid, such as phenol, indol, and skatol. When phenol is given internally or absorbed from the skin, it is excreted in combination with sulphuric acid; and as long as abundant sulphates are found in the urine no danger is to be apprehended; but whenever the ordinary sulphates become nearly absent, while the ethereal compound with phenol is abundant, there is danger of poisoning, and the use of carbolic acid should be stopped, and sulphate of sodium or of magnesium freely administered. For the clinical import of indican, *see* Section 7.

Clinical Import.—The excretion of sulphur in the urine may be used as a means of diagnosing the condition of the secretion of bile. The more sulphur is excreted in the bile, the less appears in the urine, and *vice versâ*. In biliary colic, due to impediment to the flow of bile through the ducts, the easily oxidisable sulphur has been found by Lepine to be diminished, but the difficultly oxidisable to be increased.

6. **Chlorides.**—Chlorine is present in the urine in combination with ammonium, fixed alkalis, or alkaline earths. The quantity depends chiefly on the amount of salt taken in the food. When this is constant the excretion is also tolerably constant; but if a larger quantity of salt be then regularly taken, the excess may not begin to be excreted until after about three days, when it will again remain constant; and the excretion will be in excess for about three days after the quantity taken has been diminished. The body has, therefore, the power of retaining a quantity of chlorine. In acute inflammatory diseases the chlorides are retained completely, so as to disappear from the urine. The usual test for a chloride is the curdy white precipitate given on the addition of nitrate of silver to urine acidulated with nitric acid.

7. **Pigments.**—These have not yet been fully examined, but they appear to exist in the urine both in the state of pigments and pigment-yielding substances or chromogens. The pigment of normal urine is urobilin, which, according to MacMunn, is an amorphous yellow-brown pigment. It gives in solution a spectroscopic band at F, disappearing with excess of ammonia or potash, and being again brought into view by acid. When febro-urobilin is present, caustic soda or potash causes the band at F to disappear, and to be replaced by a band nearer the red end of the spectrum. *See* SPECTROSCOPE IN MEDICINE.

Normal urobilin appears to be identical with choletelin, the body produced by oxidising acid hæmatin. Normal urine also appears to contain two chromogens, namely, the chromogen of febro-urobilin, and indican. By the addition of oxidising agents to the urine, or by long standing, febro-urobilin may be produced from the chromogen.

The quantity of indican present in normal urine is small. It is tested by mixing the urine with its own bulk of hydrochloric acid, and adding a drop or two of dilute nitric acid or of a solution of chlorinated lime, avoiding excess, which will bleach the colour. The indican is thus split up, yielding indigo, which colours the urine blue, and may be removed by shaking with chloroform and allowing it to settle. The supernatant liquid remains of a reddish or purplish colour, from the presence, probably, of indigo-red. There appears to be some difference in the indigo-yielding substance, because occasionally the addition of nitric acid to the urine has no effect, although indican be present, as shown by the test thus given; while on other occasions the writer has found the mere addition of nitric acid render the urine a dark greenish-blue, or almost black, from the immediate separation of indigo, which could be removed by the treatment with chloroform just described.

Clinical Import.—Indican appears to be derived from indol, formed by albuminous putrefaction, either in the intestines or in serous cavities such as the pleura. Indol administered subcutaneously increases the indigo in the urine. The indigo is much increased by partial or complete obstruction of the small intestines. It is less affected by affections of the large intestines. It has also been found increased in tabes mesenterica, phthisis, cancer of the stomach, lymphatic growths, cancer of the liver, Addison's disease, and cholera. It is present in large quantity in the urine of persons resident in the tropics. It appears to be increased by turpentine, oil of bitter almonds, and nux vomica. Its presence in excess usually indicates the advisability of administering a mercurial and a saline, in order to clear the decomposing albuminous substances out of the intestine, and the subsequent use of intestinal disinfectants.

A chromogen, yielding a purple colour on the addition of nitric acid, is often met with in cases of anæmia where the urine itself is of a very pale colour, but on the addition of nitric acid becomes almost cherry-red.

8. **Albumin.**—The ordinary form of albumin in urine is serum-albumin. Besides this, we have paraglobulin, fibrinogen, propeptone, and peptone. For the tests of these substances, *see* ALBUMIN; ALBUMINURIA; and ALBUMOSES; and for their clinical import, *see* ALBUMOSURIA; BRIGHT'S DISEASE; and KIDNEYS, Diseases of.

Albuminuria is much more common than is usually supposed, and has been found in America to occur in 11 per cent. of apparently healthy persons presenting themselves for assurance. According to the writer's experience, it is by no means so common in this country. Its significance in such persons has not been completely ascertained, but it has been found that in many such cases, when they are kept under observation, the health goes on deteriorating. Intermittent albuminuria is not infrequent in persons who have been exposed to malaria; and Sir Richard Quain has observed that a similar condition in youth is frequently associated with masturbation. In contracting kidney the albumin is usually small in quantity, and may also be completely intermittent, traces of it appearing only in the urine passed after meals, and being entirely absent from urine passed in the morning. This, as the writer has seen, may occur even when the patient is in a very precarious condition, and is already suffering from nephritic asthma. The late Dr. Mahomed believed that albuminuria may be quite absent in granular disease. Egg-albumin and propeptones readily pass through the kidneys (*see* ALBUMINURIA). It has, however, been found by Stokvis that, if egg-albumin is made to pass through the kidneys for a length of time, the kidneys themselves undergo structural change, glomerular nephritis being induced. These observations confirm the idea, founded on clinical observation by Sir George Johnson, that albuminuria with structural kidney-change may be secondary to continued indigestion.

Quantitative Estimation of Albumin.—The most convenient method is Esbach's. It consists in filling a tube graduated for the purpose up to a mark U with urine, and up to a mark R with a reagent. This is allowed to stand till next day, when the precipitate has settled, and the number opposite the line to which it reaches in the tube gives the proportion of albumin in 1,000 parts of urine. The reagent is composed of 20 parts citric acid, 10 of picric acid, made up to 1,000 parts with water.

9. **Sugar, Acetone, and Aceto-acetic Acid.**—For the tests and indications of these substances, *see* DIABETES MELLITUS.

10. **Inosite, or Muscle-sugar.**—This occasionally occurs in urine alternately with dextrose. It has no action on polarised light; it does not ferment with yeast; and it does not reduce cupric hydrate, although it causes it to dissolve. It is detected by precipitating the urine first with neutral lead acetate, then with basic acetate, collecting the second precipitate on a filter, suspending it in a little water, and decomposing by hydric sulphide, filtering, and evaporating to a small bulk. A drop is then mixed with nitric acid, and evaporated almost to dryness on platinum foil. A drop of ammonia and one of calcium chloride are next added, and the whole gently evaporated to dryness. A rose-red tinge indicates the presence of inosite.

11. **Blood, Hæmoglobin, Methæmoglobin.**—For the tests and indications of these, *see* HÆMATURIA; HÆMOGLOBINURIA; and HÆMOGLOBIN.

12. **Bile-acids.**—*See* JAUNDICE.

13. **Leucin, Tyrosin.** *See* LEUCIN; LIVER, Atrophy of; PHOSPHORUS, Poisoning by; and TYROSIN.

14. **Cystin.** *See* CALCULI.

15. **Abnormal Pigments.**—The chief of these are uroerythrin, giving a red colour to febrile urine, febro-urobilin, and urohæmatin. The nature and relations both of the normal and abnormal urinary pigments and chromogens are not yet fully understood (*see* ANÆMIA, PERNICIOUS). For bile-pigments, *see* JAUNDICE.

Melanin.—This black pigment has been found in the fresh urine of patients with melanotic cancer. It appears in the fresh urine as a chromogen, the urine, when freshly passed, being normal in colour; but after standing, or after the addition of oxidising substances, such as nitric acid, the black pigment melanin is formed. This must not be confounded with the dark colour from carbolic acid, or with the dark colour due to great excess of indigo already described.

Accidental Pigments.—Chrysophanic acid may occur from taking rhubarb or senna. The urine containing it becomes red when it is rendered alkaline by caustic alkali. The colour disappears on the addition of acid.

Santonin colours acid urine yellow or greenish. It is distinguished from biliary pigments by becoming cherry-red and purple on the addition of caustic alkali, this colour disappearing on the addition of acid.

The pigments of bilberries, logwood, beetroot, indigo, and gamboge also pass to a certain extent into the urine, and the *Cytisus alpinus* gives it a grass-green colour. After the use, either external or internal, of carbolic acid, creasote, or phenol, the urine may be greenish-brown or almost black. This is due to products of the oxidation of these substances, chiefly hydrochinon. Sometimes the presence of iodide or bromide of potassium in the urine may render it reddish after the addition of nitric acid, on account of the liberation of free iodine or bromine. These are distinguished by their penetrating odours, and may be separated by treating the urine with chloroform and then gently evaporating.

16. **Diamines.**—These do not occur in normal urine, but many of them having a poisonous action, occur in the urine in disease.

17. **Alkaloids.**—These may be precipitated by acidulating the urine with acetic acid, and then adding a solution of iodide of mercury in iodide of potassium. This reagent precipitates albumin, mucin, and uric acid also, but the precipitate with alkaloids is distinguished from that given by the other three bodies just mentioned by being soluble in warm alcohol.

18. **Drugs.**—Salicylates, salol, betol, all give a purple colour when perchloride of iron is added to urine containing them. Phenazone gives a purple-red, and so does thallin, but the colour with the former lasts two or three days, while with the latter it only lasts a few hours before turning to brown. Phenacetin, when taken in large doses, gives at once with perchloride of iron a brown-red, gradually changing to black. Acetanilide is detected by adding a quarter its bulk of strong hydrochloric acid to urine, and boiling for a few minutes so as to decompose the para-amido-phenol-sulphuric acid, as which it is excreted (*see* Section 5). After cooling, a small quantity of a 3 per cent. solution of carbolic acid and a drop of a dilute solution of chromic acid are added. The occurrence of a red colour, becoming blue on alkalising with ammonia, indicates acetanilide.

T. Lauder Brunton.

URINE, Retention of.—A morbid condition in which there is difficulty or inability to expel the urine from the bladder. *See* Micturition, Disorders of.

URINE, Suppression of.—Synon.: Fr. *Suppression de l'Urine*; Ger. *Harnverhaltung.*—Suppression of the secretion of urine arises under two conditions: first, where there is obstruction in the line of outflow; secondly, where there is some fault in the action of the kidney itself.

1. **Obstructive Suppression.**—This is most commonly a result of impaction of a calculus in the ureter of a patient who has already, from some cause, had one kidney permanently destroyed; or of the presence of a tumour, as of the bladder or uterus, implicating both ureters. A little urine is commonly passed during the progress of such cases. It is generally pale, and of low specific gravity. When suppression is absolute, seven or eight days may elapse before the patient appears to suffer materially, but then occur muscular twitchings, contraction of pupils, weakness of muscles, drowsiness, and in rare cases convulsions. There is neither dropsy nor urinous odour of the breath. The duration of life appears to vary from nine to eleven days.

2. **Non-obstructive Suppression.**—Sometimes in the course of acute inflammatory Bright's disease complete suppression of urine takes place. It may also occur in the later stages particularly of the inflammatory and cirrhotic forms of Bright's disease; also as a consequence of injuries and diseases of the urethra; and in the collapse stage of cholera and some other diseases. Doubtless in some of these conditions suppression is due to nervous agency, but how it is brought about is not at present understood. There are also cases on record in which complete suppression of urine has occurred in association with hysteria, persisting for days.

Treatment.—Next to removal, if possible, of the condition upon which the suppression depends, hot baths or fomentations, and the patient avoidance of active interference with powerful medicines, are among the most important indications. In cases of obstructive suppression, careful kneading of the abdomen may be tried; and this should be persevered with in the most advanced conditions, as cases are on record in which relief has been obtained when the prospect has been utterly unfavourable. In the female, the introduction of a sound into the ureter may be successfully practised. If relief be not obtained, and death be imminent, surgical interference may be necessary and practicable.

T. Grainger Stewart.

URTICARIA. — Synon.: *Cnidosis*; Nettlerash; Fr. *Urticaire*; Ger. *Nesselausschlag.*

Definition.—Urticaria is an eruption accompanied by sensations of stinging, itching, and burning, like those produced by the sting of a nettle, and is characterised by the formation of wheals.

Symptoms.—Urticaria is a very common disease, and is remarkable for its very variable and fugitive character, and for the great variety of circumstances under which it is developed. In all cases, however, the presence of wheals or some equivalent eruption is pathognomonic of the disease. The wheal consists of a circumscribed swelling of the skin, attended with active congestion of the vascular layer, and an exudation of serum into the immediate neighbourhood of the vessels. This exudation does not usually extend into the epidermic structures The degree of swelling is very variable, and depends on the amount of exudation. The occasional, almost sudden, disappearance of these curious formations is explained by the close proximity of the serous exudation to the absorbent vessels; for when the fluid finds its way into the epidermis, the process of resorption is much slower, and traces of the inflammation are often left behind for several days. Usually the central part of a fully developed wheal is pale, compared with the circumference. This is said to be due to the increased pressure of the exudation at that point, which is often so great as to empty the capillaries of the skin; it may, however, be caused by a spasmodic contraction of the muscular coats of the vessels. At all events, vaso-motor disturbance is always present in the formation of a wheal.

The size, form, and general appearance of the wheals vary greatly. Sometimes they are no larger than a split pea, while at other times they may occupy a considerable surface, and cause much swelling of the skin. In typical examples they are round or oval; not infrequently they take the form of streaks or irregularly shaped patches. Sometimes the only eruption consists of a diffuse erythematous bright red blush. But whatever be its form, it is very evanescent, and liable to appear and disappear almost suddenly, leaving little or no trace behind. In all cases the subjective phenomena are nearly the same, and consist in excessive itching, tingling, stinging, and burning sensations. Sometimes the itching preponderates, at other times, perhaps, the stinging and burning sensations are the most marked, for, like the eruption itself, they are liable to constant change. These subjective sensations are by no means always proportional to the amount of visible eruption, and often remain long after this has disappeared. The rash occasionally appears with a sudden outburst all over the body, while at other times it is developed more slowly, and appears successively on different parts. It is roughly symmetrical, though the wheals have no definite arrangement. Sometimes the mucous membrane of the mouth, tongue, and larynx is involved. The sufferer invariably rubs and scratches the skin. This greatly aggravates the symptoms, and brings out fresh wheals wherever the finger-nails are applied, and, in severe cases, small excoriations and little spots of coagulated blood may be seen scattered about the skin as the result of scratching. An ordinary attack of urticaria may last from a few hours to several days, and in chronic forms of the disease one attack follows so closely on another as to give the impression that they are continuous; this, however, is not the case, as there are always remissions and exacerbations, and generally short intervals of complete freedom.

Ætiology. — Urticaria is often only a symptomatic rash, and differs also from most other eruptions in the fact that it is a frequent attendant upon other diseases of the skin. The circumstances under which it is commonly met with may be divided conveniently into five groups: (1) It is extremely apt to complicate other irritable affections of the skin, such as scabies, phthiriasis, prurigo, and eczema. This is especially the case in children. The production of nettlerash under these circumstances is due to reflex action set up by scratching. (2) The bites and stings of poisonous insects, and the hairs of stinging plants, such as the common nettle, will produce in some people pretty severe local attacks of urticaria, so that the face or arms become much swollen and very painful. (3) Nettlerash produced by irritation of some part of the mucous tract is not uncommon, and belongs also to the group of reflex nervous actions. We often meet with examples of this kind dependent on uterine irritation from pregnancy and other causes; also in children who suffer from worms. (4) Certain kinds of food are apt to produce nettlerash; among these may be specially mentioned shell-fish, mushrooms, acid wines, and many kinds of fruit; but in these cases much depends on the idiosyncrasy of the individual. To this category belong the red rashes which are occasionally produced by certain drugs. Among the best known of these are copaiba, capsicum, turpentine, cubebs, and quinine (see Drug Eruptions). (5) The most common form of urticaria is met with in people in whom it is impossible to trace a definite exciting cause, or in whom the exciting causes are trivial and various. In these cases the disease is distinctly and wholly of nervous origin, and occurs in people whose nervous system has been overtaxed, being often associated with such nervous symptoms as neuralgia. This form of the disease is always recurrent. It may come on with great regularity at a certain time of the day, and even replace neuralgia. Urticaria is occasionally rheumatic.

Varieties of Urticaria.—In addition to the ordinary form there are three principal varieties of urticaria: (1) The acute febrile urticaria; (2) Urticaria papulosa; (3) Urticaria pigmentosa.

(1) *Acute febrile urticaria* is an idiopathic affection but rarely met with. It is ushered in with febrile symptoms, especially headache and sickness; the pulse and temperature may both be high, and the tongue furred. The characteristic feature is the suddenness of the attack, and the general outburst of red rash, which may cover the whole of the trunk, face, and limbs, and produce much swelling of the skin. The mucous membrane is also liable to be affected. This is especially the case about the fauces and throat, which become suddenly swollen, so as even to threaten suffocation. The disease may be distinguished from scarlet fever by the suddenness of the attack, the swelling of the skin, and the subjective sensations.

(2) *Urticaria papulosa* is a disease which is met with chiefly in children, and is commonly known as lichen urticatus; it is very obstinate, usually lasting for several years,

but with intervals of subsidence. The itching and irritation are very great, especially at night; this is always aggravated by the scratching of the patient. The eruption consists of wheals mixed with permanent pruriginous papules, which are probably the result of urticarial exudation into the cuticular structures. It is often mistaken for scabies, but does not especially affect those parts of the body which are liable to the attacks of the latter disease.

(3) *Urticaria pigmentosa* is a peculiar and rare form of persistent urticaria, associated with buff-coloured pigmentation of the skin. The eruption appears as persistent tubercles, and red measly-looking patches, mixed with yellowish pigment-spots, resembling pityriasis versicolor. The peculiarity of the colour, and the persistence of these spots, constitute the chief characteristics of this rare variety of urticaria. Usually, after the disease has lasted for some time, the neurotic symptoms subside, leaving simply raised patches of yellowish skin, either with or without tubercles; but the more active symptoms may be reproduced by rubbing and scratching.

Treatment.—As has already been stated, urticaria, unlike most other skin-diseases, is a symptomatic rash rather than a definite disease. That it is very difficult to deal with is proved by the vast number of different remedies recommended by writers on this subject. The first point in any given case is to ascertain whether there is any definite local cause of irritation giving rise to the nettle-rash; and with this view the skin should be carefully examined for bug-bites and pediculi, which are very common exciting causes among the poorer classes. It must not be forgotten that the dye or dressing of the underclothes is sometimes a local irritant to the skin. If we fail to find any external cause of irritation, our attention should next be directed to the alimentary canal. Worms in children are not an infrequent cause of urticaria, and injudicious feeding may be also mentioned as occasionally giving rise to it; therefore, in treating urticaria of this kind, a careful and well-regulated diet is in all cases indicated. With regard to medicines, those are most efficacious that promote the process of digestion; one of the most generally useful is a mixture containing carbonate of magnesium and bicarbonate of sodium, with some aromatic or bitter infusion, taken before each meal.

Subacute urticaria of the ordinary kind produced by poisoning from shell-fish or fungi or some other poisonous food, is best relieved by a simple emetic and a quickly acting saline purge, so as to remove the offending matter from the stomach and intestinal canal.

A large proportion of cases of chronic urticaria are distinctly of neurotic origin, and are often associated with other disturbances of the nervous system. Of all remedies for this class of cases, the most generally useful is complete rest both of mind and body. Of medicines, quinine and arsenic may be mentioned as often beneficial, especially when the attacks are of a periodic character. Complete change of air sometimes succeeds when all other remedies fail. The malady is, however, always very obstinate.

Robert Liveing.

USSAT, in Ariège, France.—Thermal sulphated calcareous water. *See* Mineral Waters.

UTERUS, Diseases of.—*See* Womb, Diseases of.

UVULA, Diseases of.—Synon.: Fr. *Maladies de la Luette*; Ger. *Krankheiten des Zäpfchens.*—Suspended from the middle of the lower and free border of the soft palate is that small conical-shaped prolongation termed the 'uvula.' In structure it is exactly the same as—indeed it is a portion of—the soft palate, which consists of a fold of mucous membrane, enclosing muscles, aponeuroses, vessels, nerves, and glands, the latter being very numerous.

From its intimate relation with the soft palate, the fauces, the tonsils, and the pharynx, the uvula is likely to become involved when any of these parts is overtaken by disease. This is most evident in cases of catarrhal angina. It is extremely rare for the uvula to be primarily and exclusively attacked with *inflammation*, and yet instances of such an affection are on record. On the other hand, it is by no means uncommon to observe the uvula swollen, œdematous, and elongated, as a consequence of prolonged irritation, *relaxation*, or often-repeated catarrh of the fauces. That form of acute catarrh, of which the uvula partakes when the throat is the subject of this affection, disappears along with the other symptoms.

Elongated Uvula often proves very intractable to treatment for a long time, and all the more so that not very infrequently this morbid condition is entirely overlooked by the practitioner. It ought to be laid down as a rule, that the parts should be inspected in all affections of the throat. In this case, inspection will reveal that the uvula is greatly lengthened, but not of necessity always thickened or œdematous; so that when the patient reclines, this pendulous body falls backwards, sometimes even dropping so low as to reach the glottis. The consequence is, that the mucous membrane of the pharynx and larynx is kept in a continual state of irritation and general uneasiness. A peculiarly annoying cough is set up by the constant tickling of the parts, so that this condition of the uvula may even at times be recognised by the rapidly repeated, resultless, brassy cough. It may be described as a quick, ineffectual hack. An inclination to vomit is also induced. An irresistible desire to swallow is observed, owing to the sensation which the patient perceives in the throat, as if something were lodging there which ought to be got rid of by swallowing. If there should be much thickening as well as elongation of the uvula, then some slight difficulty may be experienced when deglutition takes place. When the elongation is very pronounced, and the uvula finds its way into the larynx, the patient may experience a sense of suffocation, particularly if he happen to be asleep, when he suddenly wakes up in a state of great alarm and breathlessness. A more temporary condition of elongated uvula is observed in that form of relaxed fauces to which public speakers and singers are subject, and which comes on suddenly, or quickly, after continuous use of the voice for an hour or more.

Treatment.—The condition associated with elongated uvula must be treated on general principles (*see* Pharynx, Diseases of). Locally, the elongated uvula is best treated by astringent gargles. One of the best of these, which is perhaps as soothing as astringent, is the bromide of ammonium gargle, twenty grains to the ounce of water. Glycerine of tannic acid, tincture of iodine, and other agents which are quite sufficient for the cure of the simply relaxed uvula, may prove insufficient to restore the elongated uvula, and then a portion of it must be removed, even to the extent of two-thirds.

Bifid Uvula is a deformity usually congenital, the treatment of which, if necessary, by the actual or galvano-caustic cautery, or other means, falls within the domain of surgery.

Paralysis of the Uvula is met with as a sequela of diphtheria, when other parts of the throat are similarly affected. *See* Palate, Diseases of; and Paralysis, Diphtheritic.

Claud Muirhead.

V

VACCINATION (*vacca*, a cow).—Synon.: Fr. *Vaccination*; Ger. *Kuhpockenimpfung*.

Definition.—Inoculation with the material of vaccinia or the cow-pox. Its purpose, as applied to the human subject, in which relation alone we have here to consider it, is the protection of the person vaccinated from an attack, and especially from a severe or fatal attack, of small-pox.

The cow-pox, which is a natural, though not common, disease in the cow and horse, never occurs spontaneously in man. Nor is it communicable to him by effluvia, or in any other way than by the direct inoculation of its own specific virus. Such inoculation before the time of Jenner was never more than a matter of mere accident, and occurred with comparative rarity. It was matter of popular tradition, but was left for Jenner to demonstrate, that persons who had thus been accidentally vaccinated enjoyed immunity subsequently from small-pox; and it was by his great discovery that the cow-pox, once implanted in the human subject, may be continued by inoculation from individual to individual indefinitely, that the practice of vaccination became possible.

The relation of cow-pox to small-pox is still a matter of some doubt, but on the whole the tendency of the evidence (which has been impartially summed up by Dr. McVail) shows that vaccinia is, as Jenner had supposed it, variola of the cow, and that the virus of human small-pox is so attenuated or metamorphosed in the bovine animal as to be deprived both of its quality of atmospheric convection, and of its tendency to cause a generalised eruption.

Phenomena of Vaccination.—The phenomena which follow inoculation with the material of cow-pox vary according as the person, in whom the vaccine lymph is inserted, may or may not have been the subject of a previous successful vaccination, a previous inoculation, or a previous small-pox. The description may be divided into (1) the course of *primary* vaccination; and (2) the course of *secondary* vaccination, or re-vaccination.

1. Course of Primary Vaccination. This may be *regular*, *irregular*, or *complicated*.

(*a*) *Regular course.*—When lymph, taken from a vaccine vesicle at that period of its course when the vesicle is fit for the purpose, is inserted into the skin by puncture, or is applied to a small abraded surface of the skin, of an unprotected person, no particular effect is noticeable till about the end of the second day, or early on the third day. By this time, if the vaccination be about to succeed, a slight papular elevation becomes perceptible. This, by the fifth or sixth day, has become a distinct vesicle of a bluish-white colour, with raised edge and central cup-like depression.

By the eighth day (the day-week from that on which the lymph was inserted) it has attained its perfect growth; it is then plump, round, more decidedly pearl-coloured, and distended with clear lymph; its margin is firm, and central depression very marked. On this day, or sometimes even by the end of the seventh day, a ring of inflammation, called the areola, begins to form about its base; and the vesicle and areola together continue to spread for the next two days. The areola is circular, and when fully developed has a diameter of from one to three inches, being then often attended with considerable hardness and swelling of the subjacent connective tissue. After the tenth day the areola begins to fade; and in two or three days more it has usually disappeared, with whatever of hardness or swelling may have existed. With the decline of the areola the vesicle begins to dry in the centre; the lymph remaining in it becomes opaque and gradually concretes; and by the fourteenth or fifteenth day a hard brown scab is formed, which gradually contracts, dries, and blackens, and from the twentieth to the twenty-fifth day, but usually about the twenty-first day, falls off. There is then left a cicatrix, which is circular, somewhat depressed, foveated, sometimes radiated, and, with rare exceptions, permanent in after-life.

If the lymph have been inserted by two, three, or more punctures set near together about one spot, or by abrasion, over a sufficient surface, two or more vesicles may arise at the spot; and in the course of their growth, either form a large vesicle of a compound character, with but one central depression, or a crop of vesicles, generally coalescing, but each retaining its own central depression. These compound vesicles and crops are round, oval, or of irregular outline, according to the manner in which the cutis has been penetrated or exposed; and the shape of the resulting cicatrices varies accordingly. Vaccination which has gone through the course above described is held to be protective against small-pox.

The constitutional symptoms attending these local phenomena are a rise of temperature, sometimes detectable by thermometer as early as the fourth day, more marked but still often very slight from the fifth to the seventh day; more obvious feverishness, with restlessness, and frequently derangement of the stomach and bowels, from the eighth to the tenth day, that is, during the stage of areola, subsiding as that subsides. The general symptoms are in most cases quite moderate, and often exceedingly slight. Occasionally, when the areola is at its height, swelling of the axillary glands may be intense; and occasionally also at that period in young children of full habit, especially in hot weather, an eruption of roseola (*vaccine roseola*) may occur, chiefly on the extremities; or a papular eruption (*vaccine lichen*); or a vesicular one—the vesicles, however, differing from vaccine vesicles in being entirely free from central depression. The duration of any of these forms of eruption, when they do occur, is very transitory, usually not extending beyond a week, and very seldom indeed beyond the falling of the scab.

(*b*) *Irregular course.* — The exactitude with which vaccination in the immense majority of cases runs the course above described is very remarkable; but in some cases an irregular course is seen. The irregularity may be merely in point of *time*; the development of the vesicle being retarded one or two or several days, or being slightly accelerated, so as to present, for example, by the eighth day, the appearances usually seen on the ninth. If the phenomena are in all other respects regular, these mere variations in time do not, as far as known, affect the protective power of the vaccination. On the other hand, there may be irregularity of the *character* and *course* of the vesicle, constituting *spurious vaccination*, on which no reliance can be placed for protecting from small-pox. Thus, papules or even vesicles may arise, which, instead of undergoing their proper development, begin by the fifth or sixth day to die away, leaving a mere scale or slight scab by the eighth day. More frequently, there are vesicles beginning early after the insertion of the lymph, with itching and irritation—symptoms almost invariably absent in a normal primary vaccination, assuming as they rise an acuminated or conoidal form, instead of the characteristic flat form with central depression; containing straw-coloured or opaque fluid, instead of clear lymph; and developing an early and irregularly shaped areola, which is at its height by the fifth or sixth day, and far on the decline by the day-week. In other cases the vesicles, rising apparently more regularly at first, are found by the eighth day to have burst; and present either an irregular scabby appearance, or are in the state of open sores. The chief causes of these irregularities will be discussed farther on.

(*c*) *Complicated course.*—In spurious vaccinations, especially in the kind last described, and even in the course of a regular vaccination, if the vesicles have been rubbed or otherwise injured, ulcerated sores may succeed, requiring, in children who are of scrofulous or otherwise unhealthy constitution, some time to heal. Occasionally, also, in children of such habit of body, the swelling of the axillary glands, which has been mentioned as sometimes attendant on the areola, may result in abscess. But the only complication which can be regarded as at all formidable is erysipelas. This disease may of course supervene on vaccination, as it may on any other surgical operation, when the conditions which ordinarily give rise to it exist, and especially where there has been exposure to its contagium. But there have been cases, happily rare, in which it has manifestly arisen from the use of improper lymph, that is, from lymph taken from spurious vesicles, or from regular vesicles at an advanced period of their course, or which has been spoilt in keeping.

Erysipelas was included by the Local Government Board in the list of diseases scheduled under the Notification of Infectious Diseases Act, 1889, mainly for the purpose of assisting vaccinators in guarding against this complication. Should a case of erysipelas or any septic disease occur in the home of an unvaccinated infant, vaccination should be postponed, or the infant should be removed to a locality free from infection for the vaccination period.

The place of operation should always be scrupulously guarded against the entry of dirt or decomposing matter, both *at the time* and *during the course* of vaccination.

2. **Course of Re-vaccination.** — In some persons the *regular* phenomena of vaccination can only be produced once in the lifetime. But this is not always the case, and vesicles may be produced by a second vaccination, not distinguishable in their appearance from primary vesicles, though usually having a smaller and more transitory areola, and having a small and poor cicatrix. Much the most frequently the result of that process is the production of a spurious papule or acuminated vesicle, with hard, irregular areola, reaching its height by the fifth or sixth day, and having by the eighth day an imperfect scab, which soon falls. There is often much itching and more serious local irritation; and the constitutional symptoms are out of all proportion more frequent after re-vaccination than after primary vaccination. In some persons no specific local effect is producible by re-vaccination.

PERFORMANCE OF VACCINATION.—(1) **Age.** Small-pox being a disease to which persons are liable from the moment of birth, and which is peculiarly fatal in infancy, it is of great importance that vaccination should be performed in very early life. In large towns, where a weekly supply of lymph from arm to arm can always be maintained, the vaccination of children who are plump and healthy should be effected within four or six weeks from birth. If the child be less robust, it may properly be deferred for three or four weeks more. In small towns and rural districts the age at which vaccination can be performed must depend to some extent on the arrangements for lymph-supply in the district; but these are always such as admit of a child being vaccinated within a very few months from birth. It is under ordinary circumstances a preliminary condition of the performance of vaccination, that the child to be vaccinated should be healthy; and a careful examination to ascertain this is the first duty of the vaccinator. The child should not only be free from any acute febrile disease, but also from diarrhœa and from cutaneous diseases, especially those of the vesicular type. The states of constitution associated with herpes and eczema singularly interfere with the proper course of vaccination, and seem to be the most frequent causes of those spurious results of vaccination just described. They may both —especially intertrigo — without care, be overlooked; hence examination of the scalp, and of the folds of skin behind the ears, in the neck, and in the groins, is indispensable. Vaccination should also be postponed if erysipelas be prevailing in the neighbourhood in which the child is living, or if it have been recently exposed to the infection of measles or scarlatina. There is, however, a state of things under which these conditions must be disregarded, namely, when there may be *immediate* exposure to the infection of small-pox, as when an unvaccinated child is in a house in which the infection exists, or has come into direct contact with an infected person. Under such circumstances, it cannot be too strongly impressed that no age is too early for vaccination, and no state of health, except the presence of acute disease of a serious character, can be held to contra-indicate it. Life then may depend on the promptitude with which the vaccination is done.

(2) **Selection of lymph.**—The second point to attend to is the selection of the lymph to be used in vaccinating. This may be of two kinds, bovine or human. Human lymph should be taken from primary cases only, from perfectly healthy subjects, and from thoroughly characteristic vesicles. Babies selected for the purpose should not only be in good health themselves, but, as far as can be ascertained, of healthy parentage. Those of dark complexion, not too florid, with a thick, smooth, clear skin, generally yield the best and most effective lymph. Vesicles from which the lymph may be taken must be well characterised, uninjured, and free from areola. Lymph may, with perfect propriety, be taken so soon as any can be obtained from a vesicle, as at the fifth or sixth day of its course; but it is then procurable in very small quantity, and is usually and most conveniently taken on the day-week from the vaccination, when the vesicle is perfectly formed, but before the stage of areola has set in. Any vesicle which at that date manifests areola must be discarded. This was Jenner's 'golden rule,' and one which ought to be scrupulously observed. Good vaccine lymph is always perfectly limpid and has,

besides, a certain degree of viscidity. A thin, serous, too-readily flowing lymph should never be used.

The risk of conveying human disease is infinitesimal if the vaccination be done with due care. If bovine lymph be preferred to human lymph, the vaccinator should be equally careful in his selection of the source. That from which the Government supplies are obtained is the National Animal Vaccine-Lymph Station in Lamb's Conduit Street, London. The system of calf-vaccination has been in operation there since 1881. With the exception of a series of cases in 1885 and 1886 vaccinated with Simpson's lymph (obtained by the variolation of a cow), the only stock of lymph used since March 1882 had its origin in a case of natural cow-pox which occurred at Lafôret near Bordeaux, the lymph being supplied by Dr. Dubreuilh. Calves are vaccinated every week with this lymph on the shaven abdomen, the lymph being taken on the fifth day of vaccination for renewal of the stock, and for vaccination direct from the calf. Every precaution is taken at this establishment to ensure not only the healthiness of the calves, but the cleanliness of their surroundings. The lymph, besides being used for vaccination at the station, is supplied to vaccinators who require it in small quantities for the purpose of furnishing a fresh stock of lymph for 'arm-to-arm' vaccination. The lymph thus supplied to vaccinators should be used at once on being received. The 'insertion success' is, in the hands of Dr. Cory and other practised operators, about equal to that obtained by the established system of arm-to-arm vaccination. The resulting vesicles are in no way distinguishable from those produced by humanised lymph.

The chief advantage that belongs to the system of animal vaccination is, in the opinion of the present writer (Dr. Edward Seaton), that it may afford the opportunity of re-vaccinating simultaneously large numbers of persons who are exposed to the immediate danger of small-pox, as, for example, the inmates of a workhouse into which a case of small-pox has been introduced, and where the means of isolation are very imperfect. In order to facilitate the supply of lymph for such a purpose it would be well if several national or municipal animal-vaccine stations could be established near to large centres of population in the North and in the Midlands, as well as in the South of England; such stations to be open to the public like that at Lamb's Conduit Street, and to be available for supplies of lymph where the immediate re-vaccination of a large number of persons is necessary to prevent the spread of small-pox.

(3) **Method of collecting lymph: Arm-to-arm vaccination.**—The collection of lymph from the human subject for vaccinating is effected by opening the vesicle by numerous minute punctures on its surface, the utmost care being used not to draw blood. Should any accidentally be drawn, the vesicle must be discarded altogether. No lymph must be used which does not exude spontaneously; there must be no pressure or squeezing of the vesicle. The lymph which stands on the surface of the opened vesicle is taken on the point of a lancet or other instrument employed, and inserted in the arm of the child to be vaccinated. This may be done in various ways, as by puncture, by scratching, by scarifications or abrasions, by tattooing, &c. It would not be possible, within the limits of this article, to give any description of these various modes of operating. Nor would it be of much use. They should be learnt practically under a good instructor. All of these methods may, in careful and skilled hands, be made equally successful. That, however, which in the hands of practitioners generally Dr. E. C. Seaton found the most successful, was the plan by scarification or tattooing ·.·.· over surfaces of the extent here depicted. Insertions to this extent should be made on at least four, and preferably five, separate surfaces. If the vaccination be done on both arms, three insertions of this kind in each arm are recommended; if it be done on one arm only, then there should be five on that arm. In vaccination by other modes of procedure, care should be taken that local results to the full extent are obtained. An ordinary ungrooved lancet is the best of all instruments for the performance of vaccination. It is not only readily cleaned, but it is one concerning which we can always be sure that it *is* clean. Lancets used for vaccination should be kept bright, and should never be used for any other purpose. If used for more than one vaccination at a time, they should be most carefully cleansed after each case.

(4) **Storage of lymph: Indirect vaccination.**—Vaccination should, in all cases in which it is practicable, be done direct from arm to arm. The degree of success attending the use of conveyed or stored lymph, in whatever way the conveyance or storage be effected, does not approach that of lymph thus directly transferred. Where vaccination from the arm is impracticable, lymph intended for immediate use may be conveyed from case to case, in the liquid form, by means of the vaccine bottle and other contrivances for the purpose; but it must be a quite indispensable condition of this proceeding that the lymph be used within a few hours—six to eight at the outside—of its being taken. For longer keeping it must be stored either in hermetically sealed tubes, or on points thickly coated with it, then carefully dried, and kept afterwards constantly protected from damp and heat. When stored in the latter way, the

lymph needs revival before use by dipping the point for an instant in water, and laying it on the edge of a book, so that the lymph may become soft. In the use of stored lymph the process of vaccination by scarification or abrasion is always to be preferred.

(5) **After-treatment.**—When the vaccination has been done, the parent should be cautioned against allowing the vesicle to get rubbed or mechanically injured. The case should be seen again by the day-week at least, when, if the vesicle be perfectly formed, and pursuing a regular course, the success of the vaccination may fairly be pronounced. But if the case be then retarded, it should be seen again two or three days afterwards; or if there be anything abnormal in the appearance of the vesicle, the case should be watched unfailingly throughout its course.

VACCINATION AS A PROTECTION AGAINST SMALL-POX.—The protection which vaccination affords against small-pox is manifested in two ways: first, by the immunity from that disease which, as a rule, it confers; secondly, by the modification which,, when immunity is not complete, it induces in the course and severity of the disease in the majority of cases. The most precise of the numerous facts which exist in proof of this are those derived from the Small-pox Hospital in London, where it has been found that, while small-pox in the unvaccinated patients runs an unmodified course in all but 2·6 per cent., its course in vaccinated patients is modified in 73 per cent.; and that while the death-rate of natural small-pox is 35·55 per cent., that of post-vaccinal small-pox is but 6 56 per cent. This latter figure, obtained from cases admitted into the Highgate Small-pox Hospital in the years 1836–1855, is lower than would be given from the experience of the Asylums Board Small-pox Hospitals during later years. The difference is due, in part, to the circumstance that Mr. Marson excluded what he called 'antecedent or superadded disease'; in part probably to the greater fatality of small-pox during more recent years, a circumstance which has also shown itself among the unvaccinated; and in part perhaps to the cases admitted to the latter hospitals belonging to a more destitute class of the community. In the Asylums Board Small-pox Hospitals, where all deaths are included, the post-vaccinal mortality has amounted to 8 per cent. The difference between 35 and 6, however, gives but a feeble idea of the protection which vaccination really affords, provided it be thoroughly done; for in nearly all the fatal cases the vaccination was found to have been of an imperfect character, and had not been done in accordance with the rules laid down above. The following table published some years ago, based on an examination of 5,000 cases, gives the results of Mr. Marson's observations, extending over twenty years:—

[illegible]	[illegible]
1. Unvaccinated	35
2. Stated to have been vaccinated but having no cicatrix . . .	23·57
3. Vaccinated:	
(*a*) Having one vaccine cicatrix	7·73
(*b*) Having two vaccine cicatrices	4·70
(*c*) Having three vaccine cicatrices	1·95
(*d*) Having four or more vaccine cicatrices	0·55
(*α*) Having well-marked cicatrices	2·52
(*β*) Having badly marked cicatrices	8·82
4. Having previously had small-pox	19

Dr. McCombie and Dr. Gayton, of the Metropolitan Asylums Board, have recorded the experience of hospital-treated cases of small-pox in London since Mr. Marson's time. Dr. McCombie's table relates to the statistics of 11,724 cases of small-pox treated in the hospitals of the Metropolitan Asylums Board during the years 1871–78. Dr. Gayton's table relates to the 10,403 cases which have been under his own observation during twenty years of public service. The facts recorded by these twc observers are entirely confirmatory of Mr. Marson's.

Dr. Russell and Dr. Barry, from the experience of the Glasgow and Sheffield hospitals respectively, have shown in a diagrammatic form the influence of vaccination in modifying the small-pox eruption.

In 1863 Dr. E. C. Seaton and Dr. (now Sir George) Buchanan showed by means of a school census of 50,000 children the relation of 'small-pox attack' to the quality of vaccination. It was recorded that of every 1,000 children having no vaccine cicatrices 360 were marked with small-pox; that of 1,000 with one vaccine cicatrix 6·8 had marks of small-pox; with two cicatrices, 2·49; with three cicatrices, 1·42; and with four or more cicatrices, 0·67.

Dr. Cory has compared the influence of good with inefficient vaccination from another standpoint. He noted the facts as to vaccination among 147 cases of persons scarred with small-pox who came under his observation at St. Thomas's Hospital and elsewhere—people all drawn from the same class of life, living under similar sanitary circumstances. In 147 cases, 83 were admittedly unvaccinated. In other words, the 5 per cent. of the unvaccinated population contributed over 56 per cent. of the persons scarred with small-pox. The average age of attack with small-pox amongst these 83 [illegible] years. On the other hand, the 95 per cent.

of the vaccinated population contributed 64 of the cases, or about 43 per cent. of the whole number; and, further classifying these cases according to the average age of attack from small-pox, this was found to be nineteen years among those who had three or four distinct vaccination marks. The difference therefore between being 'unvaccinated' or 'vaccinated successfully in four places' consists not only in a vastly diminished liability to any attack at all in the case of the latter, but also in a postponement of the age at which attack occurs amongst those who recover their susceptibility to small-pox after successful vaccination of the best kind.

To produce, then, at least four perfect vesicles, leaving four characteristic cicatrices, should be the aim of every vaccinator.

Re-vaccination.—The necessity for re-vaccination—a term the use of which should always be restricted to cases in which vaccination had already been performed *with effect*—has always been recognised in certain cases; but it is only of late years that its importance *as a practice*, after a certain period of life, has begun to be understood. (1) The cases in which later vaccination is most obviously required are those in which the effect of the first 'vaccination' has been of the irregular or spurious kind already described, from which no protection against small-pox can be assured. Circumstances must determine in the case of any particular child how soon a completer vaccination should be performed; but especial care should be taken, before proceeding to vaccinate again, to scrutinise the health of the child, and to correct anything in it which may be found amiss. The re-vaccination should be done with every precaution against failure, and therefore always, if possible, in cases of this kind, direct from the arm. If it totally fail, it will need, of course, to be repeated at intervals till some result is obtained. This result may be a complete success, but more frequently it will be only a modified success, with which, however, the practitioner will have to be content for the present. He will not fail, however, to impress the necessity for a further re-vaccination at puberty, or earlier if there be any immediate danger of small-pox. (2) When primary vaccination has been successful to a certain extent, but not to the extent desired—for example, when there have been one or two vesicles only instead of four or more, but these vesicles quite genuine—re-vaccination at puberty is of great importance, but need not, except under circumstances of immediate exposure to small-pox, be recommended earlier. (3) Following the foregoing rules, a practitioner who has to decide the question of re-vaccination in cases in which he did not himself perform or see the original vaccination, and who must therefore determine by the marks, would recommend re-vaccination as soon as practicable in cases in which the cicatrices wanted the true vaccine character, but would advise waiting when they were genuine in character and wanting only in number. (4) The systematic performance of re-vaccination at puberty is a practice, the importance of which must now be regarded as demonstrated. It is of course infinitely more important to those whose vaccination has been incomplete, than to those whose vaccination has been thorough, but even the best vaccinated derive additional security from it. When small-pox is of epidemic intensity, even the best vaccinated adults incur appreciable danger of attack; but with them the disease, if it do occur, is in the majority of cases mild and rarely fatal. Amongst re-vaccinated adults attack is rarer still and death is almost unknown. The reason why the period of puberty, or thereabouts, is fixed on as the time for the systematic performance of re-vaccination, is simply that it is only after that period that serious attacks of post-vaccinal small-pox are, as a rule, met with.

While adhering generally to the recommendations of Dr. E. C. Seaton respecting 're-vaccination at puberty,' *as a practice*, the present writer (Dr. Edward Seaton) would draw attention to the very important effects produced in this country by able sanitary administration combined with the 'systematic notification of infectious diseases.' By the help of this system, which is now very generally adopted by sanitary authorities throughout Great Britain, it should be easy, as the present writer knows from experience, for sanitary authorities to prevent the spread of small-pox. Always assuming our present system of primary vaccination to be maintained, spread of small-pox may be checked by isolation of the sick in hospitals, and by freely offering opportunities for re-vaccination of the best kind, *when and where it is most needed.* Under these conditions, re-vaccination, as a practice, may be safely left to the age of puberty, the sanitary authorities being relied upon to give special warning of danger from small-pox to persons concerned. The period of puberty is on the whole most suitable for re-vaccination, inasmuch as at later periods of life loss of valuable time may sometimes be entailed by the 'sore arm' which occasionally follows the operation.

In the case of persons going to the East or to countries where small-pox is a prevailing disease, subject to no such control as that which has been established in Jenner's country, re-vaccination should be recommended in every case except that of children under five years of age with first-rate primary vaccination marks, or that of persons who have already been successfully re-vaccinated in adult life.

Alleged Dangers of Vaccination.—The tendency of parents to refer to vaccination every disease, especially every cutaneous disease, which the child may afterwards manifest, is well known. Most of such allegations are without proof or probability—mere illustrations of *post hoc, propter hoc.* It is quite possible, indeed, that in some cases vaccination may, like teething or other irritative cause, hasten the evolution of a constitutional eruption which the child was incubating; but even this is not a common occurrence, nor is it at all within the meaning of the allegation. The only real danger which need be considered here (the danger of erysipelas having been already indicated) is that of the introduction of syphilitic infection along with the vaccine. Such an accident, though rare, is of the most serious consequence when it does occur, not only on account of the injury inflicted on individuals, but from the damage done by it to the reputation of vaccination; and every practitioner is bound to the most scrupulous observance of the precautions whereby these evils may be avoided. The precautions are (*a*) extreme care in the choice of vaccinifer; (*b*) brightness and cleanliness of lancet, with careful cleansing after each separate vaccination; (*c*) scrupulous care in opening the vesicles of the vaccinifer not to draw any blood, and not to use the lymph of any vesicle from which blood may accidentally have been drawn; and (*d*) care also not to take from lymph-vesicles in which there is an areola, and in which therefore the normal contents of the vesicle will have become mingled with the products of common inflammation.

E. C. Seaton. Edward Seaton.

VAGINA, Diseases of.—Synon.: Fr. *Maladies du Vagin*; Ger. *Krankheiten der Scheide.*

The vagina frequently participates in the morbid processes which affect the uterus and other neighbouring organs. The vaginal affection is then a matter of minor importance, and may not call for special recognition. But this organ is often the seat of independent diseases, the more important of which will now be considered.

1. **Atresia.**—Imperforate vagina is met with as a congenital or acquired malformation. *Congenital atresia* may occur alone; or it may be complicated with absence, imperfect development, or closure of the orifice of the uterus. Occasionally the vagina is bifid, and the atresia affects only one side, in which the menstrual fluid of the corresponding horn of the uterus may accumulate, producing the condition described as *hæmatokolpos lateralis.* The occlusion may, first, affect the organ in its entire length; or, secondly, for a half or third of its length, most frequently towards the lower extremity; or, thirdly, it may be simply membranous, as from a too complete hymen. The congenital atresia is usually complete, so that the passage to and from the uterus is perfectly occluded. *Acquired* or *accidental atresia*, on the other hand, may present any degree of constriction, from a slight and partial narrowing of the canal up to its total obliteration. We find it resulting, first, from sloughing after labour, when it is frequently complicated with vesical or rectal fistulæ; secondly, from sloughing after fever; thirdly, from chronic inflammations and ulcerations; fourthly, from repeated applications of caustics.

Symptoms and Diagnosis.—There are three stages at which atresia of the vagina may betray itself by symptoms. First, after puberty has set in, the patient has the usual indications that ovulation is taking place, but she suffers from *amenorrhœa.* The uterine hæmorrhage is taking place; but the extravasated blood is detained above the seat of the occlusion, and does not appear externally. Secondly, in some women *dyspareunia* (impossibility of copulation) after marriage leads to the examination which discovers the obstruction. Thirdly, in the acquired variety the difficulty is often only discovered in consequence of the *dystocia* that results from the resistance offered to the advance of the fœtal head by the constriction of the canal. The physical examination may discover, first, on abdominal palpation, a swelling in the hypogastric or inguinal region, due to the accumulation of menstrual fluid in the upper parts of the sexual canals. Secondly, on vaginal exploration being attempted, either the finger is soon arrested within the labia, or a bulging fluctuating pouch is felt. Thirdly, we then examine *per rectum* or *per vesicam* with sound or finger, or through these cavities simultaneously, combining the exploration by means of the fingers of one hand through the available openings in the pelvic floor, with pressure and palpation with the other hand above the pelvic brim. The exact seat and extent of the occlusion can thus be detected, and at the same time an estimate can be formed of the amount of accumulation that may have taken place above it.

Prognosis.—(1) Where the obstructing membrane is thin, it may give way at a menstrual period, or under a gangrenous process. (2) The sac formed by the dilated uterine or Fallopian cavities may burst, and pour its contents into the peritoneal cavity. (3) In a considerable proportion of cases early menopause comes on, and lessens the risk. (4) Patients who suffer from atresia vaginæ, even when they have been relieved by operative measures, are said to show a tendency to die of consumption.

Treatment.—In view of the dangers associated with the accumulation of menstrual fluid in the genital canal, the indication usually becomes very clear for its evacuation by perforating the obstructing tissues. But this operation has often been followed by disastrous results. Not to speak of the risks of wounding the bladder or rectum, or of setting up pelvic cellulitis, in cases where there is total absence of the vagina, and a canal needs to be tunnelled to the uterus, emptying of a hæmatometra and hæmatokolpos has been followed by death, sometimes from septicæmia, sometimes from bursting of the sac above when pressure is made on it; or dangerous inflammation has been set up in the pelvic organs. Care must be taken never to empty the sac by pressure from above, but by washing it out with a warm antiseptic fluid through an opening, which may be made under antiseptic precautions. Where the atresia has been extensive, there is a strong tendency to its repeated closure. This must be averted by making the patient wear a glass or vulcanite tube, filled with cotton wadding soaked in carbolised oil, through which the uterine cavity can be occasionally washed out until it has collapsed. This must be worn for some months, until the vaginal canal has fully cicatrised around it.

2. **Displacements.**—When the perinæum has become relaxed or lacerated, hernia of the pelvic contents is apt to occur to a greater or less extent. The descent of the uterus in such cases has commonly been regarded as their most important feature, and they have generally been described as *prolapsus uteri*. When the protrusion or herniation, however, is complete, the walls of the hernial sac are formed chiefly by the walls of the vagina, and we get the most extensive displacement, or *inversion*, of the vagina. The symptoms and treatment of this inversion belong to the history of uterine displacements. But we may have displacement of one or other of the vaginal walls as an independent mischief, or as the most prominent disturbance, in a case where the retentive power of the pelvic floor is impaired. If the anterior wall of the vagina descend, it carries with it the back wall of the bladder—*cystocele*. If the posterior vaginal wall descend, it brings with it the anterior wall of the rectum—*rectocele*.

Treatment.—The treatment of these conditions is either palliative or radical. The palliative treatment is effected by the use of astringent injections, and the application of vaginal pessaries—such as the Hodge pessary with cross bars towards its lower end. The radical treatment implies a plastic operation for repair of the relaxed or ruptured perinæum, or for producing a contraction in the displaced vaginal wall.

3. **Foreign Bodies.**—The vaginal canal is sometimes found occupied by foreign bodies. Every gynæcologist has met with cases where pessaries have been left in for years, until by their presence and pressure they began to set up ulcerative processes in the vaginal walls. Introduced at first with a useful object, and producing for a time a beneficial effect, their presence has sometimes been forgotten, until the discharges they excited have recalled attention to them. But bodies of quite another kind are sometimes met with, usually introduced by patients with onanistic propensities. Corks, pieces of wood, pomade-pots, fir-tops, dram-glasses, &c., have been met with in such cases. Portions of glass specula and of glass syringes have sometimes broken off in the hands of practitioners or patients. Ascarides and other parasites seem occasionally to make their way from the anus into the vagina.

Some of these foreign bodies are very easy of removal. Others are a source of great difficulty—those more especially which have become embedded to some extent in the vaginal walls. Thus it may become necessary to anæsthetise the patient, to lay hold of the foreign body with a polypus forceps or vulsellum, and to detach it with the fingers or with a knife from the tissues that have granulated round it, before it can be withdrawn.

4. **Inflammation.**—Synon.: *Colpitis*; *Vaginitis.*—Apart from gonorrhœal inflammation of the vagina, we may have colpitis of a non-specific character, either as a primary disease, originating in itself, or spreading to it from the neighbouring structures. The causes of inflammation commencing in the vagina are found in chills (puerperal or menstrual); injuries (as from rude use of obstetric and gynæcological instruments); prolonged presence of pessaries; excessive coition; irritants (as in cases where nitrate of silver applied to the cervix has acted on the vaginal mucosa); neoplasms; and some of the fevers. In elderly women we meet with a *colpitis senilis* or *vetularum* (Ruge), the cause of which is not easily traceable, in which the mucous membrane, especially of the upper part of the vaginal tube, sheds its epithelial covering in patches, becomes studded here and there with papillary granulations, and shows a tendency to cicatricial contractions. In other women the colpitis in its acute forms is found as a catarrh of the mucosa, attended with swelling, rapid desquamation of epithelial cells, and exudation of a serous fluid, which, mixed with the granular cells, produces a milky discharge. In the chronic forms the discharge becomes more creamy or purulent as the exudation is less copious, and there is more exfoliation of degenerated and often unripe epithelial cells; and then the surface is often thickly strewn with red papillæ, over which the epithelium is almost destroyed. The symptoms are local discomfort, and leucorrhœal discharges of various kinds; and the diagnosis is made by examination of the discharge, and exposure of the affected surface by means of the speculum.

Treatment.—The treatment in the acute stage is directed to keeping the part at rest, and using sedative injections. In the chronic forms the use of the injection or douche must be steadily persevered in. The canal must be washed out with a stream of hot water, in the last pint of which alum or some other astringent has been dissolved. Where an acute process is likely to become chronic, or in the chronic forms attended with granulations on the surface, it is well to apply with a mop or brush a solution of nitrate of silver containing half a drachm to the ounce. Frequently the use of pessaries of oxide of zinc, bismuth, or iodide of lead proves useful in cases where patients have difficulty in using the syringe or douche. In the *colpitis senilis* the distress which the patient feels from the irritating discharge is best relieved, and the unhealthy surface is most speedily brought to heal, by the application of bismuth powder, through a speculum or other tube, to the mucous membrane, after washing or wiping away the secretion; or an injection of boric acid with cocaine may be used.

5. **Injuries.**—It is principally in connexion with labour that the vaginal walls are liable to be injured. Not only in operative cases where the walls may get bruised and torn, or in tedious cases where the walls are so long compressed that they may afterwards slough and become the seat of fistulæ, but even in ordinary cases the vaginal mucous membrane is almost always fissured, or torn more or less deeply, at its lower extremity. These lacerations are mainly important because of their liability to become the channels through which septic matters are absorbed in the puerperal patient. In every case where there is a chance of infection, the canal should be syringed with a solution of creolin, or perchloride of mercury, or carbolic acid; and it is a further safe precaution to keep the raw surface dusted with a powder of several grains of starch combined with one grain of salicylic acid, or with iodoform and bismuth.

6. **Neoplasms.**—*Fibromata* affect most frequently the anterior wall of the vagina. They may be either sessile or pedunculated. They do not give rise to much distress, except from their pressure on the bladder, or from their protruding through the vulva. Extirpation affords the only cure, and in carrying out the operation care has to be taken to avoid injuring the bladder or urethra when they are seated anteriorly, and the rectum when they spring from the posterior wall. *Sarcomata*, round-celled or spindle-celled, have been in some few cases found springing from the vaginal walls. They have sometimes been described as growing from the submucous tissue; and the writer has seen them in two instances develop from the submucous tissue of the back wall. In other cases the growths arose from the mucous membrane. Early extirpation is indicated. These growths tend to recur. *Carcinoma*, more markedly even than the other neoplasms, is oftener a secondary than a primary affection in the vaginal walls. It may, however, originate in the vagina itself, running a course at least as rapid as in the uterus, and usually leading early to infiltration of the inguinal glands. It only admits of palliative treatment. *Cystomata*, like the simple solid tumours, are most frequent on the anterior wall. The contents are usually pale, and, where they have attained the size of a walnut, watery. In the smaller cysts the contents are more viscid. Some seem to result from cavities into which blood has been extravasated, and then the contents are brownish. They must be freely evacuated, and iodine or nitrate of silver applied to their lining membrane; otherwise they are apt to be re-filled.

7. **Vaginismus.**—Under this designation has been described an affection of the vaginal orifice, which is not infrequent among recently married women, and which utterly unfits the subjects of it for enduring coition. In some of them the hymen is unruptured, and there are excoriations at its base, towards the navicular fossa. More frequently the hymen has been infringed, but the lacerations have not healed, or fissures have formed at the roots of the hymeneal flaps, and a chronic inflammation is set up in the tissues, which renders them exquisitely sensitive. In such a condition any touch, even of the finger, causes intense pain, and when an attempt is made to pass through the orifice, the constrictor vaginæ and the lower fibres of the levator ani are thrown into a tenesmic state, which prolongs the suffering. The leading symptom is the distressing dyspareunia; and the diagnosis is made by the touch of the finger, supplemented by inspection. An examination can often be effected only when the patient is placed under an anæsthetic.

Treatment.—Treatment of a palliative kind may be attempted, making the patient use sitz-baths and apply emollients and sedatives. But it is far more satisfactory to have recourse to radical measures. The patient being under the influence of chloroform, the fragments of the hymen should be pared or clipped off. An incision should be made on each side of the vaginal opening towards its posterior aspect, running in a direction outwards and backwards, and passing through the whole thickness of the mucous membrane and some portion of the thickness of the constrictor muscle. The points of four fingers of the hand, gathered together and well greased, should then be passed through the dilated opening, so as fully to distend it, and produce complete relaxation of the sphincter. With due care the bleeding is trifling; the wound heals kindly; and undue contraction is prevented by making the patient wear, for half an hour or longer twice a day, a thick vaginal bougie. For a time the introduction of the bougie is resented, but the pain passes off when it is kept in position; and after a few days its passage ceases to be painful. This operation can be carried out with a very confident expectation that the dyspareunia will disappear; and if no other complication be present, the probability is that conception will ensue.

Alexander Russell Simpson.

VALENCIA, on the East Coast of Spain. — A dry, variable, mild, winter climate; and important sea-bathing station. Mean winter temperature, 57° F. Prevailing winds E. (moist), W. and S.W. (rough). *See* Climate, Treatment of Disease by.

VALS, in Ardèche, France.—Alkaline waters. *See* Mineral Waters.

VALVES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of; and Pylorus, Diseases of.

VARICELLA (dim. of *Variola*).—A synonym for chicken-pox. *See* Chicken-Pox.

VARICOCELE (*varix*, a dilated vein; and κήλη, a tumour).—Synon.: Fr. *Varicocèle*; Ger. *Krampfaderbruch.*

Definition.—A dilated, elongated, and tortuous condition of the veins of the spermatic cord, due either to increased pressure within the vessels, or to diminished resistance in the walls of the vessels and the surrounding structures.

Pathology.—The testicle, probably like other glands, receives supplies of blood varying with its activity; and the veins are numerous and tortuous, freely anastomose, are liable to intermittent compression in their passage through the inguinal canal from muscular contraction, and terminate on each side in a single vein, which, like the companion artery, is remarkable for its great length and small size. These conditions are favourable to the production of dilatation and varicosity. Diminished resistance in the walls of the vessels and surrounding structures is, however, probably the chief cause. Varicocele is so much more frequent in the left than in the right spermatic cord, and when present in both is so much larger in the left, that the inferior muscular development of the left side of the body from predominant use of the right is very possibly a predisposing cause. The termination of the left spermatic vein at right angles in the renal vein, as compared with the termination of the right vein at an acute angle in the inferior vena cava, and the relation of the left vein to the sigmoid flexure, have been suggested as possible exciting causes; but their influence, if any, must be slight.

Symptoms.—Varicocele is generally painless, but is sometimes associated with neuralgia or hyperæsthesia of the testicle. The subjects of it sometimes complain of a feeling of weight or uneasiness in the part, after standing or prolonged exercise; and in extreme cases, when the scrotum is very much relaxed, labouring men have found it a mechanical hindrance in their work. The testicle is in many cases normal, but is sometimes soft and even atrophied, but these conditions of the testicle are probably the result of other causes, and not of the varicocele. In such cases the patient is generally very hypochondriacal.

Diagnosis.—The diagnosis is easy. The veins can be readily felt, and have been aptly compared to a bag filled with worms.

Treatment.—In slight cases of varicocele no treatment is required. The use of a light truss, with pressure sufficient to take off the weight of the superincumbent column of blood from the spermatic veins, without interfering with the current of blood through the spermatic artery, has been recommended with advantage. A well-fitting suspensory bandage, cold bathing, avoidance of constipation, and tonics, will suffice for most cases; but if operative interference be requisite, the writer has found excision of the veins, with antiseptic precautions, most satisfactory. Subcutaneous ligature and division of the veins have been recommended; but the result is always uncertain, and sometimes unsuccessful.

Jeremiah McCarthy.

VARICOSE VEINS.—*See* Veins, Diseases of; and Varicocele.

VARIETIES OF DISEASE.—*See* Disease, Types and Varieties of.

VARIOLA (*varius*, spotted).—A synonym for small-pox. *See* Small-Pox.

VARIOLOID (*variola*, small-pox; and εἶδος, form).—This term has been applied to a mild form of variola, the disease being modified by previous vaccination or inoculation. *See* Small-Pox.

VEGETABLE PARASITES.—*See* Parasites.

VEGETABLE POISONS.—*See* Poisonous Food; Mushrooms, Poisoning by; and Poisons.

VEGETATIONS.—In modern pathology this term is generally applied to growths and deposits connected with the valves of the heart (*see* Heart, Inflammation of). The name is also given to excessive granulations on wounds, and to warty growths in any situation.

VEINS, Diseases of.—Synon.: Fr. *Maladies des Veines*; Ger. *Krankheiten der Adern.*

The diseases of veins will be described in the following order: (1) Inflammation; (2) Varix; (3) Hypertrophy; (4) Atrophy; (5) Degenerations; (6) Phleboliths; (7) Wounds; (8) Air in Veins; (9) Parasites; and (10) New-Growths. Neither thrombosis nor pyæmia, except in so far as they affect the vessel-walls, will be discussed here. Until late years, the term 'phlebitis' included these diseases and many others, but they have been gradually separated now (*see* Pyæmia; and Thrombosis). The subject of the entrance of air into veins is also separately considered. *See* Veins, Entrance of Air into.

1. Inflammation.—Synon.: Phlebitis; Fr. *Phlébite*; Ger. *Venenentzündung.*

Definition.—Inflammation of the coats of a vein.

Classification.—Cases of phlebitis may be classified: (1) according to the *intensity* of the inflammation—acute, subacute, or chronic; (2) according to the *result* of the inflammation—whether the formation of new tissue (plastic) or suppuration (suppurative); (3) according to the *layer of the venous wall primarily or chiefly affected*—endo-, meso-, and exo-, to which may be added as closely associated peri-phlebitis; or (4) according to the *cause* of the phlebitis, *e.g.* septic. Practically, however, we may discuss the subject under two heads, namely, *endophlebitis* and *periphlebitis.*

Ætiology.—The following are more or less well established causes of phlebitis:—

Mechanical injury.—This frequently, but not necessarily, leads to the formation of a thrombus—a further source of mechanical irritation. A wound of a vein is generally lost sight of in the injury of surrounding parts; but the degree of inflammation resulting in the vein-wall, like that in the wound at large, will depend upon whether the injury is or is not accompanied by infection with pyogenic organisms, or whether these subsequently gain access to the injured spot. The effect of chronic strain is shown in the thickening and sclerosis of the wall of a varicose vein.

The formation of a thrombus.—For the causes of this *see* Thrombosis. Here it will suffice to say that a certain unknown degree of alteration, by injury or disease, of the endothelial layer of a vein will induce the formation of a clot, and that this is favoured by slowness of the circulation and by some blood-states. The clot is an irritant, slight or intense. When the thrombus quickly clears up, and the vein becomes patent, we may presume that the changes in the vein-wall have been but slight; when the thrombus is the seat of infective softening, the wall of the vein may suppurate or necrose. Between these two extremes come the changes accompanying the 'organisation of a clot,' and the conversion of it and the vein-wall into a mass of fibrous tissue.

The existence of an inflammation in the tissues through which the vein passes.—When a periphlebitis exists, whether acute or chronic, it tends to spread to the wall of the vein, involving first the adventitia, and extending inwards until, perhaps, sufficient change of the intima is produced to cause thrombosis. The intensity of the phlebitis varies with that of the surrounding inflammation, but it does not follow that a venous wall exposed in an abscess will become the seat of abscess, nor even that it will be thrombosed, for the vein is not one with the tissue in which it lies. Still, it is not difficult for organisms in tissues round about a vein to invade the wall of the vein, to excite in it a process similar to that going on around it, and to penetrate to any thrombus which may form within it, causing it to undergo infective softening. The veins suffer in organs and parts which are the seats of chronic sclerosing processes, which extend to their external coats, causing fibroid thickening, and contraction of their lumina. Gummatous and tubercular infiltrations of veins passing through parts which are the seats of late syphilitic or tubercular lesions occur; and the degeneration of a tubercular lesion of a vein-wall may lead to discharge of the contents of the focus into the circulation, and a more or less widespread outbreak of tuberculosis.

But *syphilis* and *tubercle* may affect the walls of veins directly, giving rise to small gummata and discrete tubercles in the walls. The former lead to changes similar to those in syphilitic arteritis. Either syphilitic or tubercular inflammation may lead to sclerosis of the wall with contraction of the lumen, and, very likely, thrombosis.

A hyperplastic phlebitis is described, corresponding to endarteritis obliterans, but it is even less common, and the subendothelial thickenings are much less marked. The cause is unknown.

There is no *à priori* reason why acute inflammation excited by the presence of organisms should not start in the external and middle coats of veins, which are vascular; but there seems to be no pathological evidence of its occurrence. On the other hand, it seems probable that blood-borne germs do settle in the intima of veins in acute necrosis and in pyæmia, and induce such changes as lead to thrombosis. Again, if the changes in acute rheumatism in the non-vascular cardiac valves are not always due to organisms settling upon them, but are caused by some irritant in the blood, the vessels may be similarly affected; there is, however, nothing but theory to support this view. The recurrent phlebitis to which the gouty are liable may possibly own a pathology of this kind.

To sum up: the great causes of phlebitis are injury, the irritation of a thrombus, and the spread of inflammation from without.

Morbid Anatomy and Histology.—When a thrombus forms, contraction of the vessel-wall and uniform reddish staining of the intima occur, exactly corresponding to the clot. The inner wall presents longitudinal folds, easily obliterated by distension. More or less injection of the vasa vasorum, more or less fluid and cellular infiltration, and consequent swelling and softening of the vein-wall, ensue, in proportion as the clot is more or less irritant. If the clot soon disappears, return to the normal is easy. If the clot organises, contraction of the vein upon the clot goes on; the clot is freely infiltrated by leucocytes from the vasa vasorum, and proportionately decolorised; new vessels form; fibrous tissue develops; and wall and clot are converted into a cord of connective tissue, in which the structure of the vein may for a long time remain more or less distinct. If the clot undergoes infective softening or putrefaction, the swelling and softening of the wall reach their greatest height; hæmorrhagic points and small collections of pus may be visible to the naked eye; under the microscope the wall is densely infiltrated with white and red corpuscles; and, finally, loss of fine structure and imperfect staining may indicate death of the part. The thrombus which has undergone infective softening may thus give rise to an abscess about the vein, and may burst through the venous wall—the most favourable termination; for it may ward off rupture of the central end of the clot into the circulation, and consequent septic embolism. These changes are well seen in cases of pyæmia, and in thrombosed veins starting from septic ulcers or wounds.

Exactly the same state of matters may be produced by a septic inflammation extending from without to the venous wall, and leading to thrombosis and infective softening of the thrombus, *e.g.* in thrombosis of the petrosal and lateral sinuses in middle-ear disease.

Symptoms.—Thrombosis of a vein—generally of the leg—is usually spoken of as 'phlebitis.' The patient complains of pain in the part, either dull aching or sharp shooting; and on examination one feels a firm rounded cord, if the affected vein is superficial. The part is somewhat tender, there is usually slight œdema around the cord, and the skin over it may be slightly or markedly reddened; these symptoms being due, apparently, to thrombosis causing a phlebitis and periphlebitis. Some, however, believe that these symptoms may arise from phlebitis without thrombosis, an inflammation spreading outwards from the wall of the vein. In the case of deep veins of no great size there may be no symptoms at all to indicate the occurrence of simple thrombosis, and it is evident from what we see in superficial veins that thrombi may cause very little irritation. When the vein thrombosed is a main one, more or less widespread œdema results, but this is a symptom of thrombosis, not of phlebitis.

When the thrombus undergoes infective softening, the vein-wall and the tissues for some distance round about it become the seat of an intense inflammation, the signs of which are obvious in the case of superficial veins; and in deep veins, like the jugular, fulness and tenderness along its course may be discovered. On the other hand, nothing used to be commoner than the occurrence of pyæmia, without any symptoms to guide the surgeon to the vein which was occupied by the breaking-down clot, unless a characteristic œdema was present.

No fresh symptoms accompany the spread of inflammation to the wall of a vein passing through a focus of inflammation, unless, again, thrombosis of it occurs and induces œdema.

Formerly, when almost all wounds suppurated, the thrombi which formed in veins, cut across in operations, were frequently infected with pyogenic and septic organisms, and the veins of bones which did not collapse on section were more liable than those of soft parts to infection. The result of the infection was sometimes a continued thrombosis of the vein, with infective softening of the clot, and thus arose a progressive phlebitis and a progressive inflammation of the tissues about the inflamed vein which, perhaps, ended in abscess. On the other hand, a very similar clinical result was produced by a septic inflammation of the lymphatics around the vein, leading to abscess in their course and, perhaps, to phlebitis by extension, and thrombosis with infective softening. These two conditions, forerunners of pyæmia, went by the name of *suppurative phlebitis*, and ranked high among the septic diseases of wounds.

Prognosis.—In a simple phlebitis, not connected with a septic wound or an inflamed mucous membrane, the prognosis is good, as regards life. Serious embolism is *the* danger, but with ordinary care the probability is that the clot will completely disappear, and the vein become again pervious, or that it will become organised, and the vessels of the new connective tissue will establish a more or less complete communication between the parts above and below the obstruction. Thus œdema will be more or less completely removed. In infective phlebitis and thrombosis the prognosis is almost, if not quite, as serious as in former days.

Treatment.—In all forms of phlebitis we must ensure absolute rest by confining the patient to bed, and by fixing the whole limb between sand-bags, or by means of splints. This is essential to procure diminution of pain, and to lessen the chance of breaking off a fragment of the clot, whereby fatal embolism might be caused. Glycerine and belladonna smeared on the part, and hot fomentations or linseed poultices are by far the most agreeable and soothing application. When abscesses form, they should be incised and dressed with fomentations wrung out of hot 1·2000 perchloride of mercury lotion. Any œdema or general thickening that may remain must be combated by Martin's elastic bandages and regular massage, after all danger of embolism is over. Medicines, except those given to support the patient's strength, such as bark and ammonia and the like, are not indicated. Opium is given only to allay pain, and the less the drug is used for that purpose the better. The treatment of peri-, suppurative, or diffuse phlebitis is to be conducted at first on the same principles; but the further treatment is discussed under PYÆMIA. *See* PYÆMIA; and THROMBOSIS.

2. Varicose Veins.—SYNON.: Varix; Phlebectasis; Fr. *Varice*; Ger. *Krampfader*.

DEFINITION.—Veins which are dilated and out of proportion to the quantity of blood which should pass through them: wherefore the current in them is slowed.

ÆTIOLOGY.—It is conceivable (1) that a wall of a vein may yield under normal intravenous pressure; (2) that it may be dilated by increased intravenous pressure; or (3) that it may be dragged open. The last cause is probably at work when dilated veins are found traversing cicatricial tissue—*e.g.* in an organising thrombus—but it is of little importance as compared with the others mentioned.

(1) Although varicose veins are not inherited, the tendency to them appears to be hereditary. The walls of any given vein vary markedly in strength in different individuals, and at different spots in the same individual. Saboroff has demonstrated these variations in strength and thickness of wall for the saphenous system. Weakness of venous walls may probably be acquired. Although we have no very certain knowledge about it, it is probable that from impaired circulation in a part malnutrition and degeneration of the walls of the veins in it will result, and that this degeneration will chiefly affect the contractile element, the loss of which is not compensated by increase in the inelastic, non-contractile fibrous element. Again, small varicose veins are common on mucosæ which are the seats of chronic catarrh, but their ætiology is complex. It is well known that under conditions of fatigue and exposure to heat, especially in air containing much moisture, the superficial veins dilate and form prominent objects on the surface; also, that in some persons this effect of 'relaxing' conditions is felt much sooner than in others. Thus a temporary weakness of the venous walls is produced; and if the conditions of life bring about this effect frequently, normal intravenous pressure may lead to permanent dilatation of veins—those which are weakest congenitally or owing to degeneration of muscle yielding first.

The 'normal intravenous pressure' is the sum or difference of the driving force of the heart, the aspirating force of the thorax, and of gravity. These may coincide in their action, or gravity may oppose the other two, and does so especially in the lower limbs and lower parts of the trunk, where the veins are thicker walled in proportion to the strain which they have to bear. The effect of gravity on a vein-wall is proportionate to the height of the column of blood in the vein, and is therefore greater in the lower limbs of tall than of short people; its effect is constant as long as the height of the column of blood in the vein and the lumen of the vein are unaltered. Retardation of flow, due to diminished driving force, diminishes the intravenous pressure; but when due to obstruction to venous return, it is accompanied by rise of pressure. But the element of *time* is a most important one in considering the dilating action of the normal pressure. No tissue in the body is able to bear, continuously or repeatedly, for long periods the maximum strain which it is capable of bearing without at once yielding. The more perfectly contractile, the more perfectly elastic it is, the longer will it withstand such trials; but, sooner or later, it will fail to recover perfectly—that is, permanent dilatation will begin. The veins are neither highly muscular nor elastic, yet they may recover from considerable and repeated dilatation, lasting even for months, as we see frequently in childbearing women.

The withdrawal of support which is usual may lead to dilatation of veins under normal pressure; thus a lax sphincter may encourage the development of piles.

(2) That heart and lung disease may cause accumulation of blood in the veins, and that these, especially the abdominal veins, dilate to accommodate it, is certain; but such general obstructions to the venous return are not causes of varix. There seems some reason to doubt the correctness of the view, held by many, that cirrhosis of the liver is a direct cause of piles. When a main venous trunk becomes thrombosed or is compressed by the gravid uterus, full rectum, aneurysm, tumour, &c., dilatation of its tributaries and œdema may result; or a collateral circulation may open up through neighbouring veins, the walls of which may simply hypertrophy; or certain veins may become varicose. As Saboroff says, the vein behaves in response to increased pressure like the bladder or heart; at first the muscle-cells hypertrophy, and then, if new vasa vasorum are developed and fuller nourishment is granted, the adventitia increases in strength; but if nourishment fails, the vein atrophies and dilates progressively. In aneurysmal varix

and varicose aneurysm intravenous pressure is approximated to arterial; the veins dilate and thicken greatly. It is believed by many that frequent and powerful muscular contractions, and the accompanying great affluxus of blood to the muscles, lead to the throwing into the veins of quantities of blood larger than they can accommodate, and thus to their permanent dilatation. Even the effect of long standing on the leg-veins has been explained thus, the calf-muscles being specially active; this, at least, seems very doubtful. Walking, short of excessive fatigue, probably promotes the nourishment of all tissues in the leg; but when it and such exercises as cycling are carried to excess—that is, to great fatigue—they may, perhaps, lead to dilatation of veins.

Anatomical Characters.—The principal seats of varix are the lower extremities; the body, when collateral circulation is set up as the result of blocking of the venous trunks; the rectum (*see* Hæmorrhoids); the spermatic plexus (*see* Varicocele); and the ovarian veins. But almost all veins have occasionally been found varicose—large and small, deep and superficial, a single vein or venule or almost all in the body.

The following changes occur in the development of a varicose vein:—

(*a*) Simple dilatation of a vein occurs when unusual strain is thrown on its walls.

(*b*) If the strain endures, and increased blood-supply is sent to the vein-wall, hypertrophy of the muscle-cells in the middle coat, and hyperplasia of the connective tissue in all the coats ensues. So far the vein is merely hypertrophied in proportion to the demands made upon it.

(*c*) Should the excessive strain continue, the vessel yields in all directions, becoming wider and longer, but not regularly: thus it becomes tortuous and irregular in its outline and calibre. Its wall is abnormally thick at some spots, very thin at others, especially in the neighbourhood of valves and towards the free surface.

The valves, too, become hypertrophied, and for a time perform their function; but by-and-by they fail to span the widening stream, and waste to fibrous cords. In the sac-like or spindle-formed dilatations behind the valves the blood frequently coagulates, and the thrombus may remain small and parietal, occasionally calcifying (phlebolith), or may grow and become obstructing. *See* Ulcer and Ulceration.

(*d*) A sac-like dilatation of the vein, as it approaches the surface, may by its pressure cause thinning of the superficial tissues; and these, together with its own walls, may finally rupture.

(*e*) The tissues round a varicose vein may appear normal, are frequently slightly œdematous, or hard and fibroid, and perhaps there is evidence of shrinking of the new fibrous tissue. In this dense tissue the veins seem to lie in definite channels. The explanation is that the circulation is slow in proportion to the dilatation of the veins, and the tissues are under-nourished, yet are kept soaked in a transudate of poor quality, which leads to thickening of the connective tissue. Such tissues offer little resistance to the causes—especially infective—of inflammation. Thus spontaneously, or as the result of injury or of rupture of a vein, ulcers but little prone to heal develop. *See* Ulcer and Ulceration.

Symptoms.—It is not until veins are seen or felt to be varicose that the disease can be known to exist. When first seen, a small part of a superficial vein, usually about the calf or ankle, looks slightly more bluish and larger than usual. This may disappear for some time—only, however, to recur; and by-and-by the condition will become permanent, and may spread to other veins. There may be no pain with very large veins; but patches of very small varices are often very painful—probably from pressure on nerve-endings.

A limb may be somewhat swollen, and pit on pressure; or it may be hard from fibroid thickening. Here and there saccules may cause localised soft prominences; and signs of old or present inflammation are common. Ulcers often form in connexion with varicose veins.

When a varicose vein bursts, hæmorrhage is likely to be excessive, more blood pouring from the upper than from the lower end of the vessel, the valves between the rupture and the heart being incompetent.

Diagnosis.—Varicose veins are unmistakable in their appearance as usually found. A saccular dilatation of the internal saphena vein, just below Poupart's ligament, has been mistaken for a femoral hernia; but there is no excuse for the error unless the sac be thrombosed, when the diagnosis from irreducible hernia may be impossible.

Prognosis.—The dangers of varicose veins are: Ulceration; thrombosis; phlebitis, simple or infective; embolism; rupture, and hæmorrhage. Much relief can be given by treatment, but cure can hardly be spoken of except in limited cases.

Treatment.—The treatment in any particular instance is to remove the cause of the veins becoming varicose, if possible. The circulation in the dilated vessel must then be encouraged, by obtaining a good cardiac and vascular tone; by support of the vein; and by particular attention to dietary and hygienic rules for some time. The vein is best supported by an elastic stocking, or by Martin's elastic bandage, or by a carefully applied roller-bandage. To help the venous return, the patient when sitting should have the feet raised on another chair, and at night should sleep with the lower end of the bed slightly raised. Cold-water bathing, followed by firm rubbing with a towel upwards towards the heart, is useful. Rules of treatment such as these are no doubt beneficial but, unfortunately, are but seldom curative.

The cases in which it is considered justifiable to operate are (1) when the vein gives rise to pain and inconvenience; (2) when hæmorrhage threatens; (3) when ulceration threatens or is present; (4) when a patient wishes to enter the public services.

The operation usually practised in this country is that of excising between double ligatures a few bits of the varicose trunks and branches, choosing such portions as will best interrupt all circulation through them; the unused vessels then waste. The little wounds almost always heal by first intention. The operation is easily done under cocaine, either in the leg or in the spermatic cord. Embolism is the danger, but rarely occurs. Other veins may dilate sooner or later after the operation.

3. **Hypertrophy of Walls.**—This takes place when extra work is thrown on the walls of the vessel, and is accompanied by increased blood-supply. *See* 2. Varicose Veins.

4. **Atrophy.**—When from any cause a vein, or part of a vein, falls into disuse, as after an amputation, its calibre diminishes, and its coats atrophy, until it finally disappears.

5. **Degeneration.** — Degenerations in veins are probably similar to those occurring in arteries; but less is known about them. Calcareous plates are found at times in the saphena veins, inferior vena cava, and uterine veins.

6. **Phleboliths.**—Phleboliths, or venous calculi, tend to form in veins in which circulation is slow, as in the veins of the prostate and bladder, and in varicose veins anywhere. They commence no doubt as precipitated fibrin, which becomes infiltrated with the less soluble salts of the blood—chiefly phosphate of calcium, and in less quantity the sulphate of calcium and sulphate of potassium. Phleboliths are harmless, and require no treatment.

7. **Wounds, and Process of Healing.** *Wounds.*—When a healthy superficial vein is wounded, dark venous blood flows in a uniform stream from the distal end; in the case of a varicose vein the blood flows from both ends, but chiefly from the cardiac. At the same time a quantity of blood escapes into the subcutaneous areolar tissue and around the sheath of the vein. When a deep vein is wounded with a breach of surface, dark, scarcely fluid, blood oozes and trickles away. When a deep vein is torn by a broken bone, without breach of surface, the part around swells, and becomes dark in colour; œdema occurs around and below the torn vein; and the fate of the limb will vary with the amount of the extravasation and the importance of the wounded vein.

Healing process.—When gentle pressure is applied over the wound a'ter venesection, and the limb is kept at rest, union takes place in a few days, so that no scar even can be found in the injured vein. The coats of a vein contract and retract only to a slight extent within the sheath, but still sufficiently to help in the arrest of the hæmorrhage and the formation of the clot. The extravasated blood coagulates, extends through the opening in the vein, and projects like a button into the blood-stream. The whole coagulum now contracts; the part projecting into the vein becomes organised; and finally it helps to close the wound. The vessel may not become obstructed, or, if it does, is soon opened up again. Instead of this favourable ending, there may arise, from excess of movement or inflammation, numerous troubles, such as complete obstruction of the vein, phlebitis leading to thrombosis and the dispersion of emboli, local suppuration, inflammation of the lymphatics, or pyæmia.

TREATMENT. Hæmorrhage from a superficial vein is readily arrested by pressure over the wound, and elevation of the limb. In the event of persistent hæmorrhage occurring from a deep vein after the employment of pressure and elevation, the vessel must be cut down upon and ligatured. When a large vein is pricked, and bleeds, the margins of the opening in the vein may be seized with a forceps, and tied with catgut; a larger opening, even in the inferior cava, has several times been closed by suture, or by clamp forceps left on twelve to twenty-four hours.

8. **Air in Veins.**—*See* VEINS, Entrance of Air into.

9. **Parasites.**—The embryos of the Tænia and the Bilharzia hæmatobia are occasionally found in the blood of the portal vein; the latter are also found in the veins of the bladder. *See* ENTOZOA.

10. **New-Growths.** — Tumours do not originate in connexion with veins, but they often compress veins or grow into their lumina, and their cells are disseminated by the passing current. Often these protrusions cause thrombosis, local or spreading. For an account of venous nævi, *see* TUMOURS: Angiomata.

JAMES CANTLIE.
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VEINS, Entrance of Air into.—SYNON.: Fr. *Aérhémoctonie*; Ger. *Lufteintritt in die Venen.*

The fact that animals could be killed by injection of air into the veins had been known since the middle of the seventeenth century, but the first case of spontaneous entry of air in man was not recorded till 1707, by Merz. After that time numerous observations were made on animals by Nysten, Bichat, Magendie, and others, in order to ascertain the cause of death, and the conditions under which it occurred. In the present century the subject has been investigated by Amussat, Erichsen, Pirogoff, Bouillaud, Brek, Panum, Fischer, and many others.

Anatomical Characters. — The air is found in the right auricle, often greatly distending it. In the whole right side of the heart it is usual to find a frothy mixture of blood and air. Bubbles of air are also found in the pulmonary artery, even in some cases in the smaller subdivisions.

Pathology.—The result of the investigations respecting the entrance of air into veins may be summed up briefly as follows:—

1. **Amount of Air necessary to Cause Death.**—This varies with the size of the animal experimented on, and the mode of injection of the air. A small animal requires a smaller amount of air to cause death than a large one. If slowly injected, enormous quantities may be pumped into the veins with impunity; while a quantity sufficient to fill the auricle, injected suddenly, is certainly fatal. Recovery may take place after the occurrence of very serious symptoms, and on the other hand death may occur after an interval of some hours or even days.

2. **Causes of the Spontaneous Entry of Air into a Wounded Vein.**—In inspiration, the diminished pressure within the thorax causes just the same tendency for the blood in the large veins at the root of the neck and the axilla to rush into the right auricle, as there is for the air to enter the lungs by the trachea. This aspiratory force does not extend beyond the veins mentioned, and the region in which they lie is often called 'the dangerous region.' If the vein be completely divided, its lax walls fall together, and thus offer a valve-like resistance to the entrance of air; but if in any way the opening be kept patent, air will rush in at each inspiration. The opening may be kept patent by a diseased condition of the walls of the vein, as when it passes through a tumour, or is embedded in inflammatory products; or the surgeon may pull open a half-divided vein by traction on the parts he may be removing; or the aperture may be circular, as when a small piece is cut out of the wall of the vein, or a branch is cut off close to the main trunk. The external jugular, if divided low in the neck, remains open, on account of its connexion with the cervical fascia. Gas formed in the uterus, as the result of decomposition of clots left in its cavity after labour, is said in some rare cases to have got up sufficient pressure to force its way in at the open mouths of the placental veins, and thus cause death.

Symptoms.—As the air enters the opening, it gives rise to a noise variously described as hissing, whistling, or lapping. If the patient be not under the influence of an anæsthetic, he cries out that he is dying, or makes use of some expression indicative of great distress. He becomes immediately pale and faint. There is intense anxiety, and the most severe dyspnœa. The dyspnœa is purely cardiac in origin, the air entering the lungs freely, with violent and hurried inspirations. The sense of want of breath is due to an interruption of the flow of blood through the lungs. The pupils are usually widely dilated. Although the patient is pale and faint, the action of the heart may at first be felt through the chest-walls to be violent and irregular, and it is said that on auscultation a peculiar churning sound may be heard. The pulse rapidly becomes weak. Convulsions have occurred in some cases, of a tetanic character; in some instances violent coughing has also been noted. If a large quantity of air has entered, death may be almost instantaneous. If a small quantity only has been sucked in, the patient may recover, occasionally after some hours or days of distress; and occasionally a fatal termination may take place a considerable time after the accident. Greene (*Amer. Journ. of the Med. Sciences*, xciii. p. 38) has collected 68 cases. Amongst these 24 died almost immediately; others died from three hours to seven days after the accident. In the cases that survived some days bronchitis supervened, and possibly the entrance of air may not have been the real cause of death.

There can be no doubt that death results from arrest of the pulmonary circulation. It is not from paralysis of the heart, as some have said, for the cardiac action continues long after the air has entered. The heart is constructed to pump onwards a fluid which, like all other fluids, is incompressible. If the right ventricle be filled with air, or a frothy mixture of air and blood, a considerable part of the force of its contraction will be wasted in merely compressing the air instead of driving it on. This, however, is but a small factor in the arrest of the circulation; the chief cause being that the air, or frothy mixture of blood and air, fails to work the valves. For the pulmonary valves to act, it is necessary that the artery should be filled and its coats stretched; but here we have the vessel only partly filled, and that with an elastic gas instead of an incompressible fluid. Its coats are but slightly stretched, and the valves probably lie flat against them, and are not closed by the current of air or froth regurgitating after the ventricular contraction has ceased. The tricuspid valve probably also fails to act. The want of blood in the lungs causes the sense of dyspnœa; and the flow through the lungs having ceased, the left side of the heart will become empty, and, no blood reaching the brain, faintness, followed quickly by death, naturally occurs. Supposing the patient to recover, the air which may have got into the circulation is absorbed by the blood.

Treatment.—The accidental entrance of air into the veins must be prevented by careful operating. If a vein can be seen to be in danger it is advisable to compress it on the proximal side. If it is necessary to divide it, a double ligature must first be applied. If the symptoms described should appear, a finger must be at once placed upon the wounded vein. The indications then are: (1) To get the air out of the auricle; (2) To fill the auricle with blood; (3) To keep up a supply of blood to the brain. To empty the auricle, the finger must be kept on the opening in the vein during inspiration, but removed during expiration, and at the same time the chest should be forcibly compressed. By these means frothy blood and air may be made to escape in considerable quantities from the opening. This is recorded as having occurred during the violent expiratory efforts of coughing that sometimes accompany this accident. To try to suck out the air by means of a tube inserted (as has been recommended) into the right jugular vein, would probably only ensure the patient's death. The auricle may be filled with blood by applying friction to the limbs in an upward direction. In order to ensure the flow to the brain of what little blood may be leaving the left side of the heart, it has been recommended to compress the abdominal aorta and the subclavian arteries. The veins being uncompressed can empty themselves into the auricle, which thus may be filled with sufficient blood to work the valves, and so restore the circulation. Should the respiration fail, it is advisable to try artificial respiration; but if the case reaches that stage, there can be but little hope of recovery, as it is not want of air in the lungs that causes death, but want of blood in the pulmonary vessels. Those who are interested in the subject will find references to the literature in Fischer's lecture, 'Ueber die Gefahren des Lufteintritts in die Venen während einer Operation,' *Volkmanns Sammlung klinischer Vorträge*, Series iv. No. 113.

MARCUS BECK.

VENEREAL DISEASES.—A common term for all forms of contagious disease usually contracted and transmitted by impure sexual intercourse. There are three principal kinds of venereal disease: namely, *gonorrhœa*, *syphilis*, and the *local venereal sore*, or *chancre*. *See* GONORRHŒA; SYPHILIS; and VENEREAL SORE.

VENEREAL SORE.—SYNON.: Local, Soft, Non-infecting Chancre or Sore; Fr. *Chancre Mou*; Ger. *Weicher Schanker*. The ambiguous term 'chancroid,' has been adopted by many American authors.

DEFINITION.—A virulent, local, contagious ulcer, communicable by contact of its pus with a breach of surface.

ÆTIOLOGY.—The ætiology of the local chancre is still a subject of dispute. Those who are known as *unicists* maintain that it is connected with syphilis. Others believe that it may be caused by the products of simple inflammation. But although the nature of the contagium is not yet established, the opinion which is most in accord with the present state of our knowledge on the subject is that the local chancre is due to a virus distinct from that of syphilis; that it never gives rise to any special constitutional symptoms; and that its effects are limited to the neighbourhood of the sore itself, and the nearest lymphatic glands.

Contagion.—The local chancre, like syphilis, may be communicated by direct or by mediate contagion; but it is of course never transmitted by inheritance. Syphilis is not infrequently conveyed in various ways independent of sexual intercourse (*see* SYPHILIS). The local chancre, on the other hand, is very rarely other than a venereal disorder; chiefly because, not being part of a general disease, it does not give rise to contagious lesions on distant parts of the body.

This disease, like syphilis, may be conveyed from one person to a third, through the medium of one whose cutaneous or mucous surface happens to be intact, and who thus escapes inoculation. One attack of the local chancre, unlike syphilis, affords no protection for the future.

DESCRIPTION.—When chancrous pus is inoculated artificially, the puncture within twenty-four hours becomes surrounded by a faint red blush; on the second day the redness extends, and the site of inoculation becomes swollen. On the third day a vesicle appears, and rapidly becomes a pustule. About the fifth day the pustule bursts, leaving a circular ulcer with well-defined, sharply cut edges, surrounded by a pink areola. The surface of the ulcer is uneven and spongy; the discharge is pus of a dirty yellow colour; and as time goes on the borders may become irregular and undermined.

When due to venereal contagion, the local chancre usually comes under observation as an ulcer which resembles that produced by experimental inoculation more or less closely, according to the circumstances of the particular case. The vesicle or pustule is rarely seen in practice, and in some cases the surface of the ulcer is raised above the surrounding parts by the development of prominent granulations; hence the term 'fungating sore,' or *chancre végétante* of French writers.

The base of the local chancre is supple, unless inflammation be present, in which case there is more or less thickening of the surrounding parts. The discharge is readily and repeatedly auto-inoculable; hence a plurality of sores is very common.

The *seat* of chancre is nearly always the genital organs or their immediate neighbourhood. A primary sore on the body of the penis is much more likely to be syphilitic than local.

The *form* and *aspect* of the chancre vary in some degree according to its position. Thus in the furrow behind the glans penis, the sore may be elongated; about the frænum, in the folds of mucous membrane around the anus, and about the female genitals it is often fissure-like. Again, when exposed to the air and neglected, it may become covered by a scab. If chancrous pus gain entrance to a follicle (*follicular chancre*) the latter may become distended, and temporarily simulate a small abscess.

As regards *size*, chancres rarely exceed half an inch in diameter, unless two or more run together, in which case they form a large irregular ulcer. Such confluent chancres are more common in women.

COURSE, DURATION, AND TERMINATIONS.—When a typical chancre is allowed to run its course, it lasts from four to eight weeks. This course is divided into three stages: (1) an increasing, (2) a stationary, and (3) a healing stage. The length of each is liable to vary from many causes. Roughly speaking, however, it may be said that the first period, during which the sore sensibly increases in size, occupies from a week to a fortnight; that the second lasts about a fortnight; and that at the end of from three to five weeks the stage of repair is reached.

By appropriate treatment the duration can be greatly shortened, but it is also influenced by the position of the sore. Thus, at the orifice of the prepuce or urethra, the irritation of the urine retards healing, and phimosis acts in a similar manner. Chancres of the frænum, again, often continue to spread until they have perforated or destroyed it. In fact, the more mobile and exposed to irritation the part, and the greater the difficulty of keeping the dressings in place, the longer will be the duration of the sore.

If the syphilitic poison have been inoculated as well as chancrous pus, the course of events will remain uninfluenced until the incubation-period of syphilis has elapsed; when, if the sore be still unhealed, it will gradually change in appearance by the development of induration at its base, until finally it assumes the characters of the initial manifestation (*see* SYPHILIS). If, on the other hand, the local sore has healed before the end of the period of incubation proper to syphilis, the scar will become indurated, and erosion or ulceration will probably, though not necessarily, follow.

COMPLICATIONS.—The less serious complications of the local chancre include *inflammation, phimosis*, and *paraphimosis*. These do not call for description here.

Phagedæna.—This graver complication of chancre may be either acute or chronic; and may attack the original sore, or the consecutive bubo, or both.

In a typical case of *acute sloughing phagedæna* the patient is usually much depressed. He soon becomes feverish, with a dry, brown tongue, quick pulse, and other signs of constitutional disturbance. The discharge from the sore diminishes; and is thin, sanious and shreddy, and very offensive. The margins of the ulcer are puffy and livid at first, but soon become black and ragged, presenting a 'gnawed' appearance. As the process goes on, the dead tissues separate in sloughs, which vary in size according to the rapidity of the destruction. In the worst cases necrosis is very rapid, and attended by severe pain. The whole of the genital organs in either sex may thus be destroyed; while, if the groin be the seat of phagedæna, the great vessels and nerves are quickly exposed at the bottom of a deep ragged cavity. If the process be not soon checked, death may occur from hæmorrhage, from exhaustion, or from some acute intercurrent inflammation.

The above description applies to a form of phagedæna which is now fortunately rare; but less severe examples, ranging in various degrees between that described and those where a sore simply becomes inclined to spread, looks unhealthy, and has 'gnawed' edges, are common enough in venereal practice.

In the *chronic form* of phagedæna the morbid process is much less active, and is not usually attended by much pain or constitutional disturbance. The sore spreads gradually, but the tendency is rather to extend widely and superficially than deeply. The groin is the most usual seat of the ulceration, whence it may extend upwards along the abdominal wall or down the thigh, laying bare the deep fascia, and dissecting out the superficial vessels and nerves. It often also undermines the skin extensively before destroying it; hence the loose and irregular margins of the ulcer are detached from the deeper parts for a considerable distance. The duration of this form of ulceration is very variable. It sometimes lasts for years; at one time appearing to be stationary, while at other times it spreads in one direction and heals in another. In such cases the patient's health suffers more or less severely, and finally he may become exhausted by the constant and prolonged irritation and discharge. If he recover, he may be permanently crippled by the contraction of the resulting cicatrices.

Bubo.—This complication, which is much less frequent in women than in men, is said to occur in about one-third of the total number of cases of chancre. Buboes may be either *simple* or *virulent*, the former being most common.

Simple or *sympathetic bubo* arises from ordinary irritation, and is similar to that caused by simple irritation of any other kind.

Virulent (*chancrous*) *bubo* may be due to the inoculation of a simple one by chancrous pus, or to matter conveyed from the sore by the lymphatics to the gland.

Bubon d'emblée.—This term has been applied to a variety of bubo, believed by some authors to result from the absorption of chancrous pus without the production of any lesion at the point of inoculation. The existence of such a bubo is not established beyond doubt. *See* BUBO, VENEREAL.

Lymphangitis.—This, like bubo, may be simple or virulent, but is a less frequent complication of the local chancre. Bubo of either kind may, and frequently does, exist without any perceptible change in the lymphatics leading to it; but when the vessels are affected, the glands are usually inflamed also. The thickened lymphatics can be felt as tender and often irregular cords, and their course is generally marked out by red streaks along the surface.

Simple lymphangitis may end in resolution, or one or more abscesses may form along the course of the vessel. The virulent form probably always proceeds to suppuration, and the resulting sore becomes chancrous in every respect similar to the original one.

DIAGNOSIS.—The local chancre is recognised by the characters which have been already mentioned, and which are recapitulated in the following table, where also they are contrasted with those of the initial manifestation of syphilis.

Local Chancre.	*Initial Manifestation of Syphilis.*
1. A local and nearly always venereal disorder, produced by the pus of a similar ulcer.	1. The first sign of a general and not necessarily venereal disease; it may be produced by the secretion of any syphilitic lesion, or by the blood during the earlier stages of the disease.
2. No period of incubation. Irritation begins within a few hours after contagion.	2. Always a period of incubation, which averages 24 days.
3. Begins as a pustule which soon bursts, leaving an excavated ulcer with sharply cut, loose, often undermined edges, and an irregular spongy floor of a dirty yellow colour.	3. Begins as a slightly elevated papule. Ulceration may be absent throughout. Edges raised, adherent, and rounded. Surface smooth and often of a ham-red colour.
4. Base supple unless inflamed, in which case it becomes firm like that of a boil; the firmness is diffused, resistant to the touch, ill-defined, and fades gradually into the surrounding tissues.	4. Base more or less indurated. The hardness is sharply circumscribed, somewhat elastic to the touch, and independent of acute inflammatory action; it varies much in amount, being sometimes superficial and scanty, and feeling like a thin layer of parchment or paper; sometimes abundant, and feeling like a mass of cartilage.
5. Discharge abundant, purulent, and freely inoculable through many generations, on the bearer as well as on others.	5. Discharge scanty, serous, and not readily auto-inoculable.
6. Inoculability on certain animals possible.	6. Inoculability on animals doubtful.
7. Usually multiple.	7. Usually single.
8. Very rarely seen far away from the genital organs.	8. Not very infrequent on the lip or finger, and on the breast in women.
9. Course acute, and often attended by pain or soreness.	9. Course chronic. Pain generally absent.
10. Duration greatly influenced by local treatment.	10. Duration usually depends on general specific treatment.
11. Inflammation and phagedæna not very uncommon.	11. Inflammation and phagedæna rare.
12. Glands remain unaffected or become acutely inflamed. Suppuration common. Bubo may be simple or virulent. Only one or two glands suffer.	12. Adenopathy constant, indolent, and generally multiple. Suppuration rare.
13. Never causes general infection of the system.	13. Is followed by constitutional symptoms.
14. Repeated attacks common.	14. A second attack rare.

While the characters given in the foregoing table are amply sufficient for the diagnosis of the two lesions in uncomplicated cases, it must be mentioned that the appearance of either sore may be altered in various ways, for example, by neglect of cleanliness, or by the application of irritants. Thus the local chancre, especially about the margin of the prepuce, may develop an amount of inflammatory thickening which cannot for a time be distinguished from that produced by similar causes in the syphilitic initial lesion; for the specific induration may become masked by inflammation. In such cases a positive diagnosis must be postponed until the irritation has subsided. Again, even if a patient present himself with a typical local chancre, it is of course not certain that the syphilitic poison has not been imbibed as well; and the incubation-period of syphilis must be allowed to elapse before the patient can be assured that his trouble is only local. Further, as regards the two most characteristic signs of primary syphilis, namely, induration of the base of the sore, and indolent multiple enlargement of the nearest lymphatic glands, one or other may be ill-marked, or in rare instances even absent, or at least inappreciable. Then, as regards number—the initial lesion of syphilis may be multiple if several places happen to be inoculated, as in the case of herpes for example; and the local chancre may be single, especially in persons of careful and cleanly habits. Inflammatory action also may mask the usually separate indolent glands of syphilis; but, apart from this, sometimes only one or two glands can be felt in the groins. This is most often the case when the glands have been spoiled by previous inflammation. Absence of enlargement also appears to be sometimes due to the pressure of a truss. In very fat people, again, the glands cannot always be felt.

Thus, in making a diagnosis, not one but all of the signs that may be present, together with the history of the case, must be taken into consideration; and if the diagnosis still remains doubtful, the case must be watched until conclusive evidence is forthcoming.

Auto-inoculation is sometimes of service in diagnosis, but in the present instance would not be of much value; for even if a typical local chancre were the result, syphilis could not be excluded until the incubation-period had elapsed. Care is always necessary in interpreting the results of inoculation; for though it may be reasonably concluded that an active sore the discharge from which is not auto-inoculable is not a local chancre, yet the converse by no means always holds good. It must be remembered that matter from various lesions, under certain conditions, becomes inoculable on the bearer. The important point is not that inoculation produces something, but the character of the lesion which it produces.

When an immediate diagnosis is imperative, *confrontation*, or comparison of the patient with the source of his disease, may set the question at rest; but many precautions are necessary in drawing conclusions from such evidence.

Ulcerating syphilides, especially mucous patches of the female genitals, occasionally resemble chancres, but the presence or history of other signs of syphilis would lead to a correct diagnosis.

Gummata about the genital region, in both sexes, after breaking down, leave ulcers which sometimes resemble local chancres, but which as a rule are not auto-inoculable.

Besides syphilitic affections, there are a few others which require to be mentioned in connexion with the diagnosis of the local chancre. *Herpes* is characterised by vesicles or small superficial erosions on an inflamed area. Itching or smarting also often precedes an attack of herpes, and there is frequently a history of previous attacks, which, again, are often independent of any suspicious sexual exposure, and are liable to recur at regular intervals, or in connexion with digestive disturbance. Herpes also usually disappears in a few days under measures of simple cleanliness.

Abrasions are irregular in form, are usually noticed by the patient at the time of their production or very soon afterwards, and heal readily in a few days if they are not irritated. Both herpes and abrasions, however, as well as the erosions due to balanoposthitis, may, under irritation of various kinds, become suppurating and inflamed ulcers, which for a time it is difficult to distinguish from chancres.

When phimosis prevents exposure of the parts, a discharge from beneath the prepuce may be due to several other causes besides the local chancre, for example, syphilis, gonorrhœa, balanitis, or warts. If the local chancre be present, its site is usually indicated by the presence of a tender spot in that situation, and pressure often causes a slight oozing of blood. Consecutive sores also quickly appear at the margin of the prepuce. In the case of *syphilis*, the presence of induration, and the multiple indolent enlargement of the inguinal glands, will usually render the diagnosis clear. In *gonorrhœa*, soreness of the deeper urethra, scalding during micturition, the presence of chordee and other signs of urethritis, and the absence of localised tenderness beneath the swollen prepuce, are points that will usually determine the nature of the case. In *balanitis* there will be an absence of circumscribed tenderness and of signs of urethritis. *Warts* can be felt through the prepuce, and a portion of the growth can usually be seen by putting the parts on the stretch. A small speculum is sometimes of use for diagnostic purposes in cases of phimosis.

PROGNOSIS.—The prognosis of the uncomplicated chancre is always favourable. If any complication arise, the prognosis will depend upon its nature and severity.

TREATMENT.—The treatment of chancre consists chiefly in the employment of local remedies. The general treatment at the same time is directed, on ordinary principles, to the maintenance of the patient's health, by tonics, regulation of the diet, moderation in, or abstinence from, alcohol, and as much rest as possible, in order to diminish the risk of complications.

A local chancre of only a few days' duration can generally be destroyed by one thorough application of heat or caustic. The advantages of such a mode of procedure are that (*a*) consecutive inoculation, and consequently multiplicity of sores, is prevented; (*b*) the risk of bubo and of other complications is diminished; and (*c*) the duration is shortened.

When the surface is large, or when the sores are numerous, destructive measures should only be employed when milder ones have failed.

The thermo-cautery is the most convenient form of actual cautery; but for small sores, caustics usually suffice, and are less alarming to the patient; strong nitric acid, and the mixture of charcoal and sulphuric acid commonly known as 'Ricord's paste,' are the most suitable forms. Nitrate of silver should not be used for this purpose, because, while probably not strong enough to destroy the virus, it causes pain and irritation, as well as inflammatory hardness, which is sometimes sufficiently extensive to interfere with the diagnosis of the case. Before using either caustic or cautery the following points should be borne in mind: (1) No sore should ever be cauterised unless *the whole* of the diseased surface can be acted on. (2) The surrounding parts must be thoroughly cleansed and disinfected.

From a purely therapeutic point of view, however, destructive measures are at the present time not often required; and as regards the prevention of syphilis, supposing the virus of that disease to have been inoculated, the results of observation so far seem to give but little hope of success.

In nearly all cases the best application is iodoform, of which the *powdered* crystals may be sprinkled on the sore by means of a quill, or applied with a moistened camel's-hair brush twice or thrice daily, according to the amount of discharge. The sore should then be covered with a piece of lint or wool, and if the dressing cannot be kept in place by the natural conformation of the parts, a narrow strip of bandage or plaster should be applied. Iodoform may also be applied as an ointment with vaseline, or with glycerine, or an ethereal solution may be painted on the part, a thin coating of iodoform being left after the evaporation of the ether.

If iodoform is not used, powdered boric acid, or salol, or a lotion of carbolic acid, sulphate of zinc, or lead, may be applied, according to the state of the ulcer. Whatever dressing is employed, care must be taken to change it frequently, to prevent the urine from coming in contact with it, and to arrange it so that opposed surfaces are kept apart. Chancres with phimosis must be treated by frequent injections, with a syringe having a long nozzle, of a lotion of carbolic acid (1 in 40), or of boric acid and glycerine. Any of the sores that are within reach should be dressed with iodoform, and a piece of absorbent wool placed within the preputial orifice.

Treatment of Complications.—Inflamed chancres should be treated by keeping the patient at rest, on simple diet; by the administration of a purge; and by the application of lead and opium lotion or some other soothing dressing. In phimosis, if the swelling is so great as to prevent the use of the syringe, or if sloughing is threatened, the prepuce must be slit up or removed altogether, and the case treated according to the directions given for the treatment of phagedæna.

If in paraphimosis the prepuce be naturally too narrow, or if strangulation occur, reduction should be effected.

Phagedæna.—On the first appearance of signs of acute phagedæna, the affected part should be immersed for nine or ten hours a day in water at a temperature of about 98° F. This can be easily accomplished by keeping the patient in a hip bath, and alternately adding and removing small quantities of water, so that the requisite temperature is maintained. Care must of course be taken to protect the patient from cold, by placing the bath in a warm room, and by wrapping the exposed parts of the body in blankets. This plan succeeded well at the Male Lock Hospital;[1] and if it be adopted at an early period the sore often becomes healthy in a few days; immersion, however, should always be continued for at least a day or two after this has occurred, to guard against relapse. The patient may generally be allowed to go to bed during the night, iodoform or some other suitable dressing being applied; but if the diseased action continue to extend, the duration of the bath must be prolonged, or even be made continuous; but in that case, as well as in the cases where the groin is the seat of the disease, a full-sized bath in which the patient can lie down will be necessary. In all cases the whole of the diseased surface must be fully exposed and thoroughly submerged.

If iodoform and immersion fail, or if immersion cannot be properly carried out, a lotion of tartarated iron (10 to 60 grains to the ounce) with extract of opium, or a saturated solution of permanganate of potassium, should be tried.

If milder measures fail to arrest the phagedænic action, the sore may be cauterised. If the surface is large, the actual cautery will be more likely to succeed than chemical agents.

Hæmorrhage from a phagedænic sore should always be checked as soon as possible. If the bleeding is slight the surface should be cleaned, and pellets of cotton wool, soaked in solution of persulphate of iron, pressed on each bleeding spot, and retained in position by a bandage applied as tightly as the patient can bear. In severe cases the actual cautery may be necessary; and in extreme instances ligature of the larger arterial trunks above the seat of disease may be required.

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[1] See *Lancet*, May 21, [illegible]

The general treatment of phagedæna consists in the administration of good food, tonics, and opium in sufficient quantity to relieve pain, but under the immersion plan of treatment pain usually quickly ceases, and little or no opium is required. Fresh air and good ventilation are also most important.

The treatment of chronic phagedæna is similar to that of the acute form, but of course more time is allowed for the trial of palliative measures before having recourse to the cautery.

For the treatment of simple bubo, *see* BUBO, VENEREAL.

The management of the *virulent bubo*, after evacuation of the pus, differs in no respect from that of the local chancre, which has been described; and the treatment already recommended for phagedæna applies equally to that morbid process, as a complication of the local chancre, of bubo, or of syphilitic ulcers, whether primary, secondary, or tertiary; but in the case of syphilis the administration of mercury or iodine or both, according to circumstances, forms an important element in the management. In fact, in every case of obstinate phagedæna, especially of the chronic form, most careful search should be made for signs or a history of syphilis; for, if that taint be present, it not infrequently happens that all local applications fail until the constitutional malady is attacked.

ARTHUR COOPER.

VENESECTION (*vena*, a vein; and *secto*, I cut).—SYNON.: Bleeding; Bloodletting.—Abstraction of blood by opening a vein. *See* BLOOD, Abstraction of.

VENOM, Effects of: VENOMOUS ANIMALS.—SYNON.: Fr. *Animaux Vénéneux*; Ger. *Giftige Thiere.*

DEFINITION.—Animals which possess the power of secreting and ejecting a poison, which, when inoculated in man or other animals, produces toxic or even fatal effects.

Venomous animals are found in many classes of the animal kingdom.

1. **Reptilia.**—Reptilia furnish the most numerous and important kinds of venomous animals, and these are limited almost entirely to the order *Ophidia* or snakes.

The statement that no *lizard* is poisonous, is not strictly correct. The heloderm (*Heloderma suspectum*) of Mexico possesses venomous properties, destructive to small animals, and injurious to man himself.

DESCRIPTION.—The poison-apparatus of a snake consists of a composite racemose gland, situated in the temporal region, secreting a clear, slightly viscid fluid, which is poured through a duct into a grooved fang situated on a movable maxillary bone

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes.

Snake-poison is very deadly; more active in some snakes, quantity for quantity, than in others; and varying in activity in the same species or individual, according to season, temperature, and state of health. It acts most rapidly when injected into the blood; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the conjunctiva, the stomach, and the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity; and sucking a snake-bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is probably small. It may be noted here that the poison of viperine forms differs considerably from the colubrine. They both contain active principles, two of which, according to Drs. Weir Mitchell and Reichert, are proteids, one belonging to globulins, the other to proteins; they attribute the difference of the physiological effects produced by different species to the varying proportions of these bodies. Analysis has shown the poison to be very nearly like albumen in composition. It is most active on warm-blooded creatures. Poisonous snakes are very insensible to the venom of other poisonous snakes, and absolutely so to that of their own species.

EFFECTS.—The action of the poison is *local* and *general.*

The *local* effects of snake-bite comprise pain; partial paralysis of the bitten part; ecchymosis; swelling; and, if death does not rapidly follow, infiltration of other and distant parts, cellulitis, and sloughing.

Associated with these local effects are many severe *general* phenomena, such as depression, fainting, nausea, hurried respiration, vomiting, exhaustion, hæmorrhagic discharges, lethargy, loss of coördinating power, paralysis, loss of consciousness, relaxation of sphincters, coma, and convulsions. If the quantity of poison injected be small or its nature feeble, the earlier symptoms may give way, and recovery take place.

Snake-poison acts by paralysing the nerve-centres, or sometimes the peripheral distribution of the nerves; and by altering the constitution of the blood. It takes effect through the circulation; and if inserted into a large vessel, such as the jugular, humeral, axillary or other large vein, it will cause almost instant death, the heart's action stopping in systolic spasm. The respiratory centres, the spinal cord, the peripheral nerve-distribution, may all be affected. In ordinary cases death seems to take place by arrest of the respiration, the heart's action continuing for some time after apparent death. The muscular fibre itself would appear in some cases to have its contractility impaired or destroyed. The poison also acts septically, producing at a later period sloughing and hæmorrhage.

There are certain points of difference in the action of viperine and colubrine venom. In the former there is greater tendency to hæmorrhage, extravasation, and fluidity of the blood; in the latter, the effect seems to be more directly upon the nervous system, the blood being less affected than in the viperine. Experiments on animals show that, generally, after death from cobra-poisoning the blood coagulates firmly, whilst after death from viper-poisoning the blood remains permanently fluid. In most cases of death in man the blood has been found fluid even after cobra-poisoning.

Prognosis.—In cases of moderate severity, remedies, with careful nursing and tending, may prove successful; but where the bite has been thoroughly effected by the ophiophagus, cobra, daboia, echis, rattlesnake, craspedocephalus, cerastes, and others, the prognosis is very unfavourable; in no case, however, should efforts be relaxed until the last.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The great shock or depression which follows a snake-bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and, if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks from those of the poison-fangs. There are exceptions to this rule, however; a few innocent snakes have the anterior maxillary teeth developed like poison-fangs, but bites from them are not very likely to occur.

It may be well to note some of the characters that distinguish the venomous snakes, such as the form and arrangement of the teeth; an examination of the wound will often reveal the true character of the bite, and serve to indicate a correct prognosis. On opening the mouth of a venomous colubrine snake, such as *naja* or *bungarus*, two slightly movable fangs will be observed, one on either side, as well as several loose reserve fangs in various stages of development; and close behind them there may be seen one or two smaller teeth. There is no row of teeth along the outer side of the mouth, but a double row of palatine teeth will be found on either side. In the viperine and crotaline snakes, a large fang only is found on either side, and a palatine row as in the colubrine. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, several loose reserve fangs will be found in various stages of development, one of which takes the place of the ordinary fang when it is shed, by becoming ankylosed to the maxillary bone. In *hydrophidæ* the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them. The circumstances under which a bite is inflicted will generally help to indicate the kind of snake.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones. But, as before stated, there are certain innocent snakes that have long anterior maxillary teeth, which might cause doubt as to the nature of the bite.

Treatment.—There is reason to believe that the numerous agents that have been recommended from the earliest times as antidotes of snake-poison are useless, and have no such properties as those ascribed to them.

The rational treatment of snake-poisoning is to endeavour to prevent the entry of the virus into the circulation; to neutralise it in the wound before it is absorbed; to support the failing nervous force if it have entered; and to favour its elimination.

The application of a tight ligature between the bite and the heart, and the immediate excision or destruction of the bitten spot, by cautery or caustic, are essential; and other local measures may appear necessary. The injection of a 5 to 10 per cent. solution of permanganate of potassium into the bitten part has for its object the neutralising of the poison retained there by the ligature, and there is reason to believe that this is sometimes effected. The ligature may then be removed, thus obviating the risk of gangrene in the part below the constriction.

The constitutional treatment requires that the strength should be supported by stimulants, such as alcohol and ammonia. Next, if the respiration be failing, artificial respiration should be resorted to. Elimination should be promoted by stimulating diuretics. The patient should be kept warm; and must not exhaust himself by walking about. Ammonia has always held a high place among remedies in snake-poisoning. Its injection into the veins has been warmly advocated in Australia, and is said to have met with success there, which it certainly had not in India.

Dr. Mueller in Australia strongly advocates the injection of strychnine in repeated doses, and cases are cited which seem to confirm its utility; but there is not yet sufficient evidence to warrant the certainty of its efficacy.

2. **Amphibia.**—None of the amphibia are known to possess a poison-apparatus like that of ophidia; but toads and salamanders secrete a fluid in glands along the back.

connected with the integument, which yields an actively venomous principle, capable of causing local irritation, and, when injected into the blood, death, preceded by symptoms indicating action on the cerebro-spinal nerve-centres. Dogs seizing the toad, *Bufo vulgaris*, are known to suffer from swelling of the lips and salivation; and a case of death was related in France, in 1865, of a child in whom an abrasion of the hand came in contact with the secretion of a toad; death was preceded by vertigo, vomiting, and fainting. When this poison is injected into guinea-pigs, small birds, and other animals, violent symptoms and death soon follow. It is a viscid, milky fluid, with a slightly yellow tint and peculiar odour; it is exuded, and may be pressed, from glands behind the orbits. Zalesky has shown that the land and water salamanders, *S. maculatus* and *Triton cristatus*, and probably others, have also the power of secreting venom; and his experiments prove that it contains a very active principle—*salamandrine*—and that its action on the cerebro-spinal nerve-centres is energetic. It appears that these poisons, like those of ophidia, though effective on others, have no action on their own species.

3. **Pisces.**—Description.—Several fishes are provided with an apparatus consisting of a cavity at the base of, or a sac and duct leading to, a channelled spine, through which an irritating secretion is ejected. No true poison-gland, however, has as yet been certainly made out. This secretion is apparently connected with the secreting mucous system; and in certain species it produces marked symptoms of poisoning, though never to the same extent as in venomous snakes. Fish armed with sharp or serrated opercular or fin spines can inflict severe injuries, liable to cause great pain, and to be followed by the grave symptoms attributable to the lacerated or punctured nature of the wounds; and these may be aggravated by the irritating nature of the mucus with which they are contaminated. In several, however, in addition to the spine, there is a distinct receptacle in connexion with it, either in the form of a sac or duct such as in the *thalassophryne*, or in a cavity in the spine itself, as in the *trachinus* or weever.

In the case of others, such as the sting-rays, which may produce severe wounds by their pointed and serrated spines, there is no distinct receptacle for the poisons in connexion with them. Whilst it is well known that many spiny fish are capable of inflicting wounds that are dangerous from their lacerated and punctured character, it is recognised that others increase the danger by the inoculation of an irritating fluid, as just stated.

Effects.—The effect of fish-poison is to produce severe burning pain at and beyond the injured part, and fever. The intensity, no doubt, depends upon the quantity of poison injected, and the state of health and constitution of the person at the time. The wound alone, even without the poison, is likely to be painful and severe from its punctured character.

Treatment.—Ipecacuanha, tobacco, alkalis, alum, and ammonia have all been recommended as useful local applications to allay the irritating action of such poisons. Poultices of onions, or warm applications of opium or other sedative fomentations, are likely to be useful; and prompt surgical relief, if suppuration or cellulitis occurs, is necessary to relieve tension, to evacuate pus, or give exit to sloughs.

The constitutional treatment is such as would be indicated by the condition and progress of any other inflamed punctured wound. In case of depression of the heart's action, alcohol or ammonia would be indicated. Rest, quiet, and due attention to the state of the bowels, and elimination by the skin and kidneys, with careful regulation of the diet, should be observed. *See* Post-Mortem Wounds.

4. **Mollusca.**—*Aphysia punctata*, the sea-hare, a gasteropod, is said by some to produce an irritating secretion capable of causing urtication and even severe inflammation, and of causing the hair to fall off.

5. **Arthropoda; Myriapoda**, family *Scolopendridæ.*—The centipedes possess mandibles, formed by a pair of dilated feet, joined at their origin, with perforated, hook-like points with an aperture near the apex, through which a poisonous fluid, secreted in a poison-gland, with sac and duct, is ejected when they bite, which they can severely. In the case of the larger tropical species the bite is sometimes very painful, and causes considerable local irritation, and even constitutional disturbance—fever and delirium. That of the smaller kind generally causes only local and transient irritation. Centipedes are found nearly all over the world, in Europe, Africa, America, the East and West Indies and Islands, and in the tropics generally. Those of warm climates are the largest and most dangerous.

6. **Arachnoidea.**—*Scorpionidæ* or *Pedipalps.*—Description.—Scorpions have a segmented abdomen, the last six joints of which are narrowed into a tail, terminated by a curved perforated spine or hook, with which they strike and wound. At its extremity are two small orifices, through which venom is injected from a gland-receptacle and duct at its base. Scorpions run about quickly, carrying the tail curved over the body. They live in holes in the ground, and under stones or logs of wood, in dark places. The tail is used as an offensive weapon. They seize small creatures with their palpi, and then pierce them with the sting. The venom is so active that it quickly destroys life in

these animals. Those of tropical climates are most active and poisonous. They attain to the length of from two to three, four, and six inches. The European genera are smaller and less active.

Scorpions exist in all tropical countries, but extend also into the warmer regions beyond the tropics. They are found in the East and West Indies, Ceylon, and other islands, Australia, Africa, Egypt, South of Europe, and America. There are several genera, and *Buthus afer*, *Androctonus*, and *Buthus Cæsar*, are good examples of the active kinds. *Europæus* and *Occitanus* are also venomous, but those of Europe are less active than the tropical forms.

Effects.—The effects of the sting of the scorpion and of the bite of the centipede have no doubt been exaggerated; but they may produce very painful, and in the case of the larger species, severe and serious symptoms, in their character not unlike, or even more severe than, those of the sting of the wasp, namely, pain, swelling, in some cases numbness, vertigo, nausea, vomiting, temporary loss of vision, swelling of the tongue, and fever. Death may occur in delicate or sickly subjects. The local and constitutional symptoms may be severe in persons of irritable constitution, or otherwise out of health; but generally in the case of bites of ordinary scorpions or centipedes inflicted on healthy subjects, the suffering is local and soon passes away.

Treatment.—A variety of remedies have been recommended for scorpion-poisoning. Probably the application of a ligature above the bitten part, or a cupping-glass, or suction of the wound, as in snake-bite, might be useful. Some authorities recommend that the wound should be scarified, and emollient ointments and poultices applied. Suction of the wound, and the application of salt water, vinegar, ammonia, alum, ipecacuanha, spirit of camphor, eau de Cologne, tobacco water, turpentine, tincture of iodine, alcohol, the leaves of cruciferous plants made into poultices, solutions of opium and lead, or other sedatives, will lessen pain and irritation. The use of diffusible stimulants, opiates, or other sedatives may be necessary, and such surgical interference as suppuration or cellulitis may require.

7. Arachnida. Description.—Some spiders are venomous, and certain of the larger tropical forms are capable of inflicting painful bites. The poison-apparatus of spiders consist of falces or modified mandibles or jaws, the last joint of which is a hard curved fang, with a fissure near the point; there is an elongated poison-sac and duct in which the venom is elaborated and thence transmitted to the fang, by which it is inoculated into the flesh of its prey.

Effects.—The venom of spiders is a very active principle, and apparently is capable of rapidly destroying the life of the small creatures on which the spider feeds. It also causes symptoms of poisoning in man and the lower animals. Probably all the species have some venomous secretion, but it is only the larger kinds that are obnoxious to man. It may be noted that whilst the fangs of one section of spiders move laterally, those of the Mygalidæ move vertically. There are several species. Those reputed venomous are tropical.

Lycosa tarantula is reputed to cause extraordinary symptoms. It is poisonous, but there is no reason to believe that its effects exceed a certain amount of local irritation. *See* Tarantism.

There are numerous families, genera, and species of spiders, all probably possessing an irritating fluid; but it is only in the larger kinds that they do so to any extent, and there is no very positive proof that even in tropical climates they inflict the grievous injuries ascribed to them, though the venom is very fatal to the creatures on which they prey.

The popular notions that the spider is very poisonous when swallowed, and that its web possesses medicinal properties, are probably exaggerated, if not altogether untrue. One species of red spider, however—perhaps a mite—called *coya*, in Popayan, is very poisonous; the juices of its body when crushed, coming into contact with the punctured skin, cause tumours, or even, it is said, death. This is no doubt an exaggeration, but it is probable that the juices are acrid and irritating, and it is therefore better not to crush these animals when detected on the person, but to brush or blow them away.

In India, a streak of almost erysipelatous redness of the skin coming on rapidly is often attributed to a spider. No one has defined the species; it is possible that it may be analogous to that just referred to.

Treatment.—The treatment of spider-bites is similar to that of centipedes and scorpions.

8. Acarina.—Description and Effects. Some mites have the power of causing considerable irritation by a secretion ejected on the surface, or injected into the wounds they make in their burrowing operations with claws or mouth.

The *Tetranychus autumnalis*, *Leptus autumnalis*, or Harvest Bug, is brick-red in colour, and very minute. It is bred on plants, but leaves them to fasten on animals, especially man, when it adheres firmly, and causes swelling, great irritation, and severe itching, if in numbers. The intense irritation causes fever. The symptoms are not unlike the sting of a nettle, erythema or even blistering being caused. The leptus is covered with hairs, and effects entrance into the skin with its claws, and thus gives rise to the great irritation, which is probably aggravated by some acrid excretion. These animals are found in Britain, France, and other parts of Europe; varieties of them in the tropics, for example, in Brazil, Honduras, on the Mosquito Coast, and in the West Indies. The *T. irritans* of the Mississippi valley causes great irritation in the same way.

TREATMENT.—The treatment is to extract the bug with a needle or the point of a knife, and then apply some soothing lotion.

Argas persicus, a gamosid, known also as the *Teigne de Miana*, venomous bug of Miana, is common in Persia. It is found in the houses, and it is said that its puncture produces serious symptoms, such as convulsions, delirium, and gangrene, or even death. This is an exaggeration, though probably it is true that local irritation, and perhaps some constitutional disturbance, may be caused. It is blood-red in colour, spotted with white on the back, the feet yellow. *Argas moubata*, a native of Angola, is said to have much the same properties.

The *Argas talaje* of Guatemala produces great irritation. It bites like an ordinary bug, and the punctures are followed by great irritation, swelling, and pain. It lives in holes in the bamboo walls, or such-like crevices, and issues at night to attack the sleepers.

9. **Hemiptera.**—Some of the *Geocorysæ* and *Hydrocorysæ*, or land and water bugs, have irritating properties, and also an offensive odour; they have a suctorial mouth, armed with a grooved instrument or rostrum for piercing the skin.

Cimex lectularius, the bed bug, causes much irritation, and in some persons inflammatory action in the bitten part. The effects are transient.

Notonecta and *Nepa*, common in pools of water in our islands, are also capable of inflicting a painful puncture. *Cimex nemorum* causes nearly as much pain by its puncture as the sting of a wasp. The wheel bug, *Reduvius serratus*, of the West Indies, gives an electric shock to the person it touches. St. Pierre mentions a species of bug in the Mauritius whose bite is as venomous as the sting of a scorpion. The *Benchucha*, or great black bug, of the pampas of South America, is more obnoxious, it is said, than the common bed bug.

10. **Aphaniptera.**—*Pulicidæ* or Fleas comprise several families. *Pulex irritans*, the common flea, is universal. It varies much in size and colour; some are almost black and very large, and are found on the sandy shores of the Mediterranean. There are many species, such as *P. canis*, *P. musculus*, *P. vespertilinus*, and others. *Pulex penetrans* of the West Indies and South America, known also as the jigger or chigoe, penetrates the skin, and beneath the nails, generally of the feet, causing great irritation. It will, if not extracted, deposit its ova, and thus give rise to severe irritation. The effects of the ordinary flea-bite are well known. Though the irritation of flea-bites is chiefly due to the wound, there is reason to believe that this is aggravated by the presence of some irritating secretion. No special treatment, beyond the application of ammonia, which may be useful, need be described.

11. **Diptera.**—DESCRIPTION AND EFFECTS. To this order belong the gnats, mosquitoes, pipsas, sand-flies, and gad-flies, all more or less dreaded for their bites. They have a proboscis composed of a grooved and flexible sheath, through which long, slender, sharp darts are protruded, that pierce the skin and inoculate some venomous secretion, though its nature is not known. They draw blood, and raise white lumps or swellings; some, such as the pipsa of the Cossiah Hills, India, leave a livid spot of effused blood, which gives to the sufferer the appearance of a purpuric rash. They swarm in many countries, generally near water. The principal forms are the *Culex pipiens*, *C. reptans*, *C. mosquito*, *C. laniger*, and the whame fly, *C. tabanus*. Some of these are formidable insects, and are insatiable blood-suckers. The *tsetze* or *timb*, *Glossina morsitans*, of Africa, is one of the most remarkable. The bite of this poisonous insect is almost certain death to the horse, ox, or dog; though it appears not to trouble man more than by causing slight irritation.

The female *Simulium*, or sand-fly, is irritating to man, the bite often giving rise to painful swellings. The pipsa is probably a simulium. It appears from the great irritation and the swelling that follows the puncture of most of these insects that some acrid secretion is injected into the wound. In young, full-blooded persons, especially recent arrivals in India or the tropics, the irritation caused by mosquito-bites is often so severe as to give rise to violent inflammatory symptoms, resulting in suppuration or ulceration, and even gangrene.

TREATMENT.—The application of common salt, solution of ammonia, soda, potash, lead, oil, ipecacuanha, or alum combined with opium, allays irritation in the first stage. The more violent inflammatory symptoms are amenable to ordinary surgical treatment. Camphor, pulegium, and lime-juice, applied to the skin, are all regarded as preventives.

12. **Hymenoptera.** — DESCRIPTION AND EFFECTS.—A number of species that secrete poison are found among the different families of hymenoptera, including bees, wasps, and ants. *See* STING.

They are distinguished by the presence of an ovipositor in the female, which not only is used for depositing the eggs, but as a weapon for injecting venom. It consists of two valves as a sheath, and three bristles which form a grooved sting. Through this groove the poison is injected into the wound, the ovipositor being connected with a poison-gland at its base.

Formicidæ.—Ants include *Formica smaragdina* and many others. The sting of the ant causes considerable irritation, especially if there are many. It has been suggested that formic acid is the irritating principle. There are several venomous species of ants, black and red, of various sizes. Some of the larger forms in the tropics are capable of inflicting a very painful injury. Some ants have no sting, but eject a fluid which irritates the skin.

Vespidæ.—The females and workers of the wasps and hornets are provided with a poison-sac and sting. *Vespa vulgaris* is a type of the tribe *Crabro.* It lives in communities. Its sting produces much irritation, pain, and swelling, especially when inflicted on the face, or where the cellular tissue is loose.

Apidæ.—True bees, and the *Bombidæ* or humble bees, have similar properties, their sting producing very much the same effect as that of the wasp.

Some of the parasitic *Hymenoptera* inject a poison into the wound made by their ovipositor. The best-known instance is that of the genus *Ophion.* The genus *Paripla* also injects a poison in the same way, and probably others of the *Ichneumonidæ.*

Treatment.—Many remedies of a simple nature have been recommended to allay the pain and irritation caused by the sting of the wasp and bee, such as vinegar, eau de Luce, ammonia, tobacco juice, solution of soda or potash, oil, indigo, eau de Cologne, alum, and all those recommended in scorpion-stings. In case of venomous stings, where constitutional disturbance is induced, stimulants or sedatives may be necessary; and as the sting is liable to be left in the wound, it ought to be picked out. In cases of wasp or bee stings in the mouth or throat, which may happen when children bite a peach or other fruit that conceals a wasp, severe consequences may arise from the œdema that supervenes, and extends to the glottis. An emetic is then useful. With the ordinary treatment of œdema, laryngotomy may become necessary. In other cases, should violent symptoms supervene, surgical aid may be required to relieve tension, or give exit to matter. Such untoward results, however, are happily rare.

Mutilla coccinea, a native of the warmer parts of North America, is said to produce loss of consciousness within five minutes of the infliction of its sting, life being in danger for some days afterwards.

13. **Lepidoptera.**—The majority of insects furnished with a sting, as a means of defence, belong to the Hymenoptera. It is but recently that a stinging lepidopterous insect has been found. The species is not mentioned (F. Smith). The bee moth of the Cape of Good Hope is said to defend itself with a sting. Though the majority of the perfect insects of this tribe are harmless, some of the caterpillars appear to be possessed of irritating properties, residing in the fine hairs with which they are cased, and which, being sharp and brittle, break off and remain in the skin, causing irritation mechanically; but also probably from the presence of some acrid substance concealed within the hairs. In Ceylon, a greenish hairy caterpillar, longitudinally striped, probably of the genus *Bombyx*, which frequents the leaves of *Hibiscus populneus*, alighting on the skin, causes as much irritation as the sting of a nettle. The larva of *Neæra lepida* has similar properties. It is short and broad, of a pale green, with fleshy spines on the upper surface, each of which is charged with venom that occasions acute suffering. The larvæ of *Adolia* are also armed with venomous hairs. Another, not uncommon in certain trees in the terai of the Himalaya, is a dark-coloured hairy caterpillar, which is apt to fall on people and cause intense irritation. It is known as the *Komlah*, but the moth that produces it is not known.

14. **Coleoptera.**—Several beetles have acrid secretions capable of exciting great irritation and inflammation, raising blisters, and if absorbed causing painful strangury and great urinary irritation. Such are *Mylabris Cichorii* of India, *Cantharis* or *Lytta*, or *Meloe vesicatoria*, *Lytta gigas* of Senegal, *Lytta vitata* of America, and *Lytta ruficeps* of Chili.

15. **Echinodermata.**—The long sharp pointed spines of some of the echinids are capable of inflicting painful punctured wounds, but convey no true venom. Whether, as in the case of some spiny fishes, there may be an irritating mucous secretion inoculated is uncertain.

16. **Cœlenterata.**—Some of the *Medusæ* or jelly-fish have the power of stinging. The poison-apparatus is placed in certain tubercles on the surface. These contain a collection of granules, amongst which are small vesicles. Within these corpuscles or nematocysts a spiral thread is found, which bursts out on pressure. These corpuscles are found in the mucus exuded by the creature, and to them is attributed the urticating power it possesses. There are several stinging species, some found on our own coasts, others in other seas. It is the larger forms generally that are venomous, the small ones having no effect on man. *Cyanea capillata* of our seas is a rather formidable creature, and the terror of bathers. It has a broad tawny disk, and a long train of ribbon-like streamers floating after it; it makes its way through the waters; and whatever comes in contact with these trailing trains soon writhes in torture, the effect produced being not unlike that of the nettle.

Physalia pelagica, the Portuguese man-of-war, has similar properties. It causes severe and stinging pain, extending up the limb, with feverishness, which has been known to continue for some hours, white wheals forming on the skin, as in urticaria. Several other medusæ possess these properties, and hence they have received the name of Acalephæ, or sea-nettles. The application of vinegar or olive oil is said to remove the unpleasant symptoms.

The *Actiniæ*, or sea-anemones, and the hydroid polyps, appear to possess a similar power, and are provided also with thread-cells. They cause urtication of the human skin when brought in contact with their tentacles. The *Sagartiadæ* furnish examples of sea-anemones with this property. The effects, however, of any of them are transient. In some parts of Europe the *Acalephæ* have been used therapeutically as counter-irritants, by being brought in contact with the patient immersed in a salt-water bath.

In the preceding description the writer has not attempted to treat exhaustively the subject of venomous animals, or to describe all the forms of animal life so endowed. His object has been to point out the principal forms, and to indicate generally the mode of dealing therapeutically with the effects of the venom. JOSEPH FAYRER.

VENOUS HUM.—A peculiar murmur heard on auscultation of the larger veins, especially those of the neck and chest, in anæmia, and in cases of interference with the flow of the blood through these vessels. *See* PHYSICAL EXAMINATION.

VENTNOR, in the Isle of Wight.—A mild, dry, tonic climate. Mean winter temperature for forty years, 42·43° F. Sheltered from N., N.E., and E.; exposed to S.S.E. and S.W. winds. *See* CLIMATE, Treatment of Disease by.

VENTRICLES OF THE BRAIN, Diseases of.—SYNON.: *Maladies des Ventricules du Cerveau*; Ger. *Krankheiten der Gehirnhöhlen.*—The chief morbid states of the ventricles of the brain are (1) New-growths, Degenerations, and Inflammatory changes in the *lining membrane* (ependyma) and *velum interpositum*; and (2) Accumulations of blood, pus, and serum in the *ventricular cavity.* The more important of these changes are fully described in special articles.

1. Diseases of the Lining Membrane and Velum.—In old age, and in some degenerative brain-diseases, such as general paralysis, the ependyma of the ventricles becomes *thickened.* The surface is smooth, or, in some cases, covered by minute warty granulations. Some of the latter may attain the size of a pea, and constitute small fibrous tumours. Similar changes are sometimes found when the brain has been subjected for a long time to passive congestion. In rare cases the thickened membrane has been found *calcified* in places. A few *morbid growths* have been met with in the ependyma, the most common being the granulations of tuberculosis, which have been found both on the lining membrane and the choroid plexus. The latter and the velum interpositum frequently present thickening, and undue adhesion to the ependyma. In rare cases *fatty growth* has been met with in this situation. The choroid plexus may present partial *fatty degeneration,* and frequently contains *corpora amylacea.* Aggregations of *brain-sand* are common in the choroid plexus, and occasionally occur in the lining membrane.

Cystic degeneration is the most common morbid appearance in the choroid plexus, especially in that part which is within the descending cornu. The cysts are clear, delicate, colourless, transparent, from the size of a pea downwards. They consist of delicate cells pressed together; these are simply normal cellular elements of the part which have undergone a peculiar degeneration. In some of the larger cysts, these cells have been destroyed in the centre, so that a true fluid-containing cyst remains.

Adhesions sometimes take place between contiguous surfaces of the lining membrane; these may cut off one posterior cornu from the rest of the ventricle, and it may thus be obliterated by the union of its walls.

The ventricles may undergo passive *congestion* in common with other intracranial structures, or from pressure upon the veins of Galen, which carry the blood from the velum interpositum. The latter may cause effusion of fluid into the ventricles, but its influence was formerly over-estimated. The cause which obstructs the veins is generally a growth which also hinders or prevents the escape of fluid from the third through the fourth ventricle.

Inflammation involves both the ependyma and the velum interpositum. It is rarely confined to the ventricles, still more rarely to one. Commonly it is part of a general meningitis. The ependyma and the velum are thickened and pulpy, being infiltrated with cells of new formation. The velum is always injected; the ependyma may be injected or pale. Occasionally a 'false membrane' is found upon its surface. The tissue of the brain beneath the ependyma is softened, and may be injected. The fluid in the ventricles is increased in quantity, and is turbid from pus and exudation-cells, and even (it is said) from the *débris* of nerve-fibres. The inflammation, of which this is part, is usually tubercular and fatal; but, when simple, it may pass away, the ependyma and velum remaining thickened and adherent. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular.

2. Intraventricular Accumulations. *Hæmorrhage* rarely occurs directly into the ventricles; it has resulted from the rupture of a vein by injury; but blood often enters them from within the cerebral substance, an ordinary hæmorrhage bursting into the cavity. Blood may even pass into the ventricles, from the subarachnoid space, by the passages through which it escapes. True *pus* may be found in the cavities, from the bursting into them of a cerebral abscess; and a purulent fluid may result from inflammation of the lining membrane. A slight amount of *serum* results from inflammation, but is rarely considerable, unless the escape of that secreted by the choroid plexus is prevented by the closure of the passage to the fourth ventricle or by the obliteration of the foramina in the membrane closing in the fourth ventricle, by which its cavity communicates with the subarachnoid space (Hilton) (*see* HYDROCEPHALUS). In atrophy of the brain, the fluid within the ventricles (as beneath the arachnoid) undergoes a considerable compensatory increase, which has been without reason regarded as a cause of symptoms.

Lastly, by violent commotions of the brain the septum lucidum may be *ruptured* (Wilks and Moxon).

Ventricular hæmorrhage and *Hydrocephalus* are described in special articles. *See* BRAIN, Hæmorrhage into; and HYDROCEPHALUS.

The other conditions discussed are marked by no distinctive symptoms, and call for no special treatment.

W. R. GOWERS.

VENTRICLES OF THE HEART, Diseases of. *See* HEART, Diseases of.

VERDIGRIS, Poisoning by.—*See* COPPER, Poisoning by.

VERMES (Lat. worms).—This is a term of variable import, according to the practical or scientific standpoint from which it happens to be viewed. Thus Gegenbaur includes in this group, not only the helminths or entozoa and their allies, but also a multitude of creatures of widely differing structure, as well as the annulated animals properly so-called (*Grundzüge der vergleich. Anatomie*, 1870, s. 155 *et seq.*). The late Professor Rolleston, in like manner, elevates the term so as to make it of *sub-kingdom* value in zoology. Practically, the term 'Vermes' is used as the equivalent of *Entozoa*. *See* ENTOZOA.

VERMICIDES (*vermis*, a worm; and *cædo*, I kill).—A group of anthelmintics which kill worms. *See* ANTHELMINTICS.

VERMIFUGES (*vermis*, a worm; and *fugo*, I expel).—A group of anthelmintics which expel worms, but do not necessarily kill them. *See* ANTHELMINTICS.

VERRUCA (Lat. A wart).—SYNON.: Fr. *Verrue*; Ger. *Warze*.

DEFINITION.—A wart or papillary growth from the skin.

ÆTIOLOGY.—The wart, being an aberration of growth of certain of the constituents of the skin, must necessarily result from a want of normal power within the integument; hence it is mostly found in children and elderly persons, and is less frequently met with in the adult. As children become developed by growth and their tissues acquire strength, these partial exuberant growths disappear. In young persons of feeble organisation they are sometimes thrown out like an exanthem, and yield to a constitutional treatment directed towards the improved innervation and nutrition of the tissues. Their direct relation with the nervous system is often evinced by their sudden disappearance under the influence of mental emotion, a circumstance which has led to the popular use of charms for their cure. In elderly persons they are often met with on the face, where their presence must be ascribed to debility of integument; and they are frequently associated with dirt and neglect. Briefly, warts may be said to be due to aberration of nutritive function of the skin, consequent on defective organisation and vitality.

DESCRIPTION.—Pathologically a wart is an hypertrophy or excessive growth of a small group of papillæ of the skin, forming a hard prominence of the integument. Warts vary in size, and are modified according to situation. They sometimes cover a considerable extent of surface in patches several inches in diameter, but more commonly appear as tubercles, either few in number and isolated, or numerous and in clusters. One kind, the senile wart, is remarkable for the minimum of prominence, resembling a flat, dirty-looking blotch on the skin; whilst another, as on the hands, may have a prominence of a quarter of an inch, or on the scalp of half an inch.

Warts on the hands afford the commonest illustration of verruca, as in this situation, from the greater nutritive energy of the skin and the abundance of epidermis, they are most frequent and most highly developed. When of recent growth they are convex and smooth on the surface, but when of longer standing the apex is flat, from the wearing away of the superficial cuticle, and the anatomy of the wart becomes disclosed. Then it is apparent that the wart is composed of a bundle of fibres, held together in a cylindrical form by a boundary of thickened cuticle. Each of these fibres is a vascular papilla of the skin, enclosed in a sheath of cuticle, and the collective mass forms the body of the growth. An old wart will frequently split up into several segments [illegible] lated wart, and then its construction of fibres

—*V. fibrosa*, is strikingly conspicuous. If a wart be cut through horizontally, the vascular papillæ will be cut across, and then the structure of a wart of papillæ and horny sheaths is still more evident. On the fingers, and especially the knuckles of children, the verruca is isolated and large; but it is not infrequently confluent, whilst on the back of the hands and wrists, as also on the forehead, it is often developed in crops, like an eruption; the latter, however, never attain the dimensions of the isolated warts of the fingers.

Verrucæ are generally sessile—*V. sessilis*; but on the scalp they are frequently pedunculate, and, from a peculiarity of structure, have been denominated digitate—*V. digitata.* The digitate character of the warts of the scalp is due to the lesser quantity of epidermis occurring in that region; consequently the hypertrophied papillæ are not held together by a ring of thickened cuticle as elsewhere, but, being left to themselves, shoot out from the centre like fingers; the papillæ likewise grow to a greater length, and their cylinder is swollen so that the bulk of the mass greatly exceeds that of the base from which they spring. Nevertheless, the digitate verruca must be distinguished from *V. acrochordon* and the cauliflower-shaped venereal warts. Both of these are growths of the integument, and are not restricted to the papillæ cutis alone; and thereby fall into the category of molluscum, with which, especially acrochordon, they are closely allied in pathological structure.

The normal colour of warts on the hands is a yellowish-grey, but from their roughness they are apt to retain dirt in their crevices, which gives them a brownish appearance. The flat warts of the trunk of the body and face are accompanied with the production of pigment, and their dirty colour is consequently more striking.

Diagnosis.—True idiopathic warts must be distinguished from other diseases which sometimes put on a warty appearance, especially *carcinoma* and *syphilis*. *Epithelioma* of the skin is occasionally seen as a circumscribed warty growth, but generally with adherent scabs covering superficial ulceration. These signs, together with infiltration of adjacent tissues, implication of neighbouring glands, and pain, would arouse suspicion. It must be remembered, however, that epithelioma frequently attacks a simple wart which has remained quite passive during a lifetime; rapid increase of growth with the above-mentioned symptoms would suggest the supervention of epithelioma.

Any chronic inflammatory process of the skin, especially *syphilis*, is liable to take on a papillary character. Without referring to the papillary growths of early syphilis (condylomata), which could scarcely be confounded with simple warts, on account of their position and moisture, mention may be made of the dry warty character assumed by old syphilitic lesions, especially such as have been preceded by ulceration. The history of the disease (previous ulceration, &c.), together with other concomitant symptoms of syphilis, would assist the diagnosis.

As of venereal origin, though never syphilitic, ordinary *venereal warts* must also be noted. Other names by which they have been described suggest their characters, such as 'pointed condyloma,' and 'cauliflower excrescence.' They are generally bright red in colour; and the individual papillæ are pointed. The rapidity of their growth, and the situation where they usually occur (the genitals), serve to distinguish them from verrucæ. Moreover, they most often accompany gonorrhœa, being caused by the irritating discharge.

Cadaveric warts are described under Post-Mortem Wounds.

Prognosis.—Verruca is a blemish rather than a disease, and unimportant in its relations to the general health. By an error of diagnosis we sometimes read of malignant warts; and warts have been confounded with those fleshy growths termed 'tegumentary nævi.' Moreover, in elderly persons a warty state of the skin is sometimes associated with asthenic ulceration, and occasionally with rodent ulcer, for which the depraved state of the skin, and not the wart, is responsible.

Treatment.—The best method of treating verrucæ is to touch them with some solvent agent, such as acetic acid. This acid dissolves the epidermis, and, reaching the vascular papillæ, destroys the whole structure of the wart down to its root. The pulpy mass then dries up into a scab; and when the scab falls off, the growth rarely reappears. This little operation may either be completed at one sitting, or it may be repeated daily until its purpose is effected. Where there are numerous verrucæ to be dealt with, the process is tedious, and is generally left in the hands of the patient. The writer prefers a saturated solution of caustic potash, carefully applied by means of a minute pencil of sponge fastened to the end of a stick. The alkali acts more speedily than the acetic acid, and effects a more thorough cauterisation of the vascular plexus, from which the hypertrophied papillæ derive their capillary loops. The verrucæ digitatæ of the scalp are speedily and easily removed by this process. In the exanthematous form the verrucæ are too small and too numerous for the caustic application. These may be treated by friction with sulphur ointment or tar ointment; and in this latter form the verrucæ are frequently entirely removed by a course of treatment with liquor arsenicalis, in three or four minim doses, taken immediately after meals, three times a day. Erasmus Wilson.

VERTIGO (*verto*, I turn). SYNON.: Giddiness; Dizziness; Swimming of the head; Fr. *Vertige*; Ger. *Schwindel*.

DEFINITION.—The consciousness of disordered equilibration.

PHYSIOLOGICAL RELATIONS.—To understand vertigo normal equilibration must be briefly considered. The equipoise is maintained by a sensori-motor mechanism. The coördinating centre is the cerebellum; the afferent or sensory apparatus consist of visual, tactile, muscular, and labyrinthine impressions; the efferent or motor apparatus are the muscles, chiefly those of the head, neck, spine, and lower extremities. Derangement of any part of this mechanism may lead to vertigo, by the interruption of its power of adjustment being appreciated by cortical centres. Vertigo is often associated with reeling or staggering, and is incorrectly said to cause it. Actually vertigo is the consciousness of disturbed locomotor coördination—a rudimentary disorder of coördination of locomotive movements (Hughlings Jackson), whilst reeling is an adaptive effort to preserve the equilibrium. It is quite possible that cortical centres in an unstable condition may give rise to vertigo, without there being any disease or disturbance of subordinate centres, or of peripheral impressions. Dr. C. L. Dana has recorded two cases in which vertigo and staggering occurred, associated in each case with a lesion of the temporal lobe. It is probable the migrainous vertigo is due to discharging lesions of the cortical centres concerned in the consciousness of equilibratory perceptions. A fact that supports the assertion that vertigo is a rudimentary disorder of coördination, is that when in a person, who has a sensation as if he were moving or turning in a certain direction, movements actually take place, they are always in the direction in which he previously felt he was turning when no outward movements occurred. Experimental researches and observations in disease have established the conclusion that the semicircular canals take an important share in normal equilibration; injury and disease of these parts occasioning locomotive incoördination, temporary when one side only is deranged, permanent when both sides are involved. The arrangement of the semicircular canals, and the physical principles involved in their actions, are very complicated, but have been carefully studied and explained by Flourens, Cyon, Crum-Brown, and others; and it has been demonstrated by Flourens that injury of each canal is followed by definite locomotive disturbance, causing the body to tend to fall, or actually to fall, in a definite and precise direction, forwards, backwards, or to one or other side, according to which of them is injured. The sensory impressions originating in the semicircular canals are caused by varying tension of the endolymph, communicated to the vestibular division of the auditory nerve spread out on the ampullæ of the membranous canal. Variations in labyrinthine tension may be produced by alterations in the position of the head, by differences in the vascular tension of the labyrinthine blood-vessels, and by the varying pressure in the middle chamber of the ear, induced by obstruction of the Eustachian tube, spasm of the tensor tympani muscle, and other causes; and it may also be due to disease of the labyrinth itself, or communicated to the labyrinth. Doubts have been thrown on the experimental evidence that disturbed equilibration is due to injuries to the semicircular canals by Ewald, Steiner, Böetcher, &c., and the effects have been attributed to injuries to the brain produced in the experiments. Schiff's observation that section of the auditory nerves does not cause disturbance of equilibration does not negative irritative lesions of the membranous canals giving rise to it. The fact that whilst injuries to the bony canals do not give rise to movements, injuries to the membranous canals do cause movements, is of much significance. Moreover, it is asserted that 'if the horizontal canal is laid bare, and the membranous canal opened so as to expose the endolymph, blowing gently over the opened canal with a fine glass cannula will produce a definite movement of the head, which is turned to the one side or to the other, according as the current of air drives the endolymph towards or away from the ampulla. From this it is inferred that a movement of the endolymph over, or an increased pressure of the endolymph on, the surroundings in the ampulla gives rise to afferent impulses which in some way determine the issue of efferent impulses leading to the movements of the head' (Michael Foster). In some cases of aural vertigo, the giddiness is much influenced by the position of the head, and it is only in certain positions that this symptom is produced. This is readily accounted for on the supposition that the disease causing it is in the semicircular canals, which are so arranged as to lie in the three directions of space, and change in the position must affect the pressure of the endolymph on the various ampullæ, resulting in adjustment of position when the coördinating centres are in proper working order, but when these are deranged leading to the consciousness of disordered equilibration or vertigo. As far as is known, change in position cannot in any similar manner disturb the relations of the auditory nucleus, nor the brain itself; though it must be admitted that in migraine, which is a cortical disease, alterations in position may intensify or cause vertigo. Further, the evidence supplied in a *post-mortem* examination of a case of Ménière's, where hæmorrhagic inflammatory material was found in the semicircular canals, and no disease of the brain, proves that disease of the semicircular canals *per se* may give rise to vertigo. Visual and tactile impressions are liable to be deranged in many ways, for instance, by unexpected or unusual movements, as in swinging, being at sea, &c.; by local disease of the visual and tactile apparatus; and by disease in the nerve-trunks and spinal cord, interrupting conduction from the periphery to the centre. By disturbances in visual, tactile, or labyrinthine impressions the equilibrising centre is uninformed or misinformed, and incoördination results, outwardly shown by reeling or falling, and inwardly by the sensation we call vertigo. Loss or perversion of visual or tactile sensations may be compensated for, if the two remaining sensory processes continue intact, but nothing compensates for entire loss of labyrinthine impressions (Ferrier). The vestibular nerve which is distributed to the semicircular canals is a branch of the auditory, the nucleus of which in the medulla is in close relation with that of the vagus; and thus the fact is explained that disturbances in the large area of distribution of the pneumogastric are found associated with labyrinthine disease, by propagation of the irritation from the nucleus of the auditory to that of the adjacent vagus; and conversely, the intimate association of these two nuclei enables us to understand how disease of the stomach and other viscera occasions vertigo. It must further be borne in mind that the labyrinth receives its blood-supply from the vertebral artery, which at its origin from the subclavian is in near propinquity to the inferior cervical ganglion of the sympathetic, from which it receives a rich plexus of nervous filaments. The inferior cervical ganglion also sends communicating branches to the vagus, and branches to the heart. In this double way, therefore, the labyrinth has important nervous relations with the stomach, heart, and other organs.

PATHOLOGY.—Vertigo may be excited by variations in the local or general blood-pressure, which cause variations in the labyrinthine tension, as in anæmia, gout, and other affections. It may be excited reflexly by disease of the nose (*vertigo a naso læso*, Joul), or by disease of the larynx. The symptom is also produced by certain drugs, such as quinine, salicin, and the salicylates, which may act on the labyrinth through the vascular system, as is rendered probable by the deafness and tinnitus accompanying it, but which may be due to its action on the auditory nucleus, or the cortical centres concerned in consciousness of auditory perceptions. Vertigo may be excited by sending a galvanic current through the head from one mastoid process to the other, but the exact mode of its action is not known.

Vertigo may be divided into degrees or stages, namely, (1) a feeling of confusion and instability; (2) a feeling as if objects are moving; (3) a feeling as if the individual himself is moving; and (4) actual movements of the body.

VARIETIES.—The important forms of vertigo which occur in practice will be further considered under the following heads: (1) Ocular; (2) Auditory; (3) Gastric; (4) Nervous; (5) Epileptic; (6) Migrainous; (7) with organic brain-disease; and (8) Gouty.

1. **Ocular Vertigo.** — Vertigo is frequently caused by ocular disorders, and is often mistaken for serious cerebral disease. The simplest form is in paralysis of a single muscle, as the external rectus. The vertigo is not occasioned by the diplopia, but by the incorrect notion formed of external objects by the paralysed eye, due to what is known as 'erroneous projection.' The confusion thereby produced gives rise to vertigo, and often to reeling. One of the most important varieties of ocular vertigo is that occasioned by insufficiency of the internal recti muscles—*muscular asthenopia.* This is most commonly met with in myopia. During reading, these muscles, which have long been overtaxed by exertions to maintain the convergence of the eyes rendered necessary when looking at near objects, suddenly give way under the strain; they relax, the eyeballs turn out, and the letters on the page become indistinct, run into each other or overlap, and a sense of confusion and giddiness occurs. It is usually accompanied by aching at the backs of the eyes, headache, and sometimes by nausea. Such cases are often misunderstood even by medical men. Muscular asthenopia may occur also with hypermetropia; and as a sequel to exhausting diseases, such as fevers and diphtheria. Many instances are recorded where, owing to this cause of vertigo not being recognised, serious errors of diagnosis and treatment have resulted. For the diagnosis of the particular optical defect and treatment, the reader is referred to the article VISION, Disorders of.

2. **Aural or Auditory Vertigo.**—SYNON.: *Vertigo ab Aure Læsa*; Labyrinthine Vertigo; Apoplectiform Vertigo; Menière's Disease.

Aural vertigo is very generally known by the name of Menière's disease, from the excellent description of the malady first given in 1861 by Menière, though strictly this term should be restricted to cases of an acute or apoplectiform character. Under the term 'Menière's disease' is grouped a class of cases in which vertigo is caused by perversion or abeyance of the labyrinthine function. The labyrinthine disturbance may be caused either (1) *directly* by an affection of the labyrinth, such as (*a*) hæmorrhage, (*b*) congestion and inflammation; or (2) *indirectly*, by (*a*) disease of the middle ear (otitis media), (*b*) obstruction of the Eustachian tube, (*c*) spasm of the tensor tympani, or paralysis of the stapedius, or (*d*) irritation or obstruction of the external auditory meatus, and pressure on the membrana tympani, as by cerumen, foreign bodies, or by syringing the ears, especially when the membrana tympani is perforated. Thus the labyrinthine affection may be either of an irritative or of a destructive nature, and the effect of the lesion will be exactly the reverse in the two cases (Ferrier). That is to say, whilst an irritative lesion would cause the tendency to fall in one direction, a destructive lesion of the same canal would cause a tendency to fall in the opposite direction. In Menière's disease, strictly speaking, there is always coincident disturbance in the functions of semicircular canals and cochlea, as indicated by the three most important associated symptoms—vertigo, tinnitus, and deafness. Accompanying these cardinal symptoms there are accessory phenomena, due to secondary visceral disturbance, namely, pallor, faintness, and nausea or vomiting—a condition of syncope. Dr. Buzzard has recently done good service in suggesting that in some cases of aural vertigo the lesion, often a functional one, may be in the medulla oblongata, and pointing out that a lesion of the auditory nucleus would, by the laws of peripheral perception, be referred to the terminations of the nerve in the semicircular canals or cochlea, or in both. Aural vertigo is rare in young persons, and is chiefly met with in the later half of life. It is more frequent in men than in women.

The disease makes its appearance, in a person apparently quite well, or the subject only of some chronic aural disease, with a loud noise in the ear, compared by different persons to the whistle of a steam-engine, the firing of a gun, or the roar of the ocean. When a person, as not infrequently happens after the first attack, has an habitual noise in the ear, this at the time of the attack is sometimes, but not always, greatly exaggerated. The noise, which is wholly or principally in one ear, is soon followed by the feeling of giddiness. This is generally of a high grade, causing the sensation of surrounding objects moving in some one direction, a feeling of translation of the patient's body in the same direction, or actual movements of the body. The movement, whether apparent or real, is usually *from* the side on which the ear is affected. In recurring attacks the movements, whether of objects or of the individual, are nearly always in the same direction. Usually the sensation of movement is from behind forward, or to one or the other side, or the patient has a feeling of rotation in a vertical axis. When in bed, the room, bed, and occupant are felt as if turning round and round, or rising or sinking. Accompanying the vertigo there is reeling, and the patient clings to surrounding objects for support. In some cases the movement is too rapid for the patient to obtain security in this way, and he is thrown to the ground, sometimes with such violence as to occasion serious injuries. One patient described the sensation as 'if his heels went up into the air.' When falling takes place, it is usually forwards or to one side. It is, however, to be especially remembered that, except in rare cases, there is no loss of consciousness; the patient being able immediately after the attack to describe the sensations he experienced, or even to answer questions in the attack itself. In some cases deafness, more or less complete, but sometimes transitory, follows—at an appreciable interval—the vertigo, and in some cases is altogether wanting. Following, in more or less rapid succession, the tinnitus and vertigo, there occur nausea and in most cases vomiting, accompanied by pallor of the face; the skin becomes cold and covered with a clammy sweat. In some cases oscillatory movements of the eyes are observed. It is generally asserted that objects appear to move in a direction opposite to that of the ocular movements. This is not universally true; and probably, contrary to the statements of most writers, the apparent movements of objects is in the same direction as the observed movements of the eyes. Gradually the attack passes off; the noises in the ear lessen, but deafness is left behind. The body recovers its warmth, and the pallor subsides, but vertigo and vomiting may persist for some hours or even days, both being aggravated or induced by rising from a horizontal position. Slight attacks may only last a few minutes. In cases where there is a direct lesion of the labyrinth, a certain degree of deafness—a limitation of the field of audition, that is, the loss of certain sounds in the musical scale—and tinnitus remain. The patient is in all other respects well, except for the dread of a recurrence of the attack. Occasionally, however, a certain degree of vertigo and reeling persist, liable to be aggravated by gastric derangement. The writer has known a patient who had extremely severe and typical attacks, who both previously and subsequently suffered from functional dysphagia between the attacks—a full-sized bougie could be easily passed. It was evidently due to disturbance in the vagus nucleus. A patient rarely escapes with one attack. Subsequent attacks are separated by distinct intervals, but in severe cases these may become less and less, until a permanent vertiginous state, of a most distressing character, may be reached, liable to paroxysmal exacerbations. In such very grave cases spontaneous cure may occur on the establishment of complete and permanent deafness, or relief may be obtained by therapeutical measures. When the labyrinthine disturbance is secondary to disease of some other part of the auditory apparatus, removal of the primary disease, as cerumen or tympanic catarrh, will, when practicable, promptly remove the symptoms, and the attacks may not recur.

Diagnosis.—Menière's disease has to be distinguished from epilepsy, apoplexy, gastric derangement, and other forms of vertigo. From all these it is distinguished by the almost invariable co-existence of tinnitus, deafness, and vertigo; with, in addition, a tendency to syncope and nausea, or vomiting. The concurrence of the first three symptoms renders it probable that the labyrinth is involved, a point which will be further established by testing audition with a tuning-fork and watch. The vertigo is generally of movement in a certain definite and uniform direction. There is never numbness, tingling, or any sensations analogous to an aura; but aching of the upper extremities, and discoloration of the hands, may occur, from irradiation of the irritation from the inferior cervical ganglion to the brachial plexus (Woakes). As to the diagnosis of the nature of the labyrinthine affection, whether primary or secondary, some rules have been laid down by authorities. If a person who has formerly heard well becomes suddenly deaf, or hard of hearing, with the symptoms of an apoplectic attack, and if there is at the same time an uncertain and staggering gait, but no symptoms of paralysis in the nerve-tracts, and if the examination shows a normal membrana tympani, and perfectly permeable Eustachian tube, we may believe with great probability that there is an affection of the labyrinth (Tröltsch). Deafness and tinnitus occurring without vertigo indicate an affection of the middle ear. Vertigo and tinnitus without deafness may be due to a similar affection of the middle ear. Vertigo, tinnitus, and deafness are certainly due to an affection of the labyrinth. When the vertigo is markedly influenced by changes in the position of the head, it is, in the writer's opinion, strong evidence that the disease is in the labyrinth. At the same time it is held by some authorities that in the present state of our knowledge we are not in a position to speak as to the exact seat of the lesion in cases of aural vertigo, though it must be in some part of the auditory nerve, or in the part of the brain where auditory impressions are perceived. Careful otoscopic examination should be made, the permeability of the Eustachian tubes tested, and the tuning-fork and watch employed to ascertain the condition of the conducting apparatus, before an exact opinion can be formed as to the seat and nature of the disease. Vomiting, following the ingestion of some rich or indigestible food, may be so severe and lasting as to monopolise attention, and the vertigo and tinnitus may not be complained of. In such a case, a mistake may readily occur in a first attack.

Prognosis. — Where the labyrinthine affection is due to some remediable defect, the disease will subside on removal of the cause, such as cerumen or tympanic catarrh; hence the great importance of an exact diagnosis as to the nature of the case. When the lesion is primarily of the labyrinth, a certain degree of deafness and tinnitus is nearly always left, and recurrence of the attack is to be anticipated, though some cases recover completely under treatment. In some instances the tinnitus and vertigo may cease on the patient becoming completely deaf.

Treatment.—In the attack, and for a short time following it, the recumbent position should be strictly maintained. Bromide of potassium or ammonium, in ten to twenty grains for a dose, should be administered, and small pieces of ice swallowed. Next, any gastric derangement should be corrected, for in some cases such derangement excites a paroxysm in a person predisposed to it by some aural affection, insufficient alone to induce an attack. Alkalis and vegetable bitters, with or without bismuth, will generally be useful for this purpose. Any abnormal local condition must be treated. Subsequent to the attack quinine in full doses, 3 to 5 or 10 grains three times a day, perseveringly used, is sometimes attended with the best results (Charcot). The writer has seen many cases which corroborate this statement. Gelsemium and salicylate of sodium have been found useful (Gowers). Counter-irritants, including the actual cautery, applied to the mastoid region, have proved serviceable in some cases, and may be used in addition to other measures. Threatened attacks of aural vertigo may be often avoided, especially in cases in which arterial tension is high, by a dose of calomel, and it is a good plan to give a patient liable to attacks calomel powders (gr. iij. or v.) to be always carried in the pocket-book, and order one to be placed on the tongue when any threatenings occur.

3. **Gastric Vertigo.**—Synon.: *Vertigo a Stomacho Læso.*

Vertigo, occasionally of a high grade, sometimes accompanies chronic gastric derangement. It is more common with slight than with grave affections of the stomach, but has been met with in well-marked organic disease of this organ. An explanation of its occurrence has been given in the introductory remarks. It sometimes occurs soon after a meal, but more often when the stomach is empty (Trousseau). At the same time it is now generally agreed that cases of gastric vertigo are much less common than Trousseau's description would lead one to believe. In the majority of such cases some ear-disease is revealed by careful examination. Associated with the vertigo are usually pain and a feeling of fulness in the stomach, increased by food; heartburn; eructations; vomiting; flatulence; and pain in the left hypochondrium and chest. The bowels may be torpid, or diarrhœa may be present. The patient often suddenly experiences a swimming in the head, objects may appear to revolve, the patient's gait becomes tottering, and he may even fall. Often there is constrictive headache, faintness and pallor with nausea, and sometimes troublesome vomiting, but there is no loss of consciousness. Visual hallucinations may be present, and buzzing in the ears experienced, but there is no deafness. The vertiginous symptoms may so predominate that the gastric symptoms may not be complained of; but treatment directed against dyspepsia cures the vertigo. When predisposing gastric disturbance is present, trivial causes, such as looking at objects which lead to confused visual impressions, may excite an attack, but this may also arise spontaneously. In many cases relief is obtained by the recumbent position, but attacks may occur when the patient is lying down.

Diagnosis.—This form of vertigo is diagnosed from epilepsy by absence of loss of consciousness; and from labyrinthine vertigo by the absence of deafness, and the physical signs of aural disease. It cannot be concluded that the vertigo is essentially gastric without thorough examination of the ears, for, as already stated, vertigo may be excited by gastric disturbance when there is labyrinthine affection insufficient alone to determine an attack. It must also be remembered that signs of gastric and intestinal derangement are induced in Menière's disease, and may be so prominent as to cause the aural affection to be overlooked.

4. Nervous Vertigo. — Synon.: Fr. *Vertige Nerveuse.*

Not uncommonly, vertigo is one of the most troublesome symptoms of nervous exhaustion and depression. This occurs in persons unduly taxing their nervous powers, by severe intellectual strain, especially when combined with anxiety, or by sexual excesses. It occurs also from the depressing effects of the immoderate use of tobacco, alcohol, and tea. The vertigo rarely reaches a high grade, manifesting itself by a sensation of confusion, or of objects revolving, occasionally only by the feeling of a tendency to fall. It may be associated with a slight reel, but more often the patient feels as if he were walking unsteadily, when there is no perceptible peculiarity of gait. As a rule giddiness is only experienced in the upright position, but in some cases it occurs when the subject is recumbent, and the patient often complains of sudden and violent startings when just in the act of falling asleep. It is often intensified by an elevated position, and in large buildings and assemblies. Hence it is often experienced in church. It is peculiarly distressing, owing to the sufferer's emotional equilibrium being easily disturbed, and is frequently associated with a dread of impending cerebral disease—epilepsy, apoplexy, insanity, &c. There often co-exist gastric derangement and flatulence, with irritability of the heart, palpitation, and sleeplessness. There may be slight and temporary buzzing in the ears, but deafness is absent, and loss of consciousness does not occur. In these respects it is readily distinguished from Menière's disease and *petit mal.*

Treatment.—This variety is to be treated by removal of the cause—over-work, excessive sexual indulgence, or the abuse of alcohol, tobacco, or tea; by correction of any dyspeptic symptoms; and by the administration of nervine tonics, such as iron, quinine, or strychnine. Bromides should be avoided if possible.

5. Epileptic Vertigo. — Vertigo may occur in a slight fit of epilepsy, or at the commencement of a severe attack. The symptom may replace an epileptic fit, or may co-exist with epilepsy. It is more common in epileptic vertigo for the patient to imagine that he himself is moving or turning round, than for external objects to appear in motion (Russell Reynolds). Care must be taken not to accept the patient's mere statement of 'giddiness.' The term is often loosely applied. It is necessary to ascertain his exact sensations, and only to conclude there is vertigo when actual feelings of movement are experienced. If the vertigo is related to change of position of the head, it is probably labyrinthine. The latter is not usually accompanied by loss of consciousness, and is more apt to be followed by vomiting (Gowers).

6. Migrainous Vertigo.—Vertigo commonly constitutes one of the phenomena of migraine, occurring as a rule after the disorders of sight, touch, and speech, when these form part of the seizure, and either attends or follows the development of the headache (Liveing). Vertigo sometimes replaces the attacks of migraine. It is apt to occur on change of posture, or on suddenly turning the head. As a rule, migrainous vertigo is slight in degree, but it may be quite severe, and accompanied by nausea and vomiting. It is unassociated with noises in the ear, or with deafness. *See* Megrim.

7. Vertigo in Connexion with Organic Disease of the Nervous System. Vertigo sometimes accompanies disease of the cerebrum, both acute, as apoplexy, and chronic, as a tumour. There are reasons for believing that vertigo may be excited by cortical lesions, thus explaining epileptic and migrainous vertigo. Diseases of the cerebellum and of its middle crura are often attended with reeling gait, and sometimes with vertigo. This symptom sometimes accompanies the ataxy of tabes dorsalis; and is a marked symptom of some cases of insular sclerosis.

8. Gouty Vertigo.—Vertigo, labyrinthine or other, is occasionally met with in gouty persons. It may disappear after an outburst of gouty arthritis; or be removed by alkalis, colchicum, salicylate of sodium, mercury, and other proper remedies, and attention to diet.

A peculiar form of disease has been described by Dr. Gerlier of Fernex, Switzerland, which he has called 'paralysing vertigo,' and which subsequent writers have named 'Gerlier's disease.' It consists of three groups of symptoms: (1) muscular weakness in the neck or trunk muscles and legs, and occasionally in the hands; (2) pain in the neck and occiput; (3) ocular symptoms, of which ptosis is the most common. Occasionally diplopia and amblyopia are present. Dizziness or mistiness before the eyes is often present, more rarely rotatory vertigo. The attacks usually occur about once or twice a day, and between the attacks the patient is well. The disease has only been observed in some Swiss villages on the French frontier, where the malady has received the name of *le tourniquet*. It appears to have had a kind of epidemic prevalence. Its nature is very doubtful, but appears to be a functional disturbance or psychosis. No evidence of organic disease has been present in the cases recorded.

STEPHEN MACKENZIE.

VESICAL DISEASES.—*See* BLADDER, Diseases of.

VESICANTS (*vesico*, I blister).—A class of counter-irritants which produce blisters. *See* COUNTER-IRRITANTS.

VESICLE (*vesicula*, diminutive of *vesica*, a bladder).—SYNON.: Fr. *Vésicule*; Ger. *Bläschen*.

DEFINITION.—An elevation of the corny layer of the epidermis, caused by a minute circumscribed collection of serum between it and the mucous layer beneath.

DESCRIPTION.—Vesicles may be minute or of considerable dimensions; a vesicle of the size of a millet-seed gives the name to the cutaneous affection *miliaria*. The vesicles of eczema are minute and frequently confluent; those of scabies are occasionally acuminated; the vesicles of varioloid are not uncommonly umbilicated; those of herpes iris are developed in rings; the vesicles of ordinary herpes attain the bulk of a split pea; and the vesicles of pemphigus, on account of their large size, are called 'bullæ.' The contents of a vesicle are apt to modify its name, since a vesicle containing a purulent fluid or pus is termed a 'pustule.' The ordinary course of a vesicle is to lose its fluid by evaporation, absorption, or rupture of the distended cuticle; to dry up into a thin scale; and to terminate by desquamation, without further lesion of the skin.

TREATMENT.—The treatment of vesicles is fully described under the heads of the several diseases of which they are a symptom. *See* CHICKEN-POX; HERPES; MILIARIA; and PEMPHIGUS.

ERASMUS WILSON.

VESICULAR EMPHYSEMA.—A form of emphysema of the lungs, in which the alveoli are distended with air. *See* LUNGS, Emphysema of.

VIABLE (*vie*, life).—SYNON.: Fr. *Viable*; Ger. *Lebendig*.—An epithet applied to a newly born child, to indicate its capacity for maintaining an independent existence. Viability has chiefly to be determined by the age of the fœtus, and by its condition as regards formation, health, and strength (*see* FŒTUS, Diseases of the). It has also been supposed to depend in some measure upon the season of the year in which a child is born (*see* PERIODICITY IN DISEASE). The question of viability has important medico-legal bearings, for which reference should be made to works upon forensic medicine.

VIBICES (*vibex*, a wale).—SYNON.: Fr. *Vergetures*; Ger. *Striemen*.—A term applied to patches of discolorisation on the surface of the body, somewhat resembling the marks of stripes or wales, and due to the presence of altered blood in the part. Vibices may arise either during life, as the result of a variety of causes (*see* EXTRAVASATION); or after death, as one form of cadaveric lividity or hypostasis. *See* DEATH, Signs of.

VIBRATION.—This word is sometimes employed as a synonym for fremitus. *See* FREMITUS; and PHYSICAL EXAMINATION.

VIBRIO (*vibro*, I shake).—SYNON.: Fr. *Vibrion*; Ger. *Zitterthierchen*. *See* MICRO-ORGANISMS.

VICARIOUS (*vicarius*, in place of another).—This word signifies substitution, and in physiology and pathology implies that some part or organ performs certain functions, or is morbidly affected, instead and in the place of some other part or organ, thus becoming a substitute for it. The notion of vicariousness is chiefly associated with a discharge of blood, whether physiological or morbid. Thus, it is very common to speak about *vicarious menstruation*, which is understood to mean that the discharge of blood that takes place normally from the uterus at the menstrual period, either does not occur at all, or only imperfectly, and that its place is taken by hæmorrhage from some other part, evidenced by epistaxis, hæmoptysis, hæmatemesis, or other forms of bleeding. The same idea is extended to morbid hæmorrhages, such as bleeding from piles, when this becomes habitual in an individual at frequent or regular intervals. It is supposed that bleeding may sometimes take place from other parts as a vicarious hæmorrhage, instead of from the hæmorrhoids.

Again, discharges, whether normal or morbid, as of secretions, mucus, pus, or other materials, are believed by many to exhibit a vicarious relation to each other in some instances, coming from one part while ceasing or diminishing at another, and so on. This may be illustrated by expectoration and diarrhœa in phthisis, which appear to modify each other as to their amount in some cases of this disease. Further, secretions and excretions are regarded as acting vicariously with reference to each other. Thus some of the secretions of the alimentary canal are undoubtedly capable of acting mutually as substitutes, and this may be looked upon as an instance of vicarious action; while such a connexion existing between the perspiration and urine is generally recognised.

Certain morbid conditions are also considered as having a vicarious relation. For example, congestion of or hæmorrhage from one part may take the place of congestion at another; or inflammation in one region may be the substitute for inflammation in another region.

There is probably more or less truth in these notions of vicariousness, as applied in relation to physiology and pathology. In actual practice, however, no case ought to be regarded as belonging to this category, without careful and thorough investigation. It has happened that hæmorrhages supposed to be vicarious of menstruation, have been important signs of grave diseases, such as gastric ulcer, or pulmonary phthisis. The principle may be of value in certain conditions as an indication for treatment.

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VICHY, in Allier, France.—Thermal alkaline waters. *See* MINERAL WATERS.

VIDAGO, in Portugal.—Bicarbonated alkaline waters, with lithium and arsenic. *See* MINERAL WATERS.

VIGILIA.—Wakefulness; a term formerly applied to conditions of insomnia, but now little used and almost obsolete. *See* SLEEP, Disorders of; and COMA-VIGIL.

VILLOUS GROWTH (*villus*, hair).—A growth composed of hypertrophied villi. *See* TUMOURS.

VIRGINIA SPRINGS, in Virginia, United States.—Sulphur waters. *See* MINERAL WATERS.

VIRULENT (*virus*, a poison).—Primarily this word signifies connected with virus or poison. It is generally, however, employed to indicate great intensity or malignancy of a disease; for example, *virulent inflammation, virulent bubo,* and *virulent small-pox.*

VIRUS (Lat.).—Literally this word signifies a poison, but in medical language it is used to designate any kind of contagious material. *See* CONTAGION.

VISION, Defects of.—SYNON.: Fr. *Troubles de la Vision*; Ger. *Sehenstörungen.*

Sight may be defective as to perception of *form*, of *colour*, or of *light*; and the whole, or only a part of the *visual field* may be affected. Sight is also disordered whenever *binocular single vision* becomes difficult or impossible (*see* STRABISMUS); and when *visual endurance* is impaired. The terms 'vision' and 'sight,' as commonly used, indicate acuteness of vision, and refer to the perception of form at the yellow spot. In this article disorders (A) of *perception of light*, (B) of *perception of colour*, and (C) of the *visual field*, will be shortly alluded to; but attention will be chiefly given to (D) disorders of *acuteness of vision* caused by optical defects in the eyes.

A. **Disorders of Perception of Light.**—Perception of light is equally good in all parts of the retinal area, except the most peripheral zone, which appears to be blind. Impaired perception of light causes disproportionate defect of vision by dull light—'night-blindness.' It may affect the whole field, or only its periphery. It occurs chiefly in diseases of the outer layers of the retina, especially syphilitic retinitis and retinitis pigmentosa, and sometimes in chronic glaucoma. Lowered light-sense over the whole field occasions the symptoms in the peculiar disease known as functional or endemic nyctalopia (*torpor retinæ*). The opposite condition, day-blindness with true retinal photophobia, is much rarer and more obscure. It is usually congenital, and accompanied by nystagmus, amblyopia, and colour-blindness. *See* NYCTALOPIA; and HEMERALOPIA.

B. **Colour-Blindness.**—SYNON.: *Dyschromatopsia*; *Achromatopsia*.—This, when *congenital*, is usually not related to any other defects of vision. Congenital colour-blindness occurs with greater intensity and far greater frequency in males than in females (M. about 3·5 per cent.; F. ·2 per cent. or less). It is shown by more or less want of power to distinguish between certain colours, and depends on want (complete or incomplete) of one of the three fundamental colour-sensations (red, green, violet). The spectrum seen by a red-blind person appears shorter at its red end than it does to one with normal colour-vision, and he sees in it only two chief colours. The red, orange, yellow, and green are all 'green,' the blue and violet are 'blue,' and the two are separated by a neutral or 'white' band at the part that to the normal eye is bluish-green. In green-blindness the spectrum is not shortened, but the red, orange, yellow, and green are 'yellow' of various shades, or sometimes 'red'; the neutral band is in the pure green. Violet-blindness is rare; in it the spectrum is shortened at the violet end. It is often impossible to distinguish red-blindness from green-blindness with certainty except by using the spectrum; and in ordinary examination the two forms are best grouped together as 'red-green-blindness.' In incomplete red-green-blindness, green, bluish-green, and often rose are confused with grey of corresponding shade, and red is confused with shades of brown, greenish-brown, and yellowish-brown. In a complete case full green and scarlet look identical, and dark yellows are more or less confused with them. The best test (of many) for ordinary use is the one due to Holmgren of Upsala, in which a skein of Berlin wool, of a particular colour and shade (green, rose, or red), is given to the patient, and he is required to match it with all the others which seem to him of the same or a similar colour, amongst a large bundle of skeins of many colours. He is not usually allowed to name the colours, because even the colour-blind often guess the colours of common objects correctly. A very pale, pure green is the first test used; and the colour-blind, even of slight degrees, will match with it not only other green skeins, but also shades of pale grey, buff, and pink. Slight cases may easily be overlooked, unless the wools are carefully selected, and the examiner practised. Red and green are not well seen even by the normal eye, except at the central part of the visual field (*i.e.* the field for these colours is smaller than for white); but even at the periphery these colours are recognised if very brightly lighted and of large size.

Acquired colour-blindness often comes on in degenerative or inflammatory diseases which begin in the optic nerve. It is rare in diseases of the retina, and in glaucoma. Like the congenital form, it usually concerns only, or chiefly, red and green. It may affect the whole visual field of these colours, or only certain parts, a gap, or 'scotoma,' being present, on the area of which the red and green are not perceived in their true colours. When acquired colour-blindness is well marked in the whole extent of the field, in cases of disease of the optic nerve, the prognosis for sight is generally very bad; but if it be localised on a central scotoma, even though it may there reach a high degree, the prognosis is usually good. Progressive atrophy of the optic nerve, however, occasionally reaches a very high degree without any colour-defect.

C. Disorders of the Visual Field.—The visual field is the whole surface visible to one eye singly whilst at rest. It forms a concave surface, all the points of which are equidistant from, and perpendicular to, their corresponding points on the retina. In the outward and downward part it reaches to 95° from the centre; inwards, upwards, and downwards only to about 60°. Projected on a flat surface it thus forms an oval. The centre of the field ('fixation point') corresponds to the yellow spot, and the 'blind spot' is about 15 degrees outwards from this point. In order to measure the field roughly, the patient, placed with his back to the light and covering one eye, looks steadily from a distance of eighteen inches at the nose or eye of the observer, who then moves his hand, or a small object, such as a square inch of paper, about in the different parts of the field, and notes any places where the object is invisible or badly seen. This test, carefully applied, will detect any considerable loss of the field. Or the patient may gaze at a spot on a black board about one foot off, and a piece of white chalk be moved from various places at the periphery until it comes into view; a line joining these points will form the boundary of the field. For accurate measurements a special instrument, the Perimeter, is necessary.

D. Disorders of Perception of Form. SYNON.: Acuteness of Vision; *Visus*; *V.*; Fr. *Acuité Visuelle*; Ger. *Sehschärfe*; *S.*—Perception of form is normal only when the image of the object looked at falls on the bacillary layer of the retina, at the centre of the yellow spot, is clearly defined, sufficiently bright, and of a certain minimum size.

PRINCIPLES.—The size of the image depends (1) upon the size of the 'visual angle' enclosed by the two lines drawn from the extremities of the object to the 'nodal point' just behind the crystalline lens; and (2) on the distance of the nodal point from the retina, which in the normal eye is fifteen mm. The form of any letter or character is distinguished by a properly formed and healthy eye, with average light, if it subtend a visual angle of five minutes, each of its separately distinguishable parts subtending an angle of one minute. If the nodal point be more than fifteen millimètres from the retina, the image will be larger, and the acuteness of vision therefore increased; this occurs in myopia, and also when a convex glass is held in front of the eye. The reverse is true if the distance be less than fifteen mm., as in hypermetropia and when a concave glass is held before the eye. Hence convex lenses always increase, and concave lenses always diminish, the size of the retinal images. Vision or 'fixation' is called *direct* or *central* when the image of the object looked at falls on the yellow spot; *indirect* or *excentric* when, in consequence of impairment of function at the yellow spot, an image falling on some other part is better seen. The sharpness of the image depends (opacities of the media apart) upon the retina being exactly at the focus of the refracting (dioptric) media of the eye; it is also influenced somewhat by the size of the pupil, being, *cæteris paribus*, better when the pupil is small.

Normal acuteness of vision is expressed as unity (V. or S. = 1); subnormal vision being expressed as a fraction. Various *test-types* are in use, composed of letters, words, and such like, of such a size that each subtends the minimum angle of five minutes at a certain distance. The test-types of Dr. Snellen are in most general use, and include letters visible under the standard angle at from 60 metres to ·5 metre. If No. 60 be read at 60 m., then V. = $\frac{60}{60}$ or 1; if No. 60 can only be seen at 6 m., V. = $\frac{6}{60}$; &c. V., therefore, is expressed by a fraction whose numerator is the greatest distance at which a given type can be read, and the denominator the distance at which it ought to be seen; or the fraction may be reduced ($\frac{6}{60} = \frac{1}{10}$, &c.). The acuteness probably becomes somewhat lowered in some old persons without demonstrable disease.

The principal disorders of perception of form calling for description here are as follows: (1) Functional Affections of the Optic Nervous Apparatus; (2) Abnormalities of Refraction, including Hypermetropia, Myopia, and Astigmatism; (3) Anisometropia; (4) Disorders of Accommodation; and (5) Asthenopia.

1. Functional Affections of the Optic Nervous Apparatus.—Amblyopia without ophthalmoscopic changes may be permanent or temporary, and exhibit many differences in the character of the failure of sight. Many persons see much better with one eye than the other, though the defective organ shows no sign of past or present disease. Hypermetropia, or some other form of ametropia, is often present, and is usually of higher degree in the amblyopic eye. When, as is common, squint occurs in such a person, the squinting eye is almost always the defective one; and it has been assumed that the defect was a result of the squint, and due to a purposive suppression of sight in order to avoid double vision. This kind of amblyopia is, however, seen without either squint or ametropia—a fact which, with others, renders it almost certain that the defect is usually, or chiefly, congenital. Whether the seat of deficiency is in the eye or the brain remains to be proved; but it is well to realise that this form of amblyopia can seldom be improved even by long practice. In cerebral hemianæsthesia there may be blindness, or amblyopia with contraction of the field and colour-blindness, in the eye opposite to the lesion, with a lower degree of the same condition in the other eye. Some rare cases of defective sight in one eye without changes, in which there is a history of previous paralytic symptoms, probably belong to this group. In *hemiopia* (properly *hemianopsia*) there is usually loss of the corresponding (R. or L.) halves of the visual fields, vision being lost on the side opposite to the lesion. The lesion may be in the tract, but is much more often higher up (optic thalamus or occipital lobe). Sometimes there is contraction of the remaining half field. Loss of both temporal halves indicates disease at the chiasma; neither this, nor loss of both nasal halves, is frequent. In hemiopia, even of long standing, from disease above the chiasma, the optic discs are seldom altered. In some cases of 'hemiopia' only a quarter of each field is lost. Cases of hemiopia for colours without loss of light- or form-sense are occasionally met with. Disease of the optic nerve at a distance from the eye causes blindness or defective sight, often at first without any ophthalmoscopic changes; but if the defect remain, signs either of inflammation or atrophy appear in a few weeks. The ophthalmoscopic changes may, however, be very slight; as in the common cases of central amblyopia caused by tobacco-smoking, in which disease of the optic nerves has been demonstrated, and in similar cases due to other causes, especially disseminated sclerosis.

Temporary fogginess of sight, usually with the appearance of coloured rings around a candle, occurs in the premonitory stage of glaucoma; these last from half an hour to a day or more; they do not usually occur in both eyes at once (*see* EYE, AND ITS APPENDAGES, Diseases of). Attacks of megrim are often ushered in by a peculiar transient, subjective defect of sight; a small cloud, appearing near the middle of the field, quickly spreads with a quivering movement and zigzag outline over about half the field; its borders are often brilliantly coloured; it affects *both* eyes; is equally visible whether the eyes are open or shut; lasts about a quarter of an hour; and is generally followed by the other megrim symptoms to which the patient is subject. But some persons merely complain of a 'cloudiness' or of 'spots' before their headaches (*see* MEGRIM). Brief attacks of defect or blindness of *one* eye, coming on suddenly, and recurring in the same eye, occasionally take place in relation with functional headaches; and in some of these the eye eventually remains blind with the appearances of retinal embolism.

Persons who suffer from severe neuralgic pain in the fifth nerve sometimes describe dimness of the same eye during an attack, but the opportunity of verifying the statement seldom occurs. In hysterical persons sight is sometimes much lowered, and may seem altogether lost in one or both eyes. There may be photophobia, and symptoms of accommodation-spasm, and the field is, or seems to be, highly contracted. Though it may be exceedingly difficult to say that there is conscious dissimulation, the groundless nature of the ocular symptoms is sometimes proved by the fact that acuteness of vision, even in the 'blind' eye, is at once and perfectly restored by the weakest possible lens, or by a piece of flat glass mounted to resemble a trial lens. Intentionally feigned blindness of one eye can nearly always be detected by one device or another; but pretended defect of both eyes is more difficult to expose.

2. **Abnormalities of Refraction.**—SYNON.: *Ametropia.*—These conditions are of importance by preventing the formation of clear retinal images; in addition they often make the sustained use of the eyes difficult or impossible (*asthenopia*). They include (*a*) *hypermetropia*, (*b*) *myopia*, and (*c*) *astigmatism*. The varieties of asthenopia will receive a short separate account at the end of this article. As ametropic conditions are remedied by optical aids, it will be convenient first to refer to the subject of spectacles.

Spectacles.—*Varieties of Construction and Mode of Wearing.*—Refracting spectacles are made either of crown-glass or of rock-crystal. The latter is more expensive, but harder, less breakable, and rather lighter. Ordinary spectacles are biconvex or biconcave spherical lenses. Meniscus lenses are sometimes used, and are called 'periscopic,' because they give a larger field. In 'Franklin' or 'pantoscopic' spectacles the upper half is made of a different focal length from the lower; they are sometimes used by persons who need distance and reading glasses of different strengths in the same frame. The various non-refracting protective glasses (goggles, domed glasses, horseshoe or D protectors, &c.) are generally included under the term 'spectacles.' The most important points in the mounting of spectacles are that the hinges should be strong, that the sides are long enough to hold securely without uncomfortable pressure, and that the bridge should fit the nose well. The centres of the lenses should, unless otherwise ordered, be opposite the centres of the pupils when the glasses are in use. All concave glasses and convex distance glasses should sit as close to the eyes as possible; convex reading-glasses may be put farther down the nose, and shaped to allow of looking over the top of the frame in distant vision.

For 'simple' astigmatism the correcting lens is a segment of a cylinder; for 'compound' and 'mixed' cases the effect of a cylindrical and spherical lens is required, and may be obtained either by combining two suitable cylindrical curvatures at right angles to each other, or by grinding the cylinder on the flat side of a plano-convex or -concave lens; they require, of course, to be mounted with the curvature of the cylinder exactly in the right direction. When prisms are ordered they are mounted like ordinary spectacles, and a lens may be ground upon each surface of the prism if necessary; it is not practicable to wear prisms of more than about 8°. Spherical lenses can be made to act to a varying degree as prisms, by putting them with their centres nearer to or farther from each other than the pupils.

Numbering. — Spectacle lenses are at present numbered on two different systems, namely—(1) the *inch* scale; and (2) the *metrical* scale. (1) In the old system the refractive unit is a lens of 1-inch focal length, and the inch may be English, Parisian, or other. The lenses in use being all weaker than the unit are expressed by fractions; thus the strongest in use in the trial case being a 2-inch lens is expressed as $\frac{1}{2}$ (+ or −, according as it is convex or concave); a lens of 10 inches focus is $\frac{1}{10}$; and so on. It is desirable that the series of lenses should rise by equal refraction-intervals, and here the inch scale is inconvenient because it introduces difficult fractions. (2) The inch scale has largely given place to the metrical dioptric scale, in which the measure is international, the refractive unit is a weak instead of a strong lens, and the refractive intervals are equal. The unit is a lens of 1 metre (100 cm.) focal length, and is called one *dioptre* (1 D.). Stronger lenses are written as whole numbers; thus a lens four times as strong as the unit is 4 D.; a lens equal to half the unit is ·5 D. The disadvantage of the system is that the numbers do not, as on the inch system, express the focal length of the glasses; but the latter is easily arrived at by dividing 100 by the number of the lens in dioptres; thus the focal length of 5 D. $= \frac{100}{5} = 20$ cm.

To convert a lens made by the Paris inch into its equivalent in dioptres, multiply its inch-value by 36 (1 m. = 36 Paris inches nearly); thus, $\frac{1}{36} \times 36 = 1$ D. To convert a metrical lens into its equivalent in Paris inches, divide its value in D. by 36; thus 4 D. $= \frac{4}{36} = \frac{1}{9}$.

The following are the most important equivalent numbers:—

Dioptres (D.)	Focal length in Paris inches	Dioptres (D.)	Focal length in Paris inches
·5	72	4	9
	(written $\frac{1}{72}$, &c.)	4·5	8
·75	50	5	7
1	36	6	6
1·25	30	7	5½
1·5	26	9	4
2	18	11	3½
2·5	14	13	3
3	12	15	2½
3·5	10 (nearly)	18	2

Several intermediate numbers found in the trial cases have been omitted.

The several abnormalities of refraction may now be discussed in due order.

(*a*) **Hypermetropia.**—In hypermetropia the retina lies within, instead of at, the principal focus of the dioptric media. Parallel rays, such as come from very distant objects, therefore meet the retina before being focussed; and divergent rays, from near objects, meet it still more in advance of their focus. Hence the hypermetropic eye, in repose, sees nothing clearly. Distant objects can be seen clearly if, by exerting accommodation, the crystalline lens be made more convex; or if the rays, before they enter the eye, be made sufficiently convergent by passing through a suitable convex lens.

Hypermetropia, due to flatness of the posterior segment of the eyeball, *axial hypermetropia*, is always congenital; and extended observations by different authorities have shown that nearly all children are hypermetropic at birth. In sections the circular fibres of the ciliary muscle are, or appear to be, more abundant than in the normal eye. The cornea is not flatter, but the anterior chamber is rather shallower, and the pupil rather smaller than normal. In high degrees the eyeball is too small in all directions.

The natural remedy for hypermetropia consists in the exercise of accommodation for distant sight, when in the normal or emmetropic eye it is in complete abeyance. A proportionate increase of accommodation is required by the hypermetropic eye for near vision. The absolute quantity, amplitude, or range of accommodation is not greater in hypermetropic than in normal eyes; hence in hypermetropia it becomes sooner insufficient for the needs; and the higher the degree of hypermetropia the earlier does this occur.

Symptoms.—The symptoms depend on the patient's age, occupation, and health, and on the degree of hypermetropia. The lower degrees only exceptionally cause symptoms in childhood. The higher degrees in children, and the lower degrees in young adults, cause difficulty in reading, writing, or sewing, especially by artificial light, and towards the end of the day's or week's work—'accommodative asthenopia.' The difficulty is expressed in the forms of mistiness of sight, weariness or aching of the eyes, headache, sleepiness, watering, chronic congestion, and irritation of the palpebral conjunctiva. In the highest degrees the attempt to see clearly is often given up; such persons often partly compensate for the bad definition of the images by holding the book very close, and so increasing the size of the images; thus they may seem myopic. All the symptoms are worse when the health is low. As accommodation fails with age, a time arrives for every hypermetrope when, unless aided by glasses, no clear vision is possible at any distance; but spectacles are generally adopted before this occurs.

Concomitant convergent squint often arises in hypermetropia (*see* Strabismus). It is at first, and may remain, periodic, present only during strong accommodation; but often it becomes constant. In either case it may alternate, or may always affect the same eye. When constant and fixed, the sight of the squinting eye is usually found to be more or less defective, as already described. This defect is greatest in the nasal part of the visual field, which is shared with the good eye. It may be so great that only the largest objects are visible, yet the direct reflex activity of the pupil is never impaired.

When the crystalline lens is absent (*aphakia*) the eye is very hypermetropic. Distant vision is restored by means of a convex lens of 10 or 11 D. (3¾ or 3½ inches) held about half an inch in front of the cornea; objects at, say, 25 cm. (10 inches) are clearly seen through a lens of about 15 D. (2¼ inches). Accommodation is abolished in the aphakic eye; but if the pupil be round and movable, its contraction aids a little in near vision, by cutting off the peripheral rays of light.

From the age of fifty-five and onwards the normal eye acquires a low degree of hypermetropia, owing to a change in the refraction of the crystalline lens.

Glaucoma is commoner in hypermetropic than in normal or myopic eyes. The habitual use of glasses by hypermetropic persons from early life may aid indirectly in preventing this disease.

Diagnosis.—The diagnosis is made subjectively by testing with glasses, or objectively by the ophthalmoscope. The former is the more generally useful. Even distant objects are seen indistinctly by the hypermetropic eye with relaxed accommodation; but they are made clear if a suitable convex lens be held in front of the cornea. (1) This test is easy to apply when the ciliary muscle is temporarily paralysed by atropine, or abolished by natural senile changes. (2) But when it is active the matter is less simple; since the old-standing habit of exerting accommodation whenever clear vision, even at a distance, is needed, in many cases inseparably connects the effort to see with the action of the ciliary muscle. Such persons cannot relax their accommodation when looking through a convex lens at a distant object. The effect of the lens is therefore added to, instead of substituted for, that of the accommodation, and distant vision made worse; no hypermetropia can be found by trial with glasses: it is entirely 'latent' (*H.l.*). (3) Between these extremes we find a large number who can partially relax their accommodation for distance in favour of a convex lens, but still use a part. They see well, or perfectly, in the distance without aid; they see equally well or better with convex lenses up to a certain strength. If now the accommodation be suspended by means of atropine we shall often find still more hypermetropia. The part that can be detected when accommodation is active is the 'manifest' (*H.m.*); the sum of the 'manifest' and the 'latent' is the 'total' (*H.*).

In testing hypermetropia, the patient being not less than three metres from the test-types, we begin with a very weak convex lens, and if vision is *not made worse*, try successively higher lenses until we reach the highest which allows the best attainable vision. This lens represents the manifest hypermetropia if accommodation be present, the total if it be absent. A stronger lens causes indistinctness by bringing the focus in front of the retina. In general the younger the patient the less is the manifest in proportion to the latent hypermetropia, even though troublesome asthenopia be present.

Hypermetropia is diagnosed by the ophthalmoscope if an erect image of the fundus is easily seen when the observer is at a distance of eighteen inches or more from the patient. The image is seen equally well when the observer comes as close as possible to the patient; and if he possess a 'refraction' ophthalmoscope, he can *in this position* measure the degree of hypermetropia by finding the strongest convex lens through which the details of the fundus still look perfectly clear. In this test the accommodation of both persons must be fully relaxed; the observer has to learn to do this, but the patient generally relaxes his ciliary muscle at once in the dark room, even though he could not do so when tried with glasses for the distant types.

Another test, *retinoscopy*, is based on the fact that when light is thrown by the ophthalmoscope into the eye at a distance of three or four feet, slight rotation of the mirror causes a shadow to move across the illuminated field; in hypermetropia the shadow moves in the opposite direction to the rotation of the *concave* mirror. The method is very useful, especially for young patients; and in skilled hands it is expeditious and very accurate.

The optic disc in hypermetropia, especially in children, often seems, and sometimes is, hazy, and is sometimes too red; and the retinal arteries are often too tortuous.

TREATMENT.—Treatment is necessary for hypermetropia whenever there is asthenopia, and when strabismus has arisen. Convex spectacles are ordered which, according to circumstances, neutralise a part or all of the hypermetropia; and are worn constantly, or only for near work. Periodic squint may always be cured by the constant use of fully correcting glasses; but in most cases where it has become constant, an operation is necessary (*see* STRABISMUS). In children with asthenopia it is usually best to order glasses for constant use, which correct almost the whole hypermetropia; but if the symptoms are in connexion with weak health and the hypermetropia be slight, the temporary use of glasses for near work alone is enough. Young adults using glasses for the first time are often satisfied with those which neutralise only the manifest hypermetropia, using them for all near work; but after some weeks or months asthenopic symptoms often recur, we find that there is more manifest hypermetropia than before, and we are obliged to order stronger glasses. But ophthalmoscopic estimation will, as stated above, generally tell us correctly almost the total even at the first examination; and when this method makes it clear that the total is much greater than the manifest hypermetropia, glasses of nearly the full strength should be ordered at once. On theoretical grounds it is undoubtedly best for glasses to be worn constantly by hypermetropes, so that the accommodation may always be at rest. But a good deal of latitude must be allowed to grown-up, and especially elderly, patients in regard to wearing them for distance, unless there be constant asthenopia.

Acuteness of sight is usually normal in corrected hypermetropia. In many cases of high degree, where vision is, both with and without glasses, subnormal, some astigmatism is also present; but cases occur where the defect cannot be thus accounted for, and it is then assumed to be due to defective development of eye or visual centre. But probably want of education of the retina in the perception of clear images in a great degree accounts for the phenomenon.

(*b*) **Myopia.**—In myopia the retina lies beyond the principal focus of the dioptric media, generally on account of lengthening of the posterior part of the eye—*axial myopia*. It is consequently at the conjugate focus of a point at some definite distance in front of the eye, which indeed is the 'far-point,' or greatest distance of distinct vision of the eye in question. The greater the elongation of the eye, the nearer is the 'far-point,' the 'shorter' the sight, or the higher the degree of myopia. By using accommodation objects can be seen at a still shorter distance.

ÆTIOLOGY.—Myopia is comparatively seldom present at birth. The elongation usually comes on between about seven and fifteen years of age, progresses for a time, and stops between puberty and adult age; but in some cases the stretching (and its attendant structural change) persistently increases through life, and leads to serious and even disastrous consequences. Myopia is often hereditary, and inheritance doubtless accounts entirely for some very severe cases where no other causes have operated. But habitual use of the eyes upon close work, especially in a stooping posture, aids very strongly in its production. Any severe or lasting ill-health may determine the onset or increase of serious myopia in a predisposed person.

Myopia may also be caused by increased

curvature of the cornea after keratitis, and is an invariable result of 'conical cornea.' Certain changes in the lens in the early stages of senile cataract sometimes produce myopia, even of considerable degree; but this form of myopia does not, as axial myopia may, indicate degeneracy of the deeper tissues, and hence does not influence the question of operation.

Anatomical Characters. The elongation occurs chiefly in the posterior part of the eye, and especially at the yellow-spot region. The sclerotic and choroid are thinned in proportion to the distension, and the choroid often locally atrophied; the term 'posterior staphyloma' is given to the bulging region. In high degrees the eye is enlarged, and its coats are thinned, in all directions. The term, 'sclerotico-choroiditis posterior' is also used to indicate the supposed nature of the change. In high degrees, particularly late in life, the vitreous often becomes fluid and contains opacities; hæmorrhages may occur from the choroid; and there is a strong predisposition to detachment of the retina and to incomplete cataract. In the ciliary muscle of myopic eyes the circular fibres are deficient or wanting. The anterior chamber is often deeper, and the pupil larger than usual. Owing to their large size, highly myopic eyes are often prominent; and from the same cause their movements are less free, and are apt to cause muscular fatigue.

Symptoms.—A low degree of stationary myopia usually causes no inconvenience. In the higher degrees advice is sought, either because distant sight is bad or near work has to be held inconveniently close; or on account of eye-ache, headache, watering, photophobia, or dimness; or for inefficiency of the internal recti (muscular asthenopia), or actual divergent squint. In the highest degrees divergent squint is nearly always present at the natural distance of distinct vision, and possibly even for distance; and in much lower degrees there is often difficulty in keeping up convergence, and consequent pain and weariness. Aching frequently shows that the myopia is increasing; it is always made worse by use of the eyes, but is often present even when at rest in bed; it may accompany the development of a squint, or of detachment of the retina. Myopic eyes, even of low grade, are often intolerant of bright light. Acuteness of vision is frequently sub-normal in high degrees, especially in old people; such defect, when not accounted for by visible structural changes, is assigned to congestion of the choroid.

Diagnosis.—A myopic person with healthy eyes can read the smallest print fluently at his own 'far-point,' but not farther. He gains perfect distant vision by looking through a concave lens, which gives to rays of light from distant objects a divergent direction, as if they came from his natural 'far-point.' Placing him not less than ten feet from the test-types we find experimentally the *weakest* concave lens that gives the best attainable vision. A stronger lens over-corrects the myopia, producing hypermetropia, which, in its turn, is corrected by the exercise of accommodation.

Myopia is diagnosed objectively as follows: (1) When, by direct ophthalmoscopic examination at a long distance, an image of the fundus is seen, which, on the observer moving his head from side to side, seems to move in the opposite direction. This image disappears when the observer comes near to the eye examined. (2) When by direct examination close to the patient, a clear image (erect) can be obtained only by placing a concave lens behind the mirror; the *weakest* lens which gives a clear image being the measure of the myopia. (3) When by indirect examination the size of the ophthalmoscopic image increases on withdrawing the objective lens from the patient's eye. (4) When by retinoscopy with the *concave* mirror, the shadow moves in the same direction as the rotation of the mirror.

The ophthalmoscopic changes depend chiefly on the atrophy of the choroid, which so often takes place on some part of the staphylomatous area. The commonest change is the 'myopic crescent,' a patch of yellowish-white colour (exposed sclerotic), due to atrophy of the choroid at the true outer border of the optic disc. It is sometimes seen in eyes not myopic. When more advanced it extends all round the disc (annular staphyloma). There may also be areas of atrophy with signs of past or present inflammation, at the yellow spot. In high myopia with abrupt bulging of the tunics, the disc is often tilted and then looks oval, and its outer side often becomes pale.

Course and Prognosis.—Axial myopia cannot diminish. Though its increase as a rule ceases about the same time as the cessation of the bodily growth, it may continue, or may take a fresh start later in life, especially if the health be bad or the eyes be excessively used for fine work. But often its course seems to depend upon causes which are not under direct control; for we see myopia of high degree, leading to disastrous results, or blindness, in persons who have never learnt their alphabet, or strained their eyes in any way; and, on the other hand, it is common to meet with very myopic people, of studious habits and advanced age, in whom the eyes have not changed since youth. In general the prognosis is worse the higher the degree, the older the patient, and the feebler the health.

Treatment.—Much may doubtless be gradually done to prevent the acquisition and transmission of myopia, by improvements in the lighting of schoolrooms, and construction of seats and desks, and by the choice of well-printed books. During the progress of myopia the time given to school-work should, whenever possible, be shortened; and if the disorder be quickly increasing, or if there be much aching or irritation, rest of the eye should be insisted upon for several months, or longer. Myopic children should use their eyes only as much as is comfortable, and should be forbidden to read fine print, to read by bad light, or to stoop. If there be severe aching and intolerance of light, or rapid increase of the myopia, especially with diminished acuteness of sight, prolonged rest, subdued light (or smoked glasses), and the use of the artificial leech at intervals of a few days, with derivative treatment, are of service, at least in relieving the symptoms and improving vision for a time.

The corrective treatment consists in the use of concave glasses. Myopic children should as a rule wear glasses for distance merely on educational grounds. These glasses may fully correct the defect, but it is better that they should be a little under than over the full strength. If there be muscular asthenopia, the glasses often cannot be continuously worn, unless treatment be also directed to the internal recti. Adults may use their own judgment as to wearing distance-glasses. Except in low degrees of myopia it is best not to encourage fully correcting glasses for near work, because they cause full action of the hitherto little exercised accommodation, and also derange the relation between accommodation and convergence, and are thus likely to tire the eyes; they also cause difficulty by diminishing the retinal images; if their use be persisted in for reading, or other purposes, when they cause discomfort, they may act indirectly in increasing the myopia. When the natural far-point in myopia is not nearer than 13 inches (33 cm.) reading glasses are seldom required. But for higher degrees it is often necessary to order spectacles which partly correct the myopia, that is, make the eyes less myopic, and thus remove the far-point farther off, and allow the patient to read, or use them in other ways, without stooping. As a general rule, subject to the peculiarities and needs of each case, about half the full correction may for this purpose be safely and comfortably used. For music or painting a rather stronger pair of spectacles are sometimes required. When there is muscular asthenopia, shown by the fact that in near vision one eye, if covered, deviates outwards, relief may sometimes be given by combining with the reading glasses prisms with their bases inwards; the prisms, by allowing the convergence to be lessened, relieve the internal recti.

(*c*) **Astigmatism.**—Astigmatism may be either *regular* or *irregular*. *Regular* astigmatism depends upon the refracting surfaces of the eye, chiefly of the cornea, not being spherical, but having different curvatures, that is, focal lengths, in different meridians, the meridians of greatest and least curvatures ('chief' or 'principal' meridians) being always at right angles to each other, and the others having regularly intermediate curvatures. The meridian of greatest curvature of the cornea is generally vertical or nearly so. The astigmatism of the lens, though less regular than that of the cornea, tends to correct the latter. In 'simple' astigmatism one chief meridian is normal, the other either myopic or hypermetropic; when 'compound' both chief meridians are myopic, or both hypermetropic, but in different degrees; when 'mixed,' the eye is hypermetropic in one chief meridian, and myopic in the other. When the focal difference between the chief meridians, *i.e.* the degree of astigmatism, is not greater than is represented by a lens of 72 inches focus (·5 D.) it may generally be neglected; even much higher degrees often cause no trouble.

Astigmatism is to be suspected in all cases of ametropia where spherical lenses do not raise vision to the normal, no other cause of the defect being found. It is detected subjectively by numerous tests, most of which consist essentially of straight lines running in various directions, some of the lines being seen by the astigmatic eye better than others. It can also be detected and measured by the ophthalmoscope and by retinoscopy.

TREATMENT.—Astigmatism is corrected by cylindrical lenses, which neutralise the difference of refraction of the two chief meridians; but in the higher degrees acuteness of vision often remains even then subnormal. *Irregular* astigmatism can seldom be remedied.

3. **Anisometropia.**—This signifies different refraction in the two eyes, and is a very common condition, the difference sometimes being extreme. When one eye is normal and the other myopic, each may be, and often is, used for vision at different distances, and each remains perfect; but if one be astigmatic, or very hypermetropic, it is generally defective.

When slight, this condition may be neutralised by corresponding spectacles, but when the inequality is great, fully correcting glasses cause so much difference in the size of the images in the two eyes, that equalisation is seldom possible. But it should be attempted when there is any tendency to squint, in order to encourage binocular vision.

Effect of blindness of one eye.—Acuteness of sight is always rather better with both eyes than with either alone; further, both eyes are necessary for the appreciation of solidity and distance. Patients often think that blindness or disuse of one eye throws 'double work' upon the other and 'weakens it.' Nearly always, however, in such a case some other cause can be found for the asthenopia of the sound eye.

4. Disorders of Accommodation.—(*a*) **Presbyopia.**—The 'amplitude' or 'range' of accommodation is expressed by the difference between the greatest distance, 'far-point,' (*r*), and the least distance, 'near-point,' (*p*), of distinct vision. Age for age, it is nearly equal in all eyes, whatever their refraction. Its natural failure with age causes presbyopia, the onset of which has been arbitrarily fixed to begin, in the emmetropic eye, at the age of about 40 to 45, when the near-point is at nine inches (22 cm.); and the failure generally progresses at a constant rate. Presbyopia is corrected by the convex lens, which enables the patient to read at nine inches; the strength of this lens varies inversely as the amplitude of accommodation; and at the age of 65, the near-point being removed to infinity, the correcting lens is one of nine inches focus.

Symptoms.—Presbyopia is first shown by difficulty in reading or sewing by artificial light, or in the train or carriage; defective accommodation prevents the work being held close enough to compensate for the defective light or for the shaking, and to remedy the former the candle is often placed between the eyes and the book. When more advanced, the patient becomes 'long-sighted,' and has to put his book at arm's length unless he wear glasses. If the refraction is normal, distant sight is perfect. In hypermetropia, presbyopia begins at an earlier age, less accommodation being available for near vision; and in myopia it sets in later because less accommodation is needed for seeing at a given distance. Hence a low degree of myopia is an advantage. When the far-point in myopia is at or within nine inches (22 cm.) presbyopia does not occur.

Diagnosis.—Presbyopia is to be distinguished from loss of accommodation due to paralysis of the ciliary nerves, and from failure due to feeble health or other causes, both of which may occur at any age. True presbyopia, however, sometimes occurs earlier and progresses more quickly than usual, especially in eyes which are threatened with glaucoma.

Treatment.—The treatment of presbyopia consists in ordering convex glasses which enable the patient to read at nine inches or a greater distance. Most people prefer glasses which enable them to read easily at twelve or fifteen inches, and with which reading at the standard nine inches is possible only for a very short time, if at all. The smaller the quantity of accommodation remaining, the less is the range of clear vision; and if accommodation is abolished, clear sight is possible only when the object is at the focus of the glasses. Hence the increase of strength of the glasses which becomes necessary as age advances should be made gradually, that the patient may grow accustomed to the loss of range, and to the necessity for keeping his book more and more at an unvarying distance. As the book has to be placed nearer by artificial than by day light, it is generally best to have a rather stronger pair of glasses for evening use than for the daytime. The following table, giving the strength of the glass necessary to bring the near-point to nine inches (22 cm.), at various ages, serves as a useful basis for the selection of spectacles for presbyopia in emmetropic persons:—

Age	[illegible] 'p' to 9 in.			
40	0			
45	+ [illegible] inch	=	+ 1	dioptre.
50	[illegible] ,,	=	2	,,
55	[illegible] ,,	=	3	,,
60	[illegible] ,,	=	4	,,
65	[illegible] ,,	=	4·5	,,
70	1/6½ ,,	=	5·5	,,

(*b*) **Paralysis of accommodation.**—Synon.: *Cycloplegia.* Paralysis of the ciliary muscle occurs in paralysis of the whole third nerve. But it may occur without affection of the extrinsic muscles of the eyeball. In these cases it is generally combined with paralysis, more or less complete, of the iris (*ophthalmoplegia interna*); but it may be present as an isolated symptom, the pupils being normal, and of this the commonest example is post-diphtheritic cycloplegia. The failure of accommodation in glaucoma may be accounted for in acute cases by compression of the ciliary nerves, but in old cases is doubtless due to the atrophy of the ciliary muscle which always exists. Cycloplegia, usually with some affection of the iris, is a common result of blows on the eye; sometimes recoverable, it is, however, often permanent. Lowered endurance of sight, pain, and sudden temporary failures of accommodation, are amongst the most important phenomena of sympathetic irritation.

(*c*) **Spasm of accommodation.**—Temporary spasmodic action of the ciliary muscle, often exceeding the necessary amount, frequently occurs in hypermetropia, with each effort to see clearly; it usually ceases at once on going into a dark room. In low myopia with irritative symptoms, the ciliary muscle often acts unnecessarily; and such spasm, when persistent, is probably one cause of further elongation of the eye. Spasm of accommodation also occurs in some functional and hysterical affections of the eyes, with other symptoms of ocular irritation. The function of accommodation is closely associated with that of convergence, although the two can be exerted separately to a limited extent. The accommodation of one eye cannot be exercised without, and scarcely in any different degree from, that of the other; but it is probable that different parts of either ciliary muscle can act in different degrees and thus to some extent correct astigmatism.

(*d*) **Micropsia.**—Definition.—Any condition of sight in which objects seem lessened in size, without diminution in the size of the retinal images. This indicates either an extreme effort of accommodation, and may be thus complained of when this function is weakened; or disease of the deep layers of the retina.

5. **Asthenopia.**—Asthenopia is any condition in which the eyes cannot be used for long without fatigue, pain, or other symptoms.

Muscular asthenopia is caused by difficulty in maintaining the convergence of the visual lines, and is commonest in myopia, though it is often seen with normal refraction, especially in youths and young adults. It causes, besides aching of the eyes, 'confusion' of the print, and sometimes double vision. In slight cases, accompanying myopia, partially neutralising concave glasses, which enable the book to be held at a greater distance, will often give relief. In a few cases, with or without myopia, spectacles, consisting of prisms with their bases inwards, are of service, by lessening the convergence necessary for vision at a given distance. In high degrees, tenotomy of the external rectus is called for (*see* Strabismus). Asthenopia may also be caused by slight vertical deviations (upward or downward) of one eye.

Asthenopia from deficient accommodation is also shown by inability to read for long, but there is no 'moving' or 'dancing' of the letters, nor any diplopia. The object simply becomes 'misty' or 'the sight goes' for a time, returning when the eyes are rested for a few minutes; or the eyes feel tired and hot, and ache. Headache and occasionally even vomiting may follow neglect of such symptoms. It is commonest in hypermetropia (asthenopia from excessive demand on accommodation); but is also seen in emmetropic, and even in slightly myopic eyes, if the tone of the ciliary muscle is low (asthenopia from weakness of accommodation). Asthenopic symptoms are not common in presbyopia.

Neurasthenic Asthenopia.—All causes of asthenopia are more effective in neurasthenic persons, and some of the worst cases are in those who have good range of accommodation, and no ametropia. Sensitiveness of lids, eyeball, and perhaps retina, may have been left by previous styes, phlyctenulæ, or follicular granulations, and the onset of symptoms often dates from some piece of eye-work requiring strenuous effort; but serious breakdown of the eyes seldom occurs unless the general conditions of neurasthenia — excitability without staying power — are present.

Retinal Asthenopia.—Functional exhaustion of the retina or optic nerve is sometimes seen in optic neuritis, and other diseases of the optic nerve; sight being good, but becoming duller after a short period of use. It is not, on the whole, an important diagnostic symptom.

E. Nettleship.

VIS MEDICATRIX NATURÆ (Lat.).—An expression formerly much used to indicate the innate power possessed by Nature of healing or curing disease. *See* Disease, Treatment of; and Therapeutics.

VITAL STATISTICS.—For the purposes of public health, vital statistics are concerned mainly with the incidence of disease and death upon communities and upon different fractions of communities, and with the renewing of population by births. Such statistics may be regarded from several points of view. It may be desired to investigate the average incidence of a certain disease, or a group of diseases, upon different populations or different sections of a population; sections marked out by race, locality, occupation, class, age, sex, or other selected characteristic. Or, again, one disease may be compared with another as to incidence upon the same population. From yet another standpoint, inquiry may be made into the changing incidence of a given disease upon a given population in the course of time, the change being perhaps progressive, perhaps fluctuating at long or short intervals, regular or irregular. Thus comparison may be made between the various seasons of the year, between one year and another, or among the averages of terms of years; and the change may prove to be one of quantity, or quality, or both. By patient record and analysis of the available data, it becomes possible to learn *how*, *when*, *where*, and *whom* a given disease attacks, and hence to obtain a clue to the further problem *why* it attacks, and even to the most important matter of all, the means of prevention.

The materials necessary for such research include, on the one hand, records of births, deaths, and sickness; and, on the other hand, accurate information as to the population among which the events so recorded have happened.

Population.—A census in this country is taken at the end of the first quarter of the first year in each decade. Between these widely distant known points, estimates can be made on the assumption that the rate of increase is uniform. Thus, if P and P′ be the numbers enumerated in 1881 and 1891 respectively, the rate of increase in ten years is $\frac{P'}{P}$, in one year therefore $\sqrt[10]{\frac{P'}{P}}$, in a quarter of a year $\sqrt[40]{\frac{P'}{P}}$. For the sake of brevity we may denote the rate of annual increase, that is $\sqrt[10]{\frac{P'}{P}}$, by r, and the quarterly rate by $\sqrt[4]{r}$. Then the estimate at the end of the first quarter of 1882, one year after the census, will be $P \times r$, in two years $P \times r \times r$ ($= Pr^2$), in three years Pr^3, and so on, year by year, till we come to $P \times r^{10}$, which is of course equal to P′. But the mid year population, which is always adopted as the basis of birth rates and death rates, will be in advance of these estimates by one quarter's growth: $P \times \sqrt[4]{r}$ in 1881, $P \times r \times \sqrt[4]{r}$ in 1882, $Pr^2 \times \sqrt[4]{r}$ in 1883.

Further than this, it is assumed that the population P′ of 1891 goes on increasing at exactly the same rate as the population P of 1881 was found to have done; the estimates for the years after 1891 are made upon the old data, until the next census again gives certainty. The estimate for the mid-year 1891 is $P' \times \sqrt[4]{r}$, for 1892 $P' \times r \times \sqrt[4]{r}$, for 1893 $P'r^2 \times \sqrt[4]{r}$.

In practice, the values of P and P′ are of course known from the census returns, and the use of logarithms makes the calculations perfectly simple. A rougher method, sufficiently accurate for small populations, is to assume that the increment in every year is one-tenth of that recorded in the ten years, and to add $\frac{P'-P}{10}$ for each year. It is obvious that the result will only be accurate about the middle of the decade, the increment being overstated during the first half, and understated during the second; for, as the population is increasing, $\frac{P'-P}{10}$ bears a higher ratio to P than it does to P′, so that the increment in 1881 is made to be *relatively* larger than that in 1891, although by hypothesis the rate of growth ought to remain unchanged.

Sometimes the estimate is based upon other data altogether, by adding to the last census-population the so-called 'natural increase,' that is, the excess of births over deaths, it being assumed that there is no gain or loss from other sources, or that these balance each other. Experience has shown that while mathematical estimates are tolerably correct for very large mixed populations, such as a whole nation, they are liable to error in proportion to the smallness of the numbers concerned. In towns the growth is chiefly marginal, the central portion being capable of little increase; and the growth, even if continued uniformly, may be outside the more or less arbitrary limits of the area under consideration. Fluctuations of trade are of great moment as affecting local immigration and emigration. In many instances the 1891 estimates, based upon the 1871 and 1881 census, were proved by the new census of 1891 to be far wide of the mark. Liverpool, instead of increasing as had been supposed, was found to have actually decreased, and the population was over-estimated by 20 per cent. Salford was over-estimated by 27 per cent, and Newcastle under-estimated by 11 per cent. For at least five years out of every decade local birth-rates and death-rates are liable to serious error, although their unreliability will usually be made known either by persistent abnormality of the rates themselves, or by the discrepant results of local observations, such as influx or efflux of artisan population, records of school attendance, inhabited houses, &c.

For many statistical purposes, much further detail is required. It is necessary to know how many there are of each sex, of each group of ages, or of each occupation, for the tendency to sickness and death varies greatly, and rates may need to be calculated separately for each class.

Births and Deaths.—Births must be registered within six weeks, and deaths within five days, of their occurrence. These form the basis of the national statistics of births and deaths. As regards the latter, the record includes not only the time and place of death, but also the age, sex, and place of residence of the deceased, the causes (primary and secondary) of death, and their duration. The age to be given is that attained at the last birthday; if less than one year it should be stated in months, weeks, days, or hours. In compiling statistics of deaths from different causes only one cause can be accepted for each death, and when two or more are recorded it is usual to give precedence to 'zymotic' diseases over all others, to 'specific' over non-specific, and to 'primary' over 'secondary' causes. Where these criteria are indecisive, priority may be given to the cause mentioned first in the certificate. 'Uncertified' deaths, in which no certificate is given either by a registered medical practitioner or by a coroner, were in 1891 2·7 per cent. of the total number, but the proportion ranged from 0·7 per cent. in Middlesex to 6·2 in Huntingdonshire. A large proportion of deaths (in towns not often less than 10 per cent., and in London as many as 25 per cent.) take place in public institutions such as hospitals, asylums, and workhouses. These ought to be credited to the locality of former residence, which may or may not be the same as that in which the institution is situated, and in which, therefore, the deaths are registered.

Still-births are not registered in this country; they are estimated to be equal to about 4 per cent. of the live-births. Of the latter about 5 per cent. are illegitimate, the proportion being greater in rural than in urban communities, and declining in England generally. About 104 males are born for every 100 females, but owing to the higher death-rate among male infants the female population exceeds the male in the second year of life and at all later ages.

Rates.—Statistics of births and deaths have to be considered with reference, first, to the magnitude of the population concerned, and, secondly, to the length of time covered by the record. It is convenient to adopt fixed standards of population and time, and birth-rates and death-rates are usually stated 'per thousand per annum,' that is, as the number of such events among each thousand of the population in the course of a year. The true (astronomical) year has 365·24 days, while the statistics of births or deaths will usually be those of 364 days (52 weeks) or 365 days. Hence an adjustment becomes necessary if great accuracy be desired. Thus, if the records of a 'year' of 52 weeks give a death-rate of 20·0 per 1,000 per annum, the true death-rate will be $20\cdot0 \times \frac{365\cdot24}{364}$, or 20·07. Similarly, birth-rates and death-rates for fractions of a year are stated as *annual* rates; they are the annual rates which would be attained if the conditions observed during the period in question were continued unchanged for a whole year. In general terms, if *n* be the number of days during which events are recorded, the rate per 1,000 per annum will be

$$\frac{\text{No. of events recorded during } n}{\text{Population at middle of year}} \times \frac{365\cdot24}{n} \times 1{,}000.$$

Thus, if there be 40 deaths in a given week in a population of 100,000, the death-rate for that week is $\frac{40}{100{,}000} \times \frac{365\cdot24}{7} \times 1000$, that is, 20·9 per thousand per annum.

The population must of course be that in which the events happen, neither more nor less. To find the death-rate at ages between 10 and 15 years, for instance, we must take as our basis, not the whole population, but merely the number of persons living at those ages; the deaths at ages 10 to 15 years must be compared with the population at ages 10 to 15 years.

Birth-rate.—The English birth-rate has declined steadily from 36·3 in 1876 to 30·2 in 1890, the first break of any moment being a slight rise to 31·4 in 1891. It is highest in districts containing the largest proportion of young married people, and high, therefore, in towns which are rapidly growing by influx of young adult persons. In mining districts, local birth-rates of 40 or 50 are not uncommon. Although birth-rates are always calculated on the whole population regardless of age or sex, it ought to be remembered that the population more immediately concerned is that of married women under 45 years of age, and that a community containing an unusually large or unusually small proportion of such persons may be expected to have a correspondingly abnormal birth-rate.

Death-rate.—Death-rates may be calculated for a community as a whole, or for a particular class or section of a community; and with regard to deaths from all causes, or deaths from one cause or group of causes only.

The English death-rate has materially declined during the last twenty years, and, on the whole, more rapidly among females than among males.

Years	Mean Annual Death-rates in		
	Both Sexes	Males	Females
1841–50	22·4	23·1	21·6
1851–60	22·2	23·1	21·4
1861–70	22·5	23·7	21·4
1871–80	21·4	22·7	20·1
1881–90	19·1	20·3	18·1
1888	18·1	19·2	17·0
1889	18·2	19·3	17·2
1890	19·5	20·8	18·3
1891	20·2	21·5	19·0

The decline has not been free from interruptions, and, indeed, after reaching a minimum in 1888, it steadily increased during the next three years, as the table shows.

In infancy and in old age the tendency to death is high, the minimum being at ages between 10 and 15 years. The following table gives the mean annual rates in England and Wales for the decades 1861–70 and 1871-80.

Ages	Both Sexes		Males		Females	
	1861–70	1871–80	1861–70	1871–80	1861–70	1871–80
0–5	68·3	63·1	73·2	68·1	63·4	58·1
5–10	8·0	6·4	8·1	6·7	7·8	6·2
10–15	4·5	3·7	4·5	3·7	4·5	3·7
15–20	6·4	5·3	6·2	5·2	6·6	5·4
20–25	8·2	7·0	8·5	7·3	8·0	6·8
25–35	9·8	8·9	9·9	9·3	9·7	8·6
35–45	12·7	12·6	13·5	13·7	12·0	11·6
45–55	17·3	17·7	19·2	20·0	15·6	15·6
55–65	30·3	31·5	33·0	34·8	27·8	28·5
65–75	62·5	64·9	66·7	69·6	58·8	60·8
Over 75	158·8	161·6	164·6	169·1	154·3	155·8
All ages	22·5	21·4	23·7	22·7	21·4	20·1

The comparison of these two decades shows that in both the death-rate was lower among females than among males, not only at all ages taken together, but also at each group of ages separately, except in the second decade of life. It shows, too, that while the general death-rate had, on the whole, declined in both sexes, the decline was limited to the ages below thirty-five years in males, and below forty-five years in females; beyond those points it actually increased. These observations are confirmed by the statistics of the decade 1881-90, not yet officially tabulated in the same way.

It is usual to state the 'infant mortality' in a different way, taking advantage of the accurate statistics of births as a basis of population, and thus avoiding the uncertainty of estimates. The infant mortality is therefore

$$\frac{\text{No. of deaths under one year}}{\text{No. of births during year}} \times 1{,}000.$$

It is not comparable with death-rates at other ages, for it is not calculated upon a mean population. It is higher in towns than in the country, and among males than among females. For the decade 1871–80 the mean infant mortality was 149—that of males being 163 and females 134. It declined to 142 in the decade 1881-90, but has fluctuated considerably in recent years, and in 1891 was 149.

Notwithstanding the high mortality among infants, a high birth-rate does not usually carry with it a high general death-rate, but rather the reverse. It implies a large proportion of young adults in the population as parents, and also a large proportion of children who have passed the period of early infancy. Among these groups the death-rate is low, as is evident from the foregoing table, and the excess of infant population is more than compensated for by the excess at ages of low mortality.

The age-constitution of the population ought always to be borne in mind as a possible source of fallacy in comparing crude death-rates. Extreme instances are met with in dealing with selected populations—for example, the public services. The death-rate among soldiers stationed in the United Kingdom was 9·1 during the decade 1871–80. In order to form an opinion whether this rate is high or low, comparison must be made with the standard death-rate among males of army ages, and not with that of a community containing women, children, and old people. Reference has already been made to the differences in age-constitution between urban and rural communities, and between one town and another. From census data the Registrar-General has worked out for each of the large towns in England a 'factor,' or number, by which the crude death-rate may be multiplied if it be desired to nullify the effect of a local age and sex distribution, differing from that of the country at large. The 'corrected death-rate' so obtained represents that which would prevail under local conditions if the local population had the same composition, as regards age and sex, as that of the kingdom as a whole. For the decade 1871–80 the 'factors' ranged from 0·9565 (Norwich) to 1·1143 (Manchester). The crude death-rates for these two towns in 1883 were 19·64 and 27·64 respectively, the corrected death-rates 18·79 and 30·80, so that when compared on equal terms the difference is increased. Rural districts usually contain an unduly large proportion of young and old persons, with comparatively few young adults, and the factor for correction would (as in Norwich) be less than unity; but most towns resemble Manchester in having an excess at those ages at which mortality ought to be low, and the factor in all such cases would be greater than unity. Corrected death-rates enable us to compare the mortality of different towns upon equal terms, and the comparison is further facilitated by calling the death-rate of the whole country 1,000, and stating the corrected death-rate of each town in terms of this, according to the following formula:—

$$\text{'Comparative mortality figure'} = \frac{\text{Corrected local death-rate}}{\text{Death-rate of whole country}} \times 1{,}000.$$

Life-Tables.—The death-toll at each age being known, it is possible to construct a life-table—that is, to estimate the gradually diminishing number who would survive at the end of each successive age-period, out of, say, a million born.

	Males				Females			
	Survivors out of a million born		Expectation of life		Survivors out of a million born		Expectation of life	
Age	1838–54	1871–80	1838–54	1871–80	1838–54	1871–80	1838–54	1871–80
0	1,000,000	1,000,000	39·9	41·4	1,000,000	1,000,000	41·9	44·6
10	689,857	708,990	47·1	47·6	715,769	738,582	47·7	49·8
20	651,903	680,033	39·5	39·4	674,119	707,949	40·3	41·7
30	595,089	630,038	32·8	32·1	612,774	658,418	33·8	34·4
40	531,657	563,077	26·1	25·3	545,844	596,113	27·3	27·6
50	455,727	476,980	19·5	18·9	473,245	520,901	20·8	20·7
60	356,330	365,011	13·5	13·1	383,974	422,855	14·3	14·2
70	223,490	222,056	8·5	8·3	253,161	277,225	9·0	9·0
80	80,343	77,354	4·9	4·8	100,394	108,985	5·5	5·2
90	9,321	8,015	2·8	2·7	13,802	14,225	3·0	2·9
100	154	82	1·7	1·6	295	225	1·8	1·6

The above data are taken from life-tables constructed by Dr. Farr (1838–54) and Dr. Ogle (1871–80). The chance of survival at each age and in both tables is greater among females than among males. The 1871–80 table shows a greater number of survivors than the other at every age up to sixty-seven in males, and ninety-two in females.

The calculation may be carried a step farther, and an estimate made of the 'expectation of life' at each age—that is, of the average number of years which persons who have reached that age will live. It has already been stated that while the death-rate as a whole is decreasing, it is increasing at ages above thirty-five years in males, and forty-five years in females. Accordingly, we find on comparing the two life-tables, that while the expectation of life is much greater under the new table than under the old at all early ages, it is actually less at ages over nineteen years in males, and over forty-five in females. The expectation at birth is also termed the 'mean duration of life,' and at later ages the 'mean after-lifetime.' Owing to the high death-rate among young children, the expectation is greater at four years of age than it is at birth; thenceforward it declines uninterruptedly. The detailed 1871–80 life-table shows that out of a given number of males born, exactly half survive at forty-seven years of age; and this has been termed the 'probable duration of life.' For females it is fifty-two years.

Causes of Death.—So far only total death-rates have been considered, without distinction of cause. If the incidence of the general death-rate upon different ages and sexes is unequal, that of single diseases or natural groups of diseases is still more so. Each disease has its characteristic curve of age-mortality; and for obvious reasons this curve is almost always more intense than that of the general death-rate. Thus whooping-cough and measles kill few except in early childhood, while cancer kills few except in later adult life, and phthisis is most destructive in early adult life.

Mean Annual Death-Rates, 1871–1880.—*England and Wales.*

Ages	Small-pox	Measles	Scarlet Fever	Enteric Fever	Whooping cough	Diphtheria	Diarrhœa	Cancer	Phthisis	Heart Disease, &c.	Respiratory Diseases	Urinary Diseases
0–5	·53	2·57	3·49	·40	3·65	·47	5·73	·01	·77	·09	12·20	·15
5–10	·28	·21	1·52	·34	·14	·29	·07	·01	·36	·14	·56	·09
10–15	·14	·02	·33	·31	·01	·09	·02	·01	·66	·24	·20	·07
15–20	·20	·01	·10	·41	·00	·03	·02	·02	2·04	·30	·30	·10
20–25	·30	·01	·06	·38	·00	·02	·04	·03	3·12	·34	·45	·15
25–35	·24	·01	·05	·29	·00	·02	·06	·13	3·62	·62	·78	·25
35–45	·17	·00	·02	·25	·00	·02	·10	·53	3·75	1·31	1·62	·43
45–55	·11	·00	·01	·25	·00	·01	·16	1·26	3·13	2·27	3·26	·66
55–65	·07	·00	·01	·27	·00	·02	·41	2·21	2·45	4·81	7·43	1·20
65–75	·05	·00	·00	·29	·00	·02	1·19	3·12	1·48	9·48	16·08	2·21
Over 75	·04	·00	·00	·22	·00	·01	3·51	3·33	·49	12·09	30·24	3·31

As regards sex, similar disproportion may be met with. The majority of diseases cause a higher mortality among males, the principal exceptions being diphtheria, whooping-cough, cancer, and, of course, the diseases connected with parturition. Cancer is nearly twice as common among females as among males, while in deaths from violence there is a still greater inequality in the opposite direction. These are extreme instances; but in comparing different local or specialised death-rates with each other or with a standard, it is necessary to bear in mind that the comparison is only legitimate on the assumption that there is no *material* difference with regard to age and sex constitution.

The table opposite shows the progressive changes during the last thirty years in the mortality attributed to certain causes.

Mean Annual Death-Rates.—England and Wales.

—	1861–70	1871–80	1881–90
Small-pox . . .	0·16	0·25	0·05
Measles . . .	0·44	0·38	0·44
Scarlet Fever . .	0·97	0·72	0·34
Typhus . . .	?	0·06	0·02
Enteric Fever . .	?	0·33	0·20
Whooping-cough .	0·53	0·51	0·45
Diphtheria . . .	0·18	0·12	0·16
Diarrhœa . . .	0·97	0·92	0·66
Cancer . . .	0·39	0·47	0·59
Phthisis . . .	2·49	2·13	1·74
Heart Diseases, &c. .	1·05	1·34	1·58
Respiratory Diseases .	3·36	3·74	3·59
Urinary Diseases .	0·27	0·35	0·43
Violence . . .	0·77	0·74	0·65
ALL CAUSES . .	22·5	21·4	19·1

The possibility of altered nomenclature of disease, as well as altered environment, must be taken into account in interpreting these changes; and as regards some of the zymotic diseases, the occurrence of epidemic variations in quantity and quality, at long or short intervals, makes it difficult to measure their average incidence against that of the more equable causes of death, or to compare the course of the death-rate of one zymotic disease with that of another upon anything like equal terms (*see* PERIODICITY IN DISEASE). It is a disputed point whether the ominous increase in the mortality attributed to cancer is real, or only due to the better diagnosis of cases which in former years would have been assigned to other causes.

Density of Population.—Even apart from any correction for age and sex distribution, the death-rate is generally higher in urban than in rural districts. In both it is declining, but as the fall is more rapid in the former the difference is growing less.

England and Wales.—Urban and Rural Death-Rates, 1861-90.

Years	Persons per Square Mile	Death-rate per 1,000 living		
		England and Wales	Town Districts	Country Districts
1861–70	365	22·5	24·8	19·7
1871–80	415	21·4	23·1	19·0
1881–90	471	19·1	20·3	17·3

The average density in 1891 was 500 persons per mile, or 0·8 per acre. If below this average, the density seems to have little influence upon the death-rate; but if above it, the increasing density is in general associated with increasing death-rate. But the density per acre or per square mile is a very crude measure of the overcrowding which is hygienically most important. In a sparsely populated district there may still be overcrowding of villages, of alleys, of houses, or of single rooms. Sheffield is said to have rather less than 17 persons per acre, but this bare average goes for little, since in one registration sub-district the density is 249 per acre, and in another 0·5 only. In London the death-rate among the better class of many-storeyed 'model dwellings' was found to be lower than the average, notwithstanding a more than tenfold greater density per acre. Farr held that, *other things being equal*, the death-rate varies as the twelfth root of the density of the population; the very necessary proviso makes the formula difficult of practical application in a given case.

With the exception of diphtheria, all the zymotic diseases cause, on the whole, higher mortality in urban than in rural districts; and even diphtheria seems likely to conform to the rule in the near future, as it is gaining ground in many towns. Observations of a narrower kind, having regard to crowding of tenements, indicate that phthisis, respiratory diseases, and infant mortality are also conspicuously increased.

Mortality as affected by Occupation.—Here we have to do with a selected population selected sometimes (*e.g.* miners) on account of robust health, sometimes (costermongers, for example) by unfitness for other pursuits. In all cases the age and sex distribution differ widely from that of a general population, and comparison has to be made after correction for this. Such a comparison upon equal terms has been made by Dr. Ogle (*Supp. to the 45th Ann. Rep. of the Reg.-Gen.*) with regard to a large number of trades. The following may serve as examples:—

Comparative Mortality according to Occupation.

—	Phthisis	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALL MALES	220	182	119	41	39	120	1,000
Agriculture . .	122	156	80	22	20	97	701
Coal mining (Lancashire) . . .	125	220	83	24	18	96	[illegible]
Wool Manufacture .	257	205	127	56	36	142	[illegible]
Cotton Manufacture .	272	271	142	32	43	112	1,088
Earthenware Manufacture . . .	473	645	140	49	49	160	1,742
File-makers (Sheffield)	433	350	262	123	41	180	1,667
Plumbers . . .	246	185	167	100	48	144	[illegible]
Innkeepers . .	140	217	200	85	240	140	1,521
Costermongers . .	475	420	207	64	47	227	1,879
Cornish Miners . .	690	458	117	38	40	111	1,839

The comparative mortality figure is lowest (556) among the clergy, and much higher (1,122) among medical men. It is highest of all among inn-servants (2,205).

Sickness.—Statistics of sickness are very incomplete. Those arising out of the compulsory notification of certain infectious diseases are not available except in detached local reports, nor are they tabulated upon any uniform plan even in districts where notification is in force. They apply to a limited number of diseases, and some of the most important are not included. Their chief statistical value at present is the measure which they afford of the local and periodic fluctuations in diffusion and case-mortality of each disease separately. Statistics of hospitals, asylums, and poor-law practice are useful, though fragmentary; and the records of the public services and of 'friendly societies' have yielded valuable results. All these have reference to 'selected populations,' and are not strictly relevant to average communities. For example, it is unsafe to draw conclusions as to the comparative age-incidence of enteric fever from hospital data, for there is no assurance that the cases in hospital are a fair sample of those outside in severity or in age-distribution.

It has been estimated that in a given community there will be about two weeks of sickness per head per annum, or about two to three years of continuous illness for each death. The incidence of sickness, unlike that of births or deaths, has to be considered with regard to *degree* and *duration*, so that the data, such as they are, scarcely lend themselves to statement in the ordinary form of rates.

Statistical Tests of Sanitary Condition.—It has become customary to regard certain statistical data as proof of the healthiness or unhealthiness of a locality, in the sense of prevalent impurity of air, water, soil, or dwellings. Chief among these in popular appreciation are the general death-rate, and the zymotic death-rate. The former is, upon the whole, a fairly reliable index of sanitary condition, but is liable to fallacy if the figures be small, or if the population be not accurately known, or if the age and sex distribution be abnormal, or, lastly, if care be not taken to exclude deaths of strangers, and to include deaths of residents dying outside the district. Further, purely local death-rates for limited periods of time are liable to disturbance by epidemics of a kind not dependent upon insanitary conditions.

The zymotic death-rate is of little constant significance in this respect. It is made up of the combined death-rates of the 'seven principal zymotic diseases,' of which four (small-pox, measles, whooping-cough, and scarlet fever) have little claim to rank as filth-diseases, although the others (enteric fever, typhus, diphtheria, and diarrhœa) have a much more direct significance.

An excessive infant mortality may be due to diarrhœa and other diseases attributable to filth conditions, but may also be accounted for by maternal neglect, or by epidemics of measles or whooping-cough. With equal reason the death-rates from phthisis and from respiratory diseases deserve to be taken into account.

The *mean age at death*, obtained by adding together the ages of those who die, and dividing by the number of deaths, is often cited as evidence of longevity, but has very little significance. It depends largely upon the age-distribution of the population; if there are many young children it will be low. By far the best criterion of longevity is, of course, the expectation of life, which can only be accurately ascertained from a life-table. Approximately it may be found by Farr's formula $x = \frac{2{,}000}{3D} + \frac{1{,}000}{3B}$, x being the expectation of life, B the birth-rate, and D the death-rate.

B. A. Whitelegge.

VITILIGO.—*See* Pigmentary Diseases of the Skin: 7. Leucoderma.

VITILIGOIDEA (*vitulus*, a spotted calf).—A term which was applied by Addison and Gull to the disease now known as *xanthoma* and *xanthelasma*. See Xanthoma.

VITTEL, in the Vosges, France.—Earthy mineral waters. *See* Mineral Waters.

VOCAL FREMITUS.—The sensation of vibration conveyed to the hand when applied over any part of the respiratory organs during vocalisation. It is felt in health, but presents various modifications in disease. *See* Physical Examination.

VOCAL RESONANCE.—The sound heard on auscultation over certain parts of the respiratory organs, during vocalisation, both in health and in certain forms of disease. *See* Physical Examination.

VOICE, Disorders of.—Synon.: Fr. *Troubles de la Voix*; Ger. *Störungen der Stimme.*

Introduction.—Voice is the sound produced in the larynx by air driven from the lungs through the rima glottidis, modified in accordance with acoustic laws in the upper air-passages. Vocalisation is a function needing for its perfect production a healthy condition of the respiratory muscles, of the lungs, trachea, and larynx, of the pharyngeal, oral, and nasal cavities, and of the nerves and nervous centres on which these parts depend for their isolated or coördinated muscular movements and their normal sensitiveness. For the production of the simplest vocal tone the cords must be free to approximate within a line of one another, while the coördinated action of about one hundred muscles is required, to regulate their tension and that of the walls of the air-passages, to modify the form of the latter, and to produce the current of air.

Acoustically the organ of the voice must be regarded as a combined reed and pipe; and for the production of a perfect note, it is necessary that the pipe should be in perfect unison with the reed. This unison depends not only on the shape of the various cavities, but on the relative rigidity or flexibility, and the tension of their walls; every variation in the number, size, or form of vibrations of the vocal cords, effected by the intrinsic laryngeal muscles, calling for similar modifications of the shape, size, and tension of the consonating cavities.

The word 'voice,' when used alone, always implies the presence of a musical tone (periodic vibrations), but sound sufficient for every purpose of speech and articulation may be produced without a musical tone. This is the *whispering voice*, caused by the rustling of air through the half-open rima and relaxed air-passages. To this condition —absence of musical tone in the voice—the term *aphonia* is applied, and it must be distinguished from the actual inability to produce sound, which we see after tracheotomy, where, in the effort to speak, the organs of articulation and sound are seen to move, but neither noise nor musical sound is heard.

PATHOLOGICAL RELATIONS.—The morbid modifications of vocalisation are necessarily numerous, in proportion to its complexity and the number of parts concerned in its production; but it may be generally stated that, in consequence of disease or perverted action in any of these parts, the voice may be altered either (1) in *loudness* or *force* (size of sound-waves); (2) in *pitch*, or relative height of its note (rate of sound-waves); or (3) in *quality* (shape of sound-waves). And even before there is obvious change in any of these respects, the power of passing rapidly and easily from one pitch to another, constituting melody, may be seriously impaired. The morbid alterations of the voice in these several directions will now be discussed; and brief reference will also be made to (4) *stammering of the vocal cords*; (5) *aphonia*; and (6) the *vocal signs in the chest*.

1. Changes in Force.—The voice is weakened in every disease which lowers the general muscular tone, or depresses the nervous system. The gradual change is well seen in phthisis without laryngeal affection, where at last even the effort to approximate the vocal cords is too much for the patient, and he speaks in only a whispering voice. In the same way painful affections of any of the parts enumerated above, interfering with muscular effort, weaken the voice. Speaking generally, mere diminished loudness of the voice depends usually on general rather than on laryngeal disease.

2. Alterations in Pitch.—The note of ordinary speech may be habitually raised or lowered, and the range of the singing voice may be seriously limited. The note of the voice depends primarily on the rate of vibration of the vocal cords; and this is the mean result of the tension, the length, the density, and the thickness of the cords at the time the tone is produced, and the force of the current of air sent through the rima. Structural changes, therefore, in any one of these respects, will alter the pitch of the voice; and change in the ordinary vocal note is usually to be referred either to an affection of the tensor muscles of the larynx, or to structural change in the mucous membrane covering the cords or in the cords themselves. Lowering of the pitch of the speaking and the range of the singing voice occurs with any condition which relaxes the mucous membrane, weakens the nervous and muscular systems, or makes the tense condition of the vocal cords and the consonating cavities painful. Paralysis of the intrinsic muscles, which admits of the approach of the vocal cords but interferes with their tension and density, affects the pitch as well as the quality, the voice being rough and deep in the paresis of the external tensors (superior laryngeal nerve) and of the abductors of the larynx (recurrent nerve).

The imperceptible transition from the chest to the falsetto voice, in which, whilst the condition of the vocal cords is suddenly altered, the form of the larynx, trachea, and other consonating cavities is simultaneously changed, requires a perfect control of the vocal organs, attained only by accomplished vocalists. On this change of register occurring involuntarily, the cracked voice in speaking is the result; and being referable to imperfect co-ordination, it is common in males about puberty, when the form of the larynx is changing, or may even persist occasionally throughout life. A curious affection of the pitch of the voice, in speaking, when two tones of different pitch are simultaneously produced (diplophonia), appears to depend on the division of the rima into an anterior and posterior opening, either by small morbid growths, strings of mucus, or irregular action of the muscles.

3. Change of Quality.—The quality of the voice is affected by every alteration, either in the cords or in the consonating cavities, the purity and character of the tone being liable to numerous modifications, until, the musical note disappearing entirely, mere noise (aphonia or whispering) remains.

Hoarseness.—Hoarseness and huskiness, a combination of whispering and a badly sustained musical note, imply imperfect and irregular approximation of the vocal cords Over-exertion of the voice, catarrh, &c., produce it temporarily, giving rise to irregular tension of the cords, to shreds of mucus, and to swellings of the mucous lining, which interfere with their regular approximation; while all changes short of those which absolutely prevent the closure of the cords, may cause it as a persistent phenomenon. To the larynx itself we look, therefore, for the source of persistent hoarseness. Amongst the pathological conditions of which hoarseness is a symptom are chronic swelling of the mucous membrane, general or local, interfering with the closure of the rima; exudation or ulceration, and therefore inflammation, simple, specific, or diphtheritic; neoplasms; old cicatricial contractions; paralysis of the adductors of one cord, which necessitates the crossing of the normal cord beyond the median line to meet its fellow, as well as other forms of paralysis; and fixing of one vocal cord by ankylosis of the crico-arytænoid joint. The paralysis may, of course, depend on disease of the nervous centres, on the nerves themselves, or on pressure by intrathoracic or other tumours on the nerve-trunks. Hoarseness, short of aphonia, is also a symptom of general exhaustion, as seen in phthisis and cholera.

The character of the speaking voice is also altered by any change in the resonating cavities. Thus the voice is said to have a *nasal twang* when the upper pharyngeal and nasal cavities are not completely shut off in vocalisation; while, on the other hand, obstruction in the nares, preventing the passage of the air through them and the formation of the nasal consonant sounds, is popularly, though wrongly, called 'speaking through the nose.' If the obstruction be situated in front of the nares, the sounds can be produced, but not continued; if the obstruction be in the upper pharynx, or at the back of the nares, they cannot be produced at all. When with obstruction in the nares there is swelling of the pharynx and the soft palate, the voice assumes the character so familiar in cases of quinsy.

Changes in the walls of the chest and the pectoral cavities also alter the character of the voice, the hollow voice of the emaciated phthisical patient illustrating this. The phonation, on inspiration, of spasmodic croup and of child-crowing or laryngismus stridulus must be referred to as the result of spasm of the vocal cords, though this involuntary function hardly comes within the definition of 'voice,' which term should be limited to sound produced in the vocal organs to establish communication between living beings.

4. **Stammering of the Vocal Cords.** Spasm and defective coördination are the source of this peculiar affection of the voice, in which there are sudden interruptions of the voice without affection of the articulation (Prosser James).

5. **Aphonia.**—The various modifications of voice hitherto considered only occur where the vocal cords are free to meet more or less perfectly. Aphonia, or complete loss of the musical tone, occurs where the cords cannot meet. Amongst the conditions which will prevent the approximation of the cords and cause aphonia are paralysis or paresis of the adductor muscles, on whatever cause it may depend; fixation of the cords by cicatricial contractions, or by ankylosis of the crico-arytænoid joints; their destruction by ulceration; any painful affection which makes the patient involuntarily rest them; or coating with false membrane. But by far the most frequent cause of this aphonia is the abrogation or perversion of the will, occurring in the morbid mental condition of hysteria or other nervous disease; perfect power of phonation existing, but the patient, for months or years, declining to exercise the power, or to make the necessary effort. The intimate relations of the voice to the higher functions of the brain would lead us to expect that it would be influenced by the emotions. Thus we have a person hoarse with rage, speechless with terror, &c.; and the origin of these cases of nervous aphonia is frequently some sudden emotion, causing loss of control over the voice. Ziemssen believes that, even where the vocal cords cannot meet, by a great effort the patient may produce a hoarse, monotonous tone by vicarious vibrations of the ventricular bands.

TREATMENT.—The local treatment of the various diseases of the respiratory organs which give rise to disorders of the voice, is fully discussed in the several articles on these subjects (*see* LARYNX, Diseases of; STAMMERING; PHARYNX, Diseases of; TRACHEA, Diseases of). The *general* treatment will depend upon the constitutional state. *See* HYSTERIA; and PHTHISIS.

6. **Vocal Signs in Chest.**—Some consideration must be given to the changes in the voice which are audible when the stethoscope is applied to the chest. Normally the vibrations of the vocal cords are conveyed to the ear applied to the chest by propagation along the contained air, the rigid portions of the air-chambers, and the thoracic walls, the voice being heard as a feeble, buzzing, musical tone. This sound is weakened when the original tone is weakened by laryngeal disease; when fluid is interposed between the lung and the chest-wall; and when the bronchial tubes are obstructed by secretions or other cause, preventing the conveyance of the vibrations. The sound may, on the contrary, be exaggerated, giving rise to the phenomena of *bronchophony*, *amphoric voice*, and *ægophony*. Bronchophony is simple increase in the vocal resonance, and is heard under the same conditions which give rise to bronchial breathing, that is, over lung consolidated by exudation or condensed by compression, and over cavities with solid walls. The term *pectoriloquy* is commonly applied to excessive bronchophony, but Dr. Bristowe would limit it to those instances in which not only the laryngeal tone, but the articulate sounds produced in the mouth, are conveyed back to the chest, and thence through the chest-wall to the ear. Amphoric voice (*amphorophony*) is the term applied where the vocal resonance is not only increased, but acquires a metallic ring, from the addition of a consonant tone acquired in large cavities of the lungs. This is sometimes heard in a marked degree in pneumothorax, though in other cases of the same disease the vocal resonance may be absent or greatly diminished.

Ægophony is heard where there is a thin layer of fluid between the ear and the lung, as in small effusions or at the margin of larger effusions. It is a bleating, tremulous tone, supposed by Stone to result from the interposed fluid preventing the fundamental note-vibrations from reaching the ear, while it permits the finer and closer vibrations of harmonics to penetrate. *See* PHYSICAL EXAMINATION.

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VOLITION, Disorders of.—SYNON.: Fr. *Troubles de la Volition*; Ger. *Störungen des Wollens*.

Various lesions of the cortex of the hemispheres may arrest or interfere with volition at its source, and that not solely when the lesions occur in the kinæsthetic or so-called 'motor' regions. If we assume that these particular regions of the cortex are the parts whence motor incitations pass off on their way to lower centres, it is only necessary to bear in mind, on the one hand, the continuity of molecular actions through definite tracts of the brain-tissue, and, on the other hand, the frequency with which volitions are immediately aroused by some antecedent sensorial processes, to understand that damages to certain sensorial centres or commissural fibres within the hemispheres are almost as liable to interfere with certain classes of volition as are those which occur in the kinæsthetic region itself. After all, volition is only, and must always be, a result of sense and intellect in action. Its manifestations may, therefore, be *impeded* either by disease at the sources in which it originates, or in one or other portion of the tracts along which its initial incitations are conducted on their way to motor centres, and thence to the muscles whose activity is to be awakened. (*See* 'On the Neural Processes underlying Attention and Volition,' *Brain*, April 1892.)

In other cases, with *exalted* activity of some of the centres in which volitional incitations arise, we may have, especially in acute mania and violent delirium, the birth of impulses which are absolutely 'uncontrollable.' Where these conditions are absent, however, and whether the persons in question have been accustomed or not to exhibit evidences of a weak or defective *morale*, it is most important not to confound 'uncontrolled' with 'uncontrollable' impulses. This is the kind of question which becomes all-important in many criminal cases—cases, that is, in which persons are under trial for murder, manslaughter, or theft, and in which 'unsoundness of mind' is pleaded in extenuation. *See* CRIMINAL IRRESPONSIBILITY.

On the other hand, a *dormant* or *sluggish* volition is met with in some other forms of insanity, as well as in hysteria, the subjects of which cannot or do not rouse themselves to perform the most ordinary actions. They may from this cause be speechless, or they may experience the most extreme difficulty in arriving at any decision even in reference to the most trivial circumstances—a defect which is very commonly met with in patients suffering from melancholia. *See* INSANITY, Varieties of.

Again, so-called defects of memory and *defects* of volition are sometimes inextricably involved in many forms of brain-disease; so that the same disability may, from one point of view, be regarded as an instance of defective memory of a special kind, or from another as a peculiar and limited interference with volition. *See* MEMORY, Disorders of.

In very many cases of apparent *loss* of volitional power—that is, in [illegible]: instances of complete paralysis of a part or of a muscle—where the causal lesion is situated in regions below the cortex cerebri (*e.g.* in lower motor centres, bulbar or spinal, or in motor nerves), there is not an arrest of volition, but rather an impediment to the actuation of volitions (*see* PARALYSIS, MOTOR). But whether volition itself is nipped in the bud, or whether, though really existent, it is rendered abortive, the patient is practically reduced to the same condition—since his power of responding to sense or thought through particular muscles may be equally interfered with in either case. *See* SPEECH, Disorders of.

H. CHARLTON BASTIAN.

VOLVULUS (*volvo*, I roll).—A form of intestinal obstruction in which the bowel is bent or twisted on itself. *See* INTESTINAL OBSTRUCTION.

VOMICA (*vomo*, I vomit, I cast out).—SYNON.: Fr. *Vomique*; Ger. *Lungengeschwür*.

DEFINITION.—A term applicable to all ulcerative spaces in the lung in open communication with bronchi.

ÆTIOLOGY.—The multifarious agencies leading to excavation may be grouped as follows:—

I. *Destructive processes*: (*a*) injury, (*b*) gangrene.

II. *Suppurative processes*: (*c*) acute pulmonary abscess; (*d*) suppuration around inhaled foreign bodies; (*e*) suppuration around new-formations (including hydatids); (*f*) extension of abscesses—(1) from the pleural cavity; (2) from the abdominal cavity, or from the abdominal organs; and (3) from the mediastina.

III. *Degenerative processes*: (*g*) ulceration of cancerous or sarcomatous growths; (*h*) ulceration of syphilomata; (*i*) ulceration of tubercle; (*j*) softening of chronic inflammatory consolidations (catarrhal pneumonia and caseous pneumonia); (*k*) softening of intensely congested or œdematous tissues (a condition sometimes due to pressure from aneurysms or tumours); (*l*) liquefaction of ancient deposits—caseous, pultaceous, or hæmorrhagic (hæmorrhagic nodules—Dr. R. E. Thompson).

Phthisis being the cause of the immense majority of pulmonary excavations, the ensuing remarks will be chiefly devoted to phthisical vomicæ.

ANATOMICAL CHARACTERS.—*Vomicæ vary in size and in shape.*—Vomicæ may be sub-lobular (then aptly termed *cavernules*), lobular, lobar, or they may involve the whole of one lung. Tubercular deposits, being usually smaller than catarrhal infiltrations, lead to smaller cavities. Catarrhal inflammation gives rise to the lobular, caseous pneumonia to the lobar excavations, and to the wholesale destruction of a lung. Œdematous forms of catarrhal pneumonia often undergo rapid and extensive softening; the interlobular septa escaping liquefaction, whilst the parenchyma is carried away. This dissecting excavation forms the counterpart of caseous pneumonia, where the tissues are destroyed *en masse*, with the sole exception of the larger branches of the pulmonary artery.

When strictly confined to a lobule, the excavation is roughly spherical. If many lobules should be simultaneously involved, their coalescence may give rise to irregular vomicæ; but the ultimate shape of cavities chiefly depends upon the peculiarities of the bronchial distribution to the district affected.

Vomicæ are frequently trabeculated. Trabeculæ (clearly to be distinguished from denuded branches of the pulmonary artery) invariably consist of blood-vessels and of collapsed or indurated alveolar substance. They are the remains of intervals of spongy tissue, originally separating distinct cavities. Their ulceration and partial absorption often give rise to a knobbed condition of the internal surface of cavities.

During the period of formation and of extension the walls of cavities are rough and ulcerous. But the completed cavity becomes surrounded by a fibro-vascular zone, the outer surface of which is continuous with the pulmonary tissue, whilst its innermost stratum constitutes, during the active stages, a pyogenic layer, and subsequently an exfoliating false membrane. Vomicæ thus invested are said to be *encapsulated.*

Important differences are noticeable in the condition of tissues around cavities. The capsule of a vomica may be immediately surrounded by alveolar substance, the expansion of which may exert a favourable amount of pressure upon it; or it may be continuous with inflamed and thickened tissue, or with tubercular infiltrations. In extreme cases the lung is to such an extent invaded by the fibrous growth from an adherent pleura, that the vomicæ present the appearance of having been formed at the expense of the fibrous tissue itself ('fibroid phthisis').

Situations. — No appreciable difference exists between the liability to excavation of the right and that of the left lung. Primary excavation almost invariably attacks the upper part of the upper lobe; its most common seat is the central part of the subclavicular region, not the apex proper; it may, however, extend to the very summit of the lung, or involve the greater part of the upper lobe. Phthisical destruction very rarely has its starting-point in the middle or in the lower third of the lung. The base of the lung, on the other hand, is the most common seat of those cavities which are not due to phthisis (for example, abscesses by extension, gangrene, and syphilitic ulceration).

The common form of phthisis, originally attacking the apex, implicates, almost without exception, the mid-dorsal region secondarily; this the writer has shown to be due to the transmission of irritating matter along the bronchus supplying that district. Similarly the base becomes affected in the latest stages of excavating disease, if life should be sufficiently prolonged.

Bronchi in relation to vomicæ.—Cavities not smaller than a lobule inevitably open into a bronchus. The communication may be temporarily obliterated, or it may in rare instances become permanently sealed. Most cavities exceeding the size of a single lobule intercept more than one bronchus; and the air-tubes ulcerate within them at an early period of the softening. Thus two sets of bronchial orifices may be recognised in vomicæ, the proximal and the distal, forming as many small islands of mucous membrane on the internal surface of cavities.

Blood-vessels in relation to vomicæ. — Trabeculæ always contain either patent or obliterated vascular branches. More resistant than all other structures, these vessels may become completely exposed and finally eroded. But aneurysm or erosion more commonly has its seat in those branches of the pulmonary artery which ramify in the thickness of the cavity wall, a fact readily explained by the persistence of circulation within these vessels, by their inability to retract, by the uneven support which their coats receive at different points of their circumference, and by their diseased condition. Fatal hæmorrhage may occur, without any warning, from the erosions or from the aneurysms. More habitually premonitory bleeding of limited extent recurs at short intervals prior to the fatal rupture. Pulmonary aneurysms sometimes undergo spontaneous cure when their growth is limited by the small size of the cavity which contains them; or the pressure of the extravasated blood may effect the same result subsequently to their rupture. It is almost the rule for aneurysms to occur simultaneously at different parts of the same lung.

Extension of vomicæ.—Cavities increase in size by the gradual necrosis of their inner wall; by the fusion of adjacent excavations; and by their encroachment upon fresh bronchial territories, which become the seat of similar ulceration.

Retrocession of vomicæ.—The *contraction* of cavities is essentially due to the shrinking of their capsule. This force is assisted in some cases by the expansion of the neighbouring spongy tissue, or even of the hypertrophied healthy lung; in other cases by the constricting pressure from a thick zone of fibrous tissue; indirectly also by the falling-in of the ribs, by the rise of the diaphragm, and by the abundant growth of new fibrous tissue in the thickness of the pleural adhesions.

The *retraction* towards the root of the lung, which is so commonly observed in chronic vomicæ, is partly due to the inflammatory thickening and shortening of the bronchus; it is often opposed by adhesions of the corresponding pulmonary surface to the chest-wall.

In their contracted state vomicæ may remain dormant for years. Final obliteration is rarely attained, chiefly owing to their deficient granulating power, and to the superficial necrosis of their opposed surfaces, both these conditions being the outcome of imperfect drainage.

Consequences of Excavation.—Amongst the *general* consequences of pulmonary excavation are loss of breathing-surface; exhausting suppuration, often leading to lardaceous degeneration of the organs; and tuberculosis. The chief *local* consequences are secondary deposits (pneumonic or tubercular) in the healthy portions of the lungs, as a result of the inhalation of the secretion of cavities, and of other products. Lastly, as the result of the contraction of cavities, we meet with local shrinking of the lung and collateral emphysema; various involutions of the pulmonary surface; various deformities of the thorax, &c.

Among the fatal accidents incidental to excavation rupture of aneurysms has already been referred to. Perforation of the lung, leading to pneumothorax, is a danger special to the more insidious varieties, in which the softening is rapid, whilst the inflammation is of low type and unaccompanied with the usual tissue-reaction on the part of the lung and pleura.

Diagnosis.—The ordinary methods of physical examination, by which the presence of cavities may be detected, are described in other articles (*see* Phthisis; and Physical Examination). A few points only claim specially to be noticed. Cavernous sounds are seldom given by cavities smaller than an ordinary filbert, probably owing to the small size of their bronchus. Cavities even of larger size are not infrequently completely masked by the interposition of spongy tissue; this is more especially the case in the tubercular forms. In the opposite condition of cirrhosis, cavernous sounds may be absent or very feeble, in consequence of deficient inspiratory movements. Lastly, the accidental blocking of a bronchus may suspend for a time all auscultatory evidence of excavation. The distance of the vomica from the surface may be roughly estimated from the intensity of the sounds; its degree of fulness from their liquid character; the smoothness of its walls from their amphoric nature; its compressibility by surrounding spongy substance, and its elastic resiliency, from the suction-sound sometimes heard during the respiratory pause following cough, aptly termed by Dr. Mitchell Bruce the *indiarubber-ball sound.*

A determination of the extent of the vomica can generally be attained by careful investigation. Sometimes, however, cavernous sounds are propagated beyond the excavated region by consolidation. Occasionally they are re-echoed at a symmetrical point in the sound lung, especially at the base. Phantom-caverns of this nature may be suspected whenever absolute identity in the position and in the auscultatory quality of the sounds on either side coincides with great disparity in percussion-resonance and in vocal fremitus.

Valuable information is derivable from the *sputa.* Abundant purulent discharge always indicates an active condition; if mixed with much mucus, it points to a coexisting bronchial catarrh; if shreddy and fœtid, to a cavity of some magnitude, imperfectly drained. The intimate admixture of blood indicates a congested state of the membrane. From the presence of abundant, well-preserved, elastic elements it is possible to diagnose the [illegible] forms of [illegible]; caseous lumps argue the existence of caseous pneumonia; the expectoration of calcareous particles shows that excavation is progressing at the expense of more or less fibrosed tissue resulting from former disease; and the discovery of bacilli of tubercle removes all doubt as to the specific nature of the affection. Lastly, the cessation of all secretion is indicative of a perfect quiescence of the vomica.

Prognosis.—In cavities not due to phthisis, the absence of the constitutional element greatly favours recovery; and their progress is mainly governed by the nature of their cause, by their size, by their situation, and by other influences enumerated below. Where healing is much delayed in such cases, the eventual development of phthisis is rendered probable.

The prognosis of phthisical vomicæ is intimately bound up with the prognosis of phthisis, a subject too wide for discussion here, but fully treated in the article Phthisis, and in Dr. James Pollock's work on *The Elements of Prognosis in Consumption.* Most unfavourable are the vomicæ due to a breaking up of tuberculo-pneumonic deposits. Vomicæ originating in pure tubercle, although they may contract, seldom heal. Where hæmorrhage occurring in a lung apparently quite free from disease subsequently leads to excavation, the closure of the cavity is encouraged by the contraction which characterises these cases. But the pneumonic class, which comprises the most rapidly fatal cases of excavation, also supplies the most striking instances of recovery. There exists a large clinical group in which the affection is limited to a small portion of one lung, and in which the disease is rather local than constitutional. On careful analysis of these favourable cases, the chief elements of their fortunate termination will be found to be the following: (1) unilateral character of the affection; (2) its small extent; (3) comparatively rapid occurrence of softening; (4) complete removal of the whole consolidation; (5) absence of close adhesions to the thoracic parietes; and (6) facilities afforded for collateral expansion.

Treatment.—The ideal treatment of cavities would have for its objects: (1) to restore healthy action to their surface; (2) to prevent a stagnation of their secretions; and (3) to encourage their contraction.

For the fulfilment of these indications various *surgical* measures have been practised: (1) free incision and injections (Barry, 1727); (2) paracentesis (Ramadge, 1836); (3) free incision and drainage (Hastings and Storks, 1845); (4) paracentesis and injections (Mosler, 1873); (5) needle-injections of medicated fluids (Pepper, 1874); (6) the resection of ribs over the site of a vomica, proposed by Neve (1887), and carried out by Quincke (1888).

Much was once expected of modern surgery in the treatment of excavating disease of the lung. Hitherto, however, there exists but meagre evidence to show that any good has resulted from surgical interference, and the range within which such interference is justifiable is very limited.

The *ordinary* methods of treatment comprise, in addition to the use of constitutional remedies:—

(1) Treatment by *inhalation* of medicated spray, of medicated vapours, of air charged with the natural exhalations from the sea, from pine-forests, &c. *See* Inhalation; and Climate, Treatment of Disease by.

(2) Treatment by *posture*, sometimes facilitating the drainage of cavities.

(3) Treatment directed to the enlargement of the thorax and to the *expansion* of the lungs, such as exercise of the thoracic muscles, inhalation of rarefied air, and especially residence at high altitudes.

Wm. Ewart.

VOMIT: Examination of Vomited Matters.—Vomited matters may consist either of substances present in the stomach when vomiting begins, or of substances entering it during the process. Those present in the stomach *when vomiting begins* include articles of food and drink, drugs, poisons, or other ingesta, more or less altered by digestion or fermentation; saliva, epithelium, mucus, pus, or blood from the nasal passages, mouth, pharynx, or œsophagus; fluid or mucus secreted by the stomach itself, epithelium-cells, casts of tubules, or even shreds of gastric mucous membrane, blood more or less altered proceeding from the walls of the stomach, cells, or small pieces from morbid growths, and occasionally, as mentioned by Sir Richard Quain, the whole of a pedunculated morbid growth; fungi, as torulæ and sarcinæ; parasitic worms; bile; pancreatic juice; pus from abscess of the stomach or liver; or fæculent matter from the intestine. *During vomiting* much saliva may be swallowed; and bile, pancreatic juice, pus or fæces, not originally present in the stomach, may be pressed into it by the straining. Effusion of blood into its cavity may also be caused by the efforts of retching.

Method of Examination.—In examining the vomited matters it is advisable, first, to separate the larger pieces of undigested food by filtering the vomit through canvas or muslin.

The *solid residue* may be investigated by washing the larger pieces and tearing them up, or making sections of them, so that their nature may be ascertained. Partially digested curd is sometimes not very easy to recognise. If a large quantity of milk have been drunk at one time, the curd which it forms in the stomach may, when vomited, have the appearance of a piece of thick, dense, grey felt.

The *filtrate* should be put into a conical glass and allowed to settle. The reaction of the fluid is to be ascertained by litmus paper. The presence of free hydrochloric acid may be tested for, by putting one drop into a watch-glass containing a 1 per cent. solution of tropeolin, the yellow colour of which is converted into a wine-red if hydrochloric acid be present. Another test is a solution of phloroglucin two parts, vanillin one part, and absolute alcohol thirty parts. A few drops of this are placed with an equal bulk of the filtrate in a porcelain dish and gently heated. If hydrochloric acid be present a deep or bright red colour is produced; if it is absent the colour is brownish-red or brown. The total acidity may be estimated by filtering, and adding a standard solution of caustic soda or potash to a measured quantity of the filtrate, until it is neutralised. For the methods of examining more particularly the various acids—lactic, acetic, butyric, &c.—and other volatile substances, *see* Stomach, Diseases of: 4. Cancer.

To ascertain the presence of pepsin in the vomit we add to it its own bulk of dilute hydrochloric acid (ten minims of diluted hydrochloric acid, B.P., to an ounce of water) and a flock of fibrin or a piece of hard-boiled white of egg; let it stand for several hours in a warm place; and then see whether or not the fibrin or albumen is dissolved.

To test for trypsin, we proceed in the same manner, but use the vomit without the addition of acid; and if it be already acid, neutralise it with bicarbonate of sodium.

To test for rennet, we add some neutralised filtrate to some neutral milk, and let the mixture stand at 98° for half an hour. If rennet is present coagulation will occur.

To test the vomit for peptone, we must put some of it into a small dialyser, and let it stand for some hours. We then add to the water in which the dialyser has stood, solution of corrosive sublimate, which gives a precipitate with peptones; or some liquor potassæ and a drop of very dilute sulphate of copper solution, which gives a precipitate dissolving on shaking, and forming a red solution, changing to purple when more copper is added.

Bile is tested for in the filtered liquid by Gmelin's and Pettenkofer's tests.

For blood in the vomit, *see* HÆMATEMESIS.

If the vomited matter be too thick to allow the sediment to subside, a little of it should be mixed with some distilled water and allowed to settle. A drop of the sediment is then to be examined microscopically; and the examination is facilitated by adding to one specimen a drop of iodine solution, and to another a drop of aniline red or blue solution. The substances most likely to occur are partially digested fibres of voluntary or involuntary muscle, elastic fibres, connective-tissue bundles from meat in the food, spiral fibres and green chlorophyll-granules from vegetables, starch-granules (stained blue by iodine), torulæ or sarcinæ, blood-corpuscles, leucocytes, scaly epithelium from the mouth, cylindrical epithelium from the stomach, and casts of the gastric follicles—sometimes fibrinous, sometimes composed of cells and granules which take up the aniline colour and are thus rendered more easily visible.

Poisons in vomited matters must be searched for by special chemical methods.

Clinical and Pathological Indications.—If the vomited food be unchanged, or but little changed, it indicates either that the vomiting has occurred soon after a meal, or that the secretion of gastric juice is deficient either in quantity or in quality. The food is usually comparatively little changed in nervous vomiting, or in cancer of the cardiac extremity of the stomach. In vomiting from cancer of the pylorus, or duodenal ulceration, the food is much more digested, as it remains much longer in the stomach. If undigested food be vomited some hours after a meal, the vomit should be examined in order to ascertain whether pepsin or acid be deficient. Complete absence of hydrochloric acid has been observed in cases of cancer and amyloid degeneration of the stomach, and a deficiency of this acid has been found experimentally in acute anæmic and febrile conditions. Abnormal acidity from fermentation of saccharine or farinaceous articles of food, and the consequent production of acetic, lactic, and butyric acids, occurs in chronic catarrhal conditions. In some cases of gastric catarrh starch appears to undergo a mucous fermentation, and large quantities of glairy material are formed. When fermentation has gone on to a great extent, the vomit may have a yeasty look, and should then be examined for sarcinæ and torulæ. *See* SARCINA; TORULA; and STOMACH, Diseases of: 7. Dilatation.

Sometimes large quantities of a watery fluid are vomited. This is occasionally alkaline or neutral, contains potassium sulphocyanide, and digests starch. It consists of saliva, which has been secreted abundantly on account of reflex irritation arising from the stomach, and swallowed. At other times it is strongly acid, and appears to be secreted by the stomach. Sometimes the vomit appears to be a mixture of both of these fluids. Such vomiting may occur from nervous disturbance of the stomach, but may be symptomatic also of catarrh, ulcer, or cancer. Mucus in the vomit indicates catarrh of the gastric mucous membrane; and the more acute the inflammation, the more leucocytes occur in the mucus. Bile may be vomited pure, in the form of a tasteless golden-yellow substance like yolk of egg, from the action of poisons, but this rarely happens. Vomiting of bile, more or less green and diluted, or mixed with digestive secretions or food, occurs as a symptom in congestion of the liver; but it may take place in all kinds of vomiting, whatever its cause. Large quantities of bile, mixed with the secretions from the mouth and stomach, and forming a grass-green liquid (*vomitus æruginosus*), may be vomited in peritonitis and cerebral affections. The writer has also observed this character of vomit in opium-eaters. Constant absence of bile, when vomiting is persistent, points to pyloric stenosis. Pus may get into vomit from the bursting of an abscess in the mouth or tonsils; it sometimes, though rarely, may arise from an abscess in the walls of the stomach; but it is more likely to come from abscess of the liver. Blood vomited in large quantity, and of a bright red colour, usually indicates ulceration of the stomach or cirrhosis of the liver. More or less altered, and in smaller quantity, it occurs in the diseases just mentioned, and also in cancer and yellow fever (*see* BLACK VOMIT; and YELLOW FEVER). It may also be present in hysterical persons who have swallowed blood, obtained from external sources, or by sucking hollow teeth. Cancer-cells in the vomited matters are diagnostic of the presence of malignant disease.

T. LAUDER BRUNTON.

VOMITING (Lat. *vomo*).—Synon.: Fr. *Vomissement*; Ger. *Erbrechen*.

Definition.—Forcible expulsion of the contents of the stomach through the œsophagus.

Ætiology and Pathology.—Two things are necessary in vomiting, namely, squeezing of the stomach, and relaxation of its cardiac orifice. Although the muscular fibres of the stomach itself may contract under the action of emetics, they seem to be unable to expel its contents unless aided by external pressure, for when the muscles of the abdomen are cut across vomiting does not occur. When the diaphragm and abdominal muscles are paralysed, vomiting is impossible, though the stomach may be in active movement. The stomach is not necessary to vomiting, which will occur when that organ is excised, and a simple bladder tied in its place; but when the stomach is present, mere pressure upon it by the diaphragm and abdominal muscles, as in coughing, does not expel its contents. In vomiting, the contents of the stomach are squeezed out of it by the mechanical pressure of the diaphragm and abdominal parietes contracting simultaneously. When these muscles contract, if the cardiac orifice of the stomach remains closed, an ineffectual effort at vomiting, or retching, occurs; but if the cardiac orifice dilate, the gastric contents are expelled. The cardiac orifice is relaxed by means of the longitudinal fibres, which run along the under end of the œsophagus below the diaphragm, and then radiate completely over the stomach. When they contract they dilate the cardiac orifice, and at the same time aid the evacuation of the stomach by drawing the whole viscus towards the diaphragm. In the act of vomiting, then, the simultaneous contraction of three sets of muscles is required: (1) of the diaphragm, (2) of the abdominal wall, and (3) of the muscular fibres just mentioned in the stomach itself. The movements of these muscles are coördinated by a nervous centre, situated in the floor of the fourth ventricle in the medulla oblongata. This centre is closely associated with, though of course not identical with, the respiratory centre. The motor impulses from this centre are sent to the abdominal muscles, diaphragm, stomach, and œsophagus, by the intercostal, phrenic, and pneumogastric nerves respectively. The reasons for supposing that the nervous centre for vomiting is closely associated with the respiratory centre, are that the movements of vomiting are modified respiratory movements, that emetics excite the respiratory centre, and that their action is usually preceded by increased respiratory movement, while depression of the activity of the respiratory centre stops vomiting. When the blood is rendered very arterial by excessive respiration, a condition of apnœa, in which no need of respiration is felt, and no respiratory movements are made, is produced; but if emetics are then injected into the veins, respiration not only becomes more frequent, but apnœa can no longer be induced, unless the activity of the respiratory centre be lowered by narcotics.

The vomiting centre is usually excited to action by irritation of certain *afferent nerves*. These may act either directly upon it, or through the medium of the brain. The nerves of special sense act through the brain. The sight of a disgusting object, a disagreeable stench, or an unpleasant taste, may excite vomiting, and it may also be produced by the simple thought of such subjects. A blow on the head, or inflammation of the brain or its membranes, also excites vomiting. According to Budge, the cerebral centres for the movements of the stomach are in the right corpus striatum, and especially in the right optic thalamus. When these parts are irritated the stomach moves. Irritation of the corresponding parts on the left side of the brain does not affect the stomach. Vomiting occurs in certain cerebral conditions, either affecting the brain itself or its membranes, such as cancer or tubercle of the brain, apoplexy, cerebellar hæmorrhage, softening of the cerebral substance, sometimes encephalitis, poisoning by narcotics, melancholia, profuse hæmorrhage, or tubercular meningitis. It is also one of the symptoms of Menière's disease of the semicircular canals. It also occurs in various diseases, in which, however, it is difficult to say whether the vomiting be due to direct affection of the brain itself, or to reflex action upon it from other organs. Such diseases are typhus, plague, yellow fever, cholera, and the cold stage of ague. Very painful impressions on sensory nerves throughout the body may excite vomiting. This is seen in cases of loose cartilages in the knee, in dislocation of a joint, or in a painful wound or operation. Here, also, it is uncertain whether the vomiting be produced through a direct connexion of sensory nerves with the vomiting centre, or whether the irritation acts indirectly through the cerebrum.

Certain afferent nerves appear to have a more direct connexion with the vomiting centre than others, and these require special consideration:—

(1) *Branches of the glosso-pharyngeal nerve to the soft palate, the root of the tongue, and the pharynx.*—These parts have a very close connexion with the vomiting centre, and tickling them with the finger or with a feather is one of the readiest means of inducing vomiting.

We find vomiting occurring in inflammation of the soft palate or tonsils, and also of the pharynx, especially in children.

(2) *The nerves of the stomach.*—The sensory nerves of the stomach are chiefly

branches of the vagi, but they belong partly also to the sympathetic system. When the vagi are cut, vomiting becomes difficult, but efforts at retching occur, and the writer has seen vomiting take place from the action of emetics after section of the vagi. It is therefore evident that irritation of the stomach produces vomiting reflexly through other nerves than the vagi. Vomiting may occur from irritant substances in the stomach, whether introduced into the stomach, or formed within it; from irritation within the stomach, due to an inflamed or irritated condition of its walls; or from mechanical pressure, from without or from within. Thus it may occur from the presence of undigested food, from irritating substances produced by imperfect digestion, or from irritant poisons within the stomach. It may be due to catarrh or congestion of the mucous membrane itself, to softening of the mucous membrane, or to ulcer or cancer in the gastric wall. It may be produced by extreme distension of the stomach, by gas, liquids, or solids; by compression of a part of it within the body, as in hernia of the stomach; or by the pressure of a tumour upon it. It may be caused by violent compression externally with the hands; by the pressure of a too tightly laced corset; by the pressure against the abdominal walls of hard tools or benches in certain trades. It frequently occurs in cough, especially the cough of phthisis; but here it is probable that the vomiting is due partly to the violent compression between the diaphragm and abdominal walls, and partly to the congestion of the vessels which the continued interruption of the circulation during the fit of coughing brings on.

(3) *The nerves of the liver and gall-ducts.*—These consist chiefly of branches of the vagus and sympathetic. From irritation of them vomiting occurs in hepatitis, or during the passage of a biliary calculus. It is from irritation of these branches, also, that vomiting may occur in pleurisy of the right side, the congestion of the pleura on the upper surface of the diaphragm having led to congestive changes in the liver.

(4) *Intestinal nerves.*—Ligature of the intestine in animals produces vomiting, which is arrested by dividing the nerves passing from the ligatured parts. In man it is the almost invariable accompaniment of strangulated hernia or intussusception, and it may even occur in obstruction of the bowel by fæcal matters in cases of obstinate constipation. It also takes place in peritonitis from irritation of these nerves.

(5) *The renal nerves.*—Vomiting occurs from irritation of these nerves, as by calculi in the pelvis of the kidney or passing down the ureter, and also in nephritis.

(6) *Vesical nerves.*—In cystitis vomiting occurs. It may possibly be due, however, not to irritation of the vesical nerves, but to extension of inflammation to neighbouring parts.

(7) *Uterine nerves.*—Irritation of these nerves is one of the commonest causes of reflex vomiting. It may be produced in animals on irritation of the uterine plexus, and occurs in the human subject during pregnancy or in metritis.

(8) *Ovarian nerves.*—Vomiting is a symptom of inflammation of the ovaries.

(9) *The nerves of the testicle.*—A blow on this organ tends very readily to produce nausea and vomiting.

The cause of vomiting in *sea-sickness* is uncertain; but it appears to the writer to be partly due to the condition of the nerve-centres, and partly to that of the viscera. *See* SEA-SICKNESS.

TREATMENT.—The treatment of vomiting is to be directed to two ends—(1) *to remove the cause* if possible; and (2) to *lessen the irritability of the vomiting centre.* The chief drugs which lessen the irritability of the vomiting centre are opium, morphine, bromide of potassium, chloral hydrate, and probably, also, hydrocyanic acid and belladonna. Strychnine and small doses of ipecacuanha are also useful in vomiting, and they probably owe their power to their action on the vomiting centre. Most of these drugs have a local sedative action on the stomach, and therefore it is advantageous to give them by the mouth when possible. Even when the stomach is very irritable, they may be retained by giving them in a concentrated form. When the stomach will not retain them, they must be given by the rectum or by subcutaneous injection. In sea-sickness the effect of the position of the head is sometimes very marked, and the vomiting may occasionally be arrested completely by removing all pillows and putting the head on a level with, or rather lower than, the body.

In cases of disease of the brain or its membranes, where it is difficult or impossible to remove the cause, we must try to lessen the congestion by means of leeches and cold applications to the head; and also to soothe the vomiting centre by diluted hydrocyanic acid, or by bromide of potassium. At the same time, however, considerable benefit is obtained from the use of remedies which act locally on the stomach, these seeming to have some reflex effect upon the vomiting centre. One of the most useful is ice, which may be constantly sucked, and also swallowed in small lumps. Where the vomiting is dependent on the action of the poisons circulating in the blood, as in the later stages of contracting kidney, we must endeavour to eliminate these by increasing the action of the kidneys and of the skin. In vomiting dependent on inflammation of the mouth and fauces, we lessen the irritability by soothing or astringent gargles, confections, or glycerine. A confection or glycerine is often better than a gargle, inasmuch as it remains longer attached to the parts, and thus exercises a more prolonged effect upon them. When vomiting is due to irritant substances in the cavity of the stomach, such as indigestible food, and acrid fluids or poisons, it is best treated by evacuating them. A large draught of lukewarm water, alone or mixed with a teaspoonful of mustard, is one of the best means. Large draughts of warm water alone, even if they are not ejected, may give relief by diluting the acrid substances in the stomach so much as to prevent their irritating the mucous membrane. In this way they sometimes relieve sick-headaches. It is of great importance sometimes, not only to prevent the formation of acrid substances by slow and imperfect digestion, but to prevent the mechanical irritation of the mucous membrane by undigested food. For example, we not infrequently notice that sickness and vomiting will occur in susceptible individuals after meals containing such substances as are not only slowly digested, but are swallowed in lumps. Examples of these are uncooked apples and cheese, or even potatoes, especially when imperfectly boiled or new. These articles, instead of being crushed to a powder by the teeth, are swallowed in lumps of considerable size, and apparently, instead of passing the pylorus, are retained in the stomach, and, partly by the mechanical irritation, and partly by their giving rise to acrid products, cause sickness. Milk, when swallowed in large draughts, or when there is too much acidity in the stomach, instead of falling in fine flakes will coagulate in large lumps, which have a similar effect to cheese. To prevent this it is advisable to mix the milk with soda-water or lime-water, or to take it, as in the whey cure, by sipping.

When vomiting is due to slow or imperfect digestion, which allows decomposition or fermentation of food to take place in the stomach, it may be arrested by improving the digestion. Thus five grains of calomel, by acting on the stomach through the liver, may arrest vomiting; and tincture of walnut (the active principle of which, juglandin, is an hepatic stimulant) has also been recommended. Pepsin also, by facilitating digestion, may prevent vomiting; and bitters, such as calumba, may do so by preventing putrefaction or fermentation.

When decomposition or fermentation of food, with formation of acrid or irritating products, has once set in, it may continue a long time, as the organisms which cause it remain constantly in the stomach, and renew the process in every fresh supply of food. It may be stopped by antiseptics. Where the vomited matters are frothy and yeasty-looking, the sulphurous acid of the Pharmacopœia, in doses of one fluid drachm, diluted with half a wine-glassful of water, often arrests such vomiting like a charm. Creasote has a similar action, but possibly has some additional action on the nervous system, as it is useful even in cases where the vomiting does not appear to be due to decomposition of food. In dilatation of the stomach these antiseptics may fail, and the best results are obtained by washing out the stomach by a syphon-apparatus. *See* LAVAGE.

For the treatment of irritant poisoning, *see* POISONS.

When the mucous membrane of the stomach itself is inflamed or irritated, we must try to lessen the irritation. The best drugs for this purpose are ice, diluted hydrocyanic acid, opium, and bismuth. The insoluble salts of bismuth, and especially the subnitrate, are to be preferred to the solutions; and it is advisable to combine them with magnesia, potash, soda, or carbonate of lime, according to the condition of the intestines, preferring the magnesia when the bowels are confined, and carbonate of lime when they are too loose. Sometimes the tendency to vomit is increased by lying on the right side. This is probably partly due to the drag of the stomach itself upon the cardiac extremity, and partly to the difficulty with which gaseous eructations escape from the stomach in this position. When there is a tendency to vomit, therefore, the patient should lie down on the left side after a meal. In the vomiting of hepatitis, in addition to opium and diluted hydrocyanic acid, we may use ice-water, or ice swallowed, and leeches over the liver. In biliary calculus, we may give, along with opium, a full dose of ether internally, and in addition may employ ether or chloroform by inhalation; similar treatment may be adopted in cases of renal calculus.

In intussusception or hernia we must remove the cause, if possible. In peritonitis full doses of opium are best. For the vomitting in cystitis and ovarian diseases we must lessen the sensibility of the vomiting centres by the drugs already mentioned, and treat the local conditions.

In the vomiting of pregnancy we trust partly to the drugs already mentioned to act on the vomiting centre, and partly to local applications. It is sometimes arrested by the application of a 10 per cent. solution of nitrate of silver to the os uteri, or by slight detachment of the membranes around the margin of the internal os. Where all other methods fail, the induction of premature labour must be resorted to. *See* PREGNANCY, Diseases and Disorders of.

T. LAUDER BRUNTON.

VOYAGES.—*See* SEA-VOYAGES.

VULVA, Diseases of.—SYNON.: Fr. *Maladies de la Vulve*; Ger. *Krankheiten der Schamritze.*—The vulva or external genitals of the female comprise all the structures external to the hymen, having the navicular fossa and perinæum behind, the urethral orifice, vestibule, clitoris, and mons Veneris in front, and at the two sides the nymphæ and labia majora. These parts may be the seat of many diseases, which will be described in the following order:

1. **Atresia Vulvæ.**—Closure of the genital fissure is sometimes found as a congenital malformation. This is usually of itself of no great importance, as it is almost always associated with other defects in development, as with atresia ani, hermaphroditisms, and extroversion of the bladder. *Acquired* atresia results from mismanagement of infantile vulvitis, from injuries of the pudenda in childhood, or from cicatrisation following upon some ulcerative process. It may give rise to trouble in micturition if the urethral orifice be involved. In rare cases it is only after puberty that trouble arises, from retention of the menses, or after marriage, from dyspareunia; or even during labour, from narrowness of the orifice delaying the escape of the infant. In the slighter and more recent cases, where the labia have only been agglutinated, they may be torn apart by pressure with the thumbs; or by passing a probe or sound behind the line of adhesion, and tearing it up with the handle of a scalpel, or with the nail. Where the union has become organised, the edge of the knife must be employed. In any case the patient should be anæsthetised; and care must be taken subsequently to prevent the reproduction of the adhesions.

2. **Inflammation.**—Synon.: *Vulvitis.*—Inflammation of the vulva may be (*a*) *general*; or (*b*) *localised.*

(*a*) *General vulvitis.*—This variety is found affecting the apposed aspects of the labia, and the whole of the mucous surface they enclose, up to the borders of the hymen. It may be due to gonorrhœal infection, in which case the catarrhal process is apt to extend to the urethra and the vagina. In infants and young children of strumous constitution, it sometimes arises from exposure to cold, want of cleanliness, or irritation from ascarides that have passed out of the anus. In the adult it may result from injury, or rude coition; or from the escape of acrid uterine or vaginal discharges. It shows itself with heat, and tenderness, or sometimes itching in the part; a discharge of viscid glairy mucus bathes the surfaces, which sometimes becomes purulent, and glues together the labia. When the labia are separated the seat of the mischief is exposed, and is seen to be red, and sometimes resentful of touch. Apart from the constitutional remedies that may be indicated in individual cases, the treatment consists in keeping the parts at rest, and carefully clean; and in bathing or douching the surface with hot water, followed by an astringent lotion or dusting powder.

(*b*) *Localised vulvitis.*—The vulvitis may be localised—(*a*) in the *vestibule*; (β) in the *navicular fossa*; or (γ) in the muciparous *follicles* and *glands*, and especially in the *Bartholinian glands*. (β) and (γ) occur under the same conditions as the more diffused inflammation, and may be a source of considerable distress in walking or when the part is touched, without being attended by any leucorrhœal discharge. Such cases require the same treatment as cases of general vulvitis; only it is important to make the applications directly to the affected spot, and hence it is usually best to apply sulphate of copper in the form of a solid crystal. (γ) Inflammation in the Bartholinian glands is the commonest cause of *labial abscess.* It may attack females at any age, but is most frequently seen in women from twenty to thirty, whether married or unmarried. It may arise during pregnancy, and some women are liable to repeated attacks, the glands becoming swollen and cystic whenever the patient gets a chill. In some cases there is profuse secretion, which escapes freely. Far more frequently the swelling in the lining of the duct leads to occlusion. This occlusion is in some instances transitory, and when the swelling in the duct and around its orifice subsides, the secretion that had accumulated escapes. In other instances the duct becomes permanently closed. These are the cases where the patient acquires a swelling in the labium majus of the affected side, varying in size from a pigeon's to a hen's egg. The accumulated fluid may be clear and limpid; but often it is turbid and distinctly purulent. In all the suppurative cases, if the cyst be evacuated through a small opening, the fluid is apt to reaccumulate, and the cyst walls are now more likely to be the seat of a mischievous inflammation. So that the *treatment* consists, first, in trying to reduce the inflammation with hot fomentations or poultices, perhaps aided by sedative lotions containing belladonna or laudanum, with the view of getting the orifice relaxed; and where the contents do not escape through the duct, the cyst should be freely opened, and the cavity cauterised. Huguier's suggestion, to extirpate the gland, is not ordinarily required, especially if the evacuation be effected with a Paquelin's thermo-cautery, which first makes a large and safe cut into the cyst, and can then be applied to the interior, so as to destroy the secreting surface.

Specific inflammations.—The specific inflammations, *gonorrhœal* and *syphilitic*, are treated of in their respective articles. But it is to be noted that the vulva may be the seat of *erysipelas*; and female children have sometimes suffered from a gangrenous vulvitis or *noma*, of the same nature as the noma of the mouth and cheeks, which may come on after some of the eruptive fevers, such as scarlatina, and require the same kind of treatment, with chlorate of potassium and tincture of the perchloride of iron and stimulants, from an early stage of the mischief.

3. **Eruptions.**—Various forms of eruption may be met with in the vulva, sometimes on the nymphæ or internal aspect of the labia majora, sometimes on the external aspect, and extending to the mons Veneris, or inside of the thighs. The commonest are *eczema*, *erythema*, *herpes*, *prurigo*, and *acne*. They are diagnosed and treated in the same way as the same affections in other situations. It is to be remembered, however, that the tendency to chronicity, which is a marked feature of inflammatory processes in the sexual apparatus generally, is apt to show itself in these vulvar eruptions, and that patients, from motives of delicacy, are apt to allow them to remain untreated for too great a length of time. Further, many of them give rise to itching, which tempts the patient to rub and scratch herself to obtain relief, and may thus cause pruritus.

4. **Pruritus.**—Ætiology.—Itching of the vulva is a not infrequent symptom of some of the eruptive and inflammatory affections of the part, either when these are healing or have got into a chronic stage; and it may remain as a permanent trouble after healing has taken place, if the patient have acquired the habit of relieving herself by friction. Sometimes it is reflex, from oxyuric irritation in the rectum, or when the worms have travelled from the anus to the vulva. Or it may be associated with disease of the vagina or uterus, as in cases of chronic colpitis or carcinoma of the cervix, in which the itching may either be due to irritation from the nature of the discharge, or be a reflex phenomenon. In some instances it can be traced to circulatory disturbance in the labia, as when the veins are enlarged, and in the congestion of early pregnancy. In others the renal secretion is at fault; and it is such a common phenomenon in women who are the subjects of diabetes mellitus, that in every patient who suffers from pruritus vulvæ, the urine should be tested for sugar. Lastly, there are some cases that can only be described as idiopathic.

Symptoms.—The itching may be localised on the internal aspects of the nymphæ, or of the labia majora, or around the clitoris or the perinæum. In most cases of long standing it becomes diffused all around to the anus and inside of the thighs. Sometimes it is temporary, as in the pruritus of pregnancy, which passes off under careful management in a few weeks, or in rarer cases during the puerperium; in other patients it becomes chronic, and constitutes one of the most distressing troubles to which a woman is liable. The itching may come on only occasionally. For the most part it is likeliest to prove distressing when the patient is warm, as at bedtime, or after exercise; but with some the feeling is never quite in abeyance, and the patient has the almost constant desire to relieve herself, as for a time she can do, by scratching or, rather, rubbing the parts with her dress or a towel, until the pain overcomes the feeling of itch, or sometimes until the collapse consequent on the onanistic orgasm which she has involuntarily produced, renders her for a time less sensitive to her trouble. The result of such friction, however, is to keep up the local irritation; so that even in cases where there may not originally have been any local pathological change, but where the itching and friction have persisted for months or years, the skin and mucous membrane become thickened and indurated, and a condition resembling that of a chronic eczema becomes induced. In several cases the writer has seen epitheliomatous nodules develop at the sides of the clitoris and in the vestibule.

Treatment.—When diabetes mellitus is present it must be combated; and if the patient is gouty, or have her urine too acid or alkaline, these conditions must be rectified. Morbid processes that may be present in the vulva or other neighbouring structures must be treated according to the requirements of the case. A carefully regulated non-stimulating diet should be enjoined, and a due amount of exercise. The internal remedies that have been found most helpful are bromide of potassium and arsenic. Then, for the relief of the itching, the patient must be warned against the danger of rubbing the parts, and be taught to soothe it by bathing with very warm or sometimes with cold water, and drying the parts with a soft towel or napkin. It can be still better allayed by mopping with a lotion containing infusion of tobacco or belladonna or opium; or by applying afterwards a piece of lint soaked in black lotion, or a lotion of acetate of lead. The most effectual sedatives are ointments containing sulphur, camphor, tar, carbolic acid, thymol, iodide of lead, perchloride of mercury, bismuth, prussic acid, iodoform (deodorised with tonquin bean), or cocaine. In several otherwise intractable cases, patients in private practice and in the Buchanan ward of the Royal Infirmary of Edinburgh have been cured by ablation of the clitoris and surrounding mucous membrane, as far back as the vaginal orifice, and bringing the raw surfaces together by means of catgut sutures.

5. **Tumours.**—The following enlargements may be found in the volva:—

(*a*) *Hypertrophy.*—The clitoris has sometimes been found of a size sufficient to cause discomfort, and warrant its removal. Far more frequently the nymphæ are of unusual dimensions, their margins projecting beyond the labia, and then they are liable to become the seat of ulcerative processes, and require to be trimmed, which may be done with the knife or scissors, but better with the thermo-cautery. Enlargements of the labia majora, in the form of elephantiasis, are met with among Hindu women. The mass is sometimes of enormous size, and in consequence of the calibre of the nutrient vessels, ablation is apt to be attended with dangerous hæmorrhage, so that the application of an elastic ligature is in most cases the best means of effecting its removal.

(*b*) *Hernia.* Hernial protrusions may occur into the labia, and be found among the swellings of this part. The detection and treatment are to be effected and conducted as in the case of other herniæ.

(*c*) *Cysts.*—Cystic swellings are found in the upper part of the labia, when the canal of Nuck becomes the seat of an accumulation of fluid, which corresponds to hydrocele of the cord in the male; or lower down, when the duct of a Bartholinian gland has become occluded, and the secretion of the acini accumulates so as to distend the gland without its becoming inflamed. If a complete aspiration in either case is not followed by perfect cure, and the fluid reaccumulates, as it is apt to do, the second tapping should be accompanied with an injection of iodine; and in the case of the Bartholinian cyst, the wall of which is formed of a mucous rather than of a serous membrane, the evacuation may require to be effected through a larger opening, and followed by the application of a more powerful escharotic.

(*d*) *New-growths.*—Various neoplasms may have their seat in the vulva. At the orifice of the urethra not infrequently small red fleshy growths, the so-called *urethral caruncles*, make their appearance. They are sometimes unattended with any symptom; more frequently they cause intense suffering during micturition, during coitus, or when the patient takes exercise. The pain is usually referred to the urethral orifice, but it is sometimes reflected to distant parts, as to the heel. Relief from suffering may be temporarily obtained by application of sulphate of copper or nitrate of silver; but cure is only effected by removal of the growth. It is imperatively necessary to remove not only the small red body, but the portion of the urethra from which it springs, and the raw surface should be freely cauterised if the ablation have not been effected with a thermo-cautery. *Specific* swellings, warty or gummatous, are, of course, frequently to be met with on the vulva. *Lipomata* sometimes grow under the skin of the labia pudendi. More frequently *fibromata* occur, which may attain considerable size, and demand removal. Lastly, the law that *carcinomata* have a predilection for surfaces where a transition takes place from one variety of epithelium to another, is illustrated by the frequency with which different forms of cancer affect the vulva. Their development, symptoms, and treatment present no special features. Only it is well to remember that when the mischief is met with in a stage where there is still hope of its eradication, it is best to effect the removal of the neoplasm by some of the bloodless methods with which modern surgery has become familiar. The tissues in which the growth develops are very vascular; and whilst in some situations—as at and around the clitoris—it is comparatively easy to control hæmorrhage by pressure against the pubic bones, in the parts immediately to the side and back of the vaginal aperture the bleeding from a cut surface is apt to be uncontrollable and dangerous. Hence commencing carcinomata ought to be extirpated with the écraseur, or, better still, with Paquelin's thermo-cautery, which is the most serviceable of all instruments for the removal of the different varieties of neoplasm that infest the vulva.

Alexander Russell Simpson.

W

WAKEFULNESS.—*See* Sleep, Disorders of.

WARTS.—*See* Verruca.

WASTING.—A synonym for atrophy. *See* Atrophy, General; and Atrophy, Local.

WASTING PALSY.—A synonym for progressive muscular atrophy. *See* Progressive Muscular Atrophy.

WATER, Ætiological Relations of.—*See* Disease, Causes of; and Public Health.

WATER, Therapeutics of.—*See* Baths; Hydrotherapeutics; Mineral Waters; Sea-air, Sea-baths; and Temperature.

WATER BRASH.—A popular synonym for pyrosis. *See* Pyrosis.

WATER CANKER.—A synonym for cancrum oris. *See* Cancrum Oris.

WATER-ON-THE-BRAIN. — A popular name for hydrocephalus. *See* Meninges, Cerebral, Inflammation of, Tubercular; and Hydrocephalus, Chronic.

WATERS, MINERAL.—*See* Mineral Waters.

WAXY DISEASE.—One of the synonyms for albuminoid disease. *See* Albuminoid Disease.

WEAL, WALE, or WHEAL.—This is an old-English word signifying the mark of a stripe, that is, the prominent pale ridge caused by the stroke of a lash upon the skin. In Medicine the term is applicable especially to the prominent risings of a lengthened figure which are met with in urticaria, in contradistinction to the button-like tubercles or protuberances of that affection. *See* Urticaria.

WEILBACH, in Nassau, Germany. Sulphur waters. *See* Mineral Waters.

WEN.—A popular term for a tumour of the integument, without reference to its pathological structure. Wens are commonly fleshy or encysted; in the latter case proceeding from distension of the sac or excretory duct of a cutaneous gland, more especially a sebaceous gland.

WESTON-SUPER-MARE, in Somerset.—A fresh, open, marine climate. Exposure W. Prevailing winds S.W. Mean temperature for the year 49·8° F. *See* Climate, Treatment of Disease by.

WET-PACK. — *See* Hydrotherapeutics.

WEYMOUTH, in Dorset.—A bright, open, marine climate. Exposure E. Mean temperature for the year 50·1° F. *See* Climate, Treatment of Disease by.

WHEEZING.—A peculiar sound, of a dry piping or whistling character, which may be heard in connexion with the respiratory organs during the act of breathing, and caused by certain forms of obstruction to the passage of air. *See* Asthma, Spasmodic; Bronchi, Diseases of; and Physical Examination.

WHIFFING.—A peculiar quality of a murmur heard in connexion with the heart and vessels. *See* Heart, Valves and Orifices of, Diseases of; and Physical Examination.

WHIP-WORM.—This term is not infrequently applied to the small human nematode that is better known to the profession as the *Trichocephalus dispar*. *See* Entozoa.

WHISPERING PECTORILOQUY. A form of pectoriloquy in which the whispered voice is distinctly heard. *See* Pectoriloquy; and Physical Examination.

WHITE GUM.—A popular name for the white form of strophulus, *S. albidus*. *See* Strophulus.

WHITE LEG.—A common name for phlegmasia dolens. *See* Phlegmasia Dolens.

WHITE SWELLING.—A common name for scrofulous or tuberculous disease of a joint. *See* Joints, Diseases of.

WHITES.—A common name for leucorrhœa. *See* Leucorrhœa.

WHITLOW.—Synon.: Paronychia; Fr. *Panaris*; *Tourniole*; Ger. *Paronychia*.

Definition.—Whitlow is a term somewhat loosely applied to any acute inflammation of the finger or thumb which tends rapidly to terminate in suppuration, and is not limited to the matrix of the nail, in which case it would be called *onychia*.

Whitlow may be divided into four chief varieties, but these often merge into one another: (1) Paronychia Ungualis; (2) Paronychia Cellulosa; (3) Paronychia Tendinosa; and (4) Paronychia Osseosa.

1. **Paronychia Ungualis.** — Synon.: Superficial Whitlow of Abernethy.—This form is limited to the ungual phalanx. The skin only is affected, and frequently at the side of the nail. It commences usually as the result of some slight injury, such as a bruise or puncture, or from the inoculation of septic or other irritating matter. The first signs are heat, tenderness, and itching in the inflamed part. The pain is not severe. On the third or fourth day pus forms, raising the epithelium from the cutis vera. As the pus cannot point through the dead cuticle, it remains pent up, and the tension so caused increases the pain, and if unrelieved leads to further ulceration of the true skin, the pus then finding its way into the cellular tissue beneath. The whitlow then merges into the second variety. It may also spread to the matrix of the nail, and so become complicated with onychia. If relieved early, by cutting away the cuticle which has been raised by the pus, it seldom leads to any unpleasant consequences.

Treatment. — The treatment consists in bathing the finger frequently in hot water, and applying lint soaked in hot water, which is cleaner and better than a poultice. A combination of equal parts of glycerine and extract of belladonna will be found an invaluable application, frequently cutting the inflammation short, and always relieving the pain. As soon as there is any sign of the cuticle being raised by fluid beneath, it should be cut away with a pair of scissors, or a razor or sharp knife. An incision is never necessary.

A form of superficial whitlow is sometimes seen occurring without any apparent cause, and attacking one finger after another. The fluid beneath the cuticle is not always purulent — sometimes being merely albuminous, and mixed with flakes of lymph. It never leads to any deep suppuration. It is most common in children and females, and is consequent upon general debility. It is described by the French under the name of *tourniole* or *panaris phlycténoïde*. It is a troublesome affection, and difficult to get rid of. Tonics and iron are the most important remedies. Sometimes arsenic is of use.

2. **Paronychia Cellulosa** — The inflammation in this variety commences in the cellular tissue of the pulp of the ungual phalanx. It arises almost invariably as the result of some slight puncture or other injury, or as the consequence of neglecting the variety just described. The tip of the finger is swollen, tense, and excessively tender. There is severe burning, throbbing pain; and possibly red lines are observed spreading from the inflamed part in the course of the lymphatics. There is more or less fever, with general constitutional disturbance. Pus forms by the third or fourth day. It tends to point through the skin, but the thick cuticle usually resists its pressure for some time, and if this be not cut away early the gravest results may ensue. The pus may find its way into the sheath of the flexor tendons; or the bone may be exposed, and necrosis may follow, the disease then merging into the two following varieties. If an incision be made about the fourth or fifth day, a large slough will usually be found beneath the skin.

TREATMENT. — A free incision must be made longitudinally into the pulp of the finger as soon as the condition is recognised, and by this means all complications will be averted. If the pus have already found its way through the cutis, and be pent up beneath the epidermis, it is often sufficient merely to cut away the loosened cuticle with scissors. In other respects the treatment is the same as for the first variety.

3. **Paronychia Tendinosa.**— SYNON.: Thecal Abscess.— This is usually classed with whitlow, and is often secondary to the other varieties. It frequently begins, however, as a primary inflammation of the sheath of the flexor tendons. It is supposed by some to be related to erysipelas, and in many cases it probably is so; but frequently its cause is uncertain. It may arise from a wound opening the sheath of the tendon, but then would hardly be called a whitlow. The whole finger swells, and becomes tense and red. The pain is most severe, usually shooting up the hand and arm. Pus forms early, and, if not evacuated by incision, exposes the bones, destroys the tendons, bursts into the joints, and rapidly destroys the finger. If affecting the thumb or little finger, the sheaths of which are continuous with the common sheath at the wrist, the suppuration rapidly extends to the palm of the hand, and to the forearm above the annular ligament. The wrist-joint may then be opened, and destruction of the whole hand result. The constitutional disturbance and fever are usually very marked. The disease is most common after middle life, and in patients of a broken constitution. The affected finger or hand seldom recovers perfect utility; and death is not uncommon, either from exhaustion or from some secondary complication.

TREATMENT. — Hot baths to the hand, fomentations and poultices, and free and early incisions are required. Glycerine and extract of belladonna is a most useful application. Stimulants, good diet, and tonics are always necessary.

4. **Paronychia Osseosa.** — This is a comparatively rare variety of whitlow, arising sometimes from injury, sometimes without apparent cause. It is an acute inflammation of the periosteum of the ungual phalanx. It is characterised by redness and swelling, with most intense aching and tensive pain, and acute tenderness. If an incision be made as soon as pus is recognised, the bone will be found to be already bare and necrosed. This condition can only be averted by cutting down to the bone before suppuration has occurred, and this is rarely possible.

TREATMENT.—This is the same as in the other varieties, namely, hot applications and free incisions. The necrosed phalanx must be removed as soon as it is loose. If more than one phalanx be affected, amputation may be necessary.

One or two points common to the treatment of all varieties of whitlow require further notice. All incisions should be made as far as possible in the middle line, so as to avoid wounding the digital arteries. The sheath of the flexor tendons should on no account be opened, unless there is pus within it. In all doubtful cases an anæsthetic should be administered, the limb made bloodless by Esmarch's method, and the incision carried carefully towards the flexor tendons. In this way the exact situation of the pus can with certainty be ascertained, and an unnecessary wound of the sheath of the tendon avoided. Incisions are frequently made into the pulp of the ungual phalanx of the finger when the pus is really on the dorsum. This arises from the sense of fluctuation yielded by a swollen finger covered by somewhat thick cuticle. In all cases the cuticle should be cut away as soon as it is loose, and not allowed to hang about in shreds caked with putrid pus and linseed meal. The best application in all cases is boric lint, three or four layers thick, wetted with hot water, and covered by oiled silk and cotton wool. This is perfectly clean, and in every way as efficient as a poultice. Soaking the hand frequently for an hour at a time in an arm-bath usually gives great relief in the more severe forms.

MARCUS BECK.

WHOOPING-COUGH. — SYNON.: Kin-cough; Hooping-cough; Pertussis; Fr. *Coqueluche*; Ger. *Keuchhusten*.

DEFINITION.—An infectious specific disease, chiefly affecting children, lasting six or eight weeks, rarely attacking the same person twice, and accompanied by a peculiar spasmodic cough. The cough, not characteristic till the second week, comes on suddenly with quick, short, forcible expirations, and flushed face; then a long, shrill inspiration, or whoop occurs. Several of such coughing efforts in repeated paroxysms follow, the attack ending in the expulsion of viscid mucus, or in vomiting. A return of cough is readily excited for some time after the disease has subsided.

ÆTIOLOGY.—Infectious particles thrown off by the cough, and carried to the air-passages of the susceptible, there fixing and multiplying, set up the same series of disturbances by which they are produced, and reproduce abundantly more infectious material. Whooping-cough occurs in epidemics, chiefly prevalent in the spring, extending over a large part of any town or district associated by various means of intercommunication, such as common educational establishments; and it spreads as long as young children who have not had the disease before are brought within its influence. For a disease of this kind, attacking the respiratory surfaces, and there exciting a specific secretion, with violent cough to scatter it, a more widely diffused air-borne infection might be imagined than for other infectious diseases; but there is no proof that such infection is ever carried across any wide distance. What the limit may be for such transportation is quite uncertain: a child at school commonly takes it near at hand, as from another in the same class; in crowded tenements all are not seized at once.

From the reception of infection to the evidence of its effects, an interval for incubation always intervenes. When children are said to have been attacked soon after exposure to keen air, this has only roused into activity a cause already in operation. Some quality of the air or season may act as a predisposing cause. Certain bodily states—the condition of teething, and that left after measles and some other diseases—predispose the mucous surfaces to receive and foster the germs of whooping-cough. This infection is often received with that of measles, and the characteristic cough of the one disease is not recognised till the rash of the other has passed away. Three weeks may elapse before children, who have been exposed to infection, show signs of it by the whoop; they, therefore, should not mix with others who are susceptible till this period is safely over. Infection persists for six or eight weeks after the disease is declared; after this there may be a return of cough or spasm without fresh danger of infection. During the illness any bit of mucus thrown off by the cough may be the medium of infection; whether other secretions are infectious is a matter of doubt, but emanations from the sufferers may be so, even after death. The disease is readily propagated by *fomites*. It is frequently carried from house to house by the clothes of visitors. The sick create an atmosphere around themselves into which the susceptible cannot enter without danger of being seized; a portion of this atmosphere is easily removed and carried in the folds of dress to other houses and rooms. Some infectious particles cling to the clothing of convalescents for a long time. Active infection is given off by those affected slightly, or only beginning to be so while sickening for the disease; even the insusceptible, who are not liable to suffer in the same way again, may have slight cough or irritable throat after being with the sick, and so, ailing little or nothing themselves, be the means of carrying infection elsewhere.

Whooping-cough prevails so extensively in early childhood, that it is rare to find anyone grow up without having been exposed to it. Those who escape infection in childhood mostly escape it altogether. Adults are rarely seized. When this happens—and no age is entirely exempt—the disease goes through its full course with the same symptoms, and the same instinctive dread of recurrent spasm, as in infancy, but with none of the dangers then arising, only with the vexations of a tiresome and embarrassing ailment.

The greatest number of cases occur in children under eight years of age. It is one of the three diseases most fatal to young infants, and, like the bronchitis of cold weather, and the diarrhœa of summer, is most fatal to the youngest; it differs from these in not being more fatal either in very hot or in very cold years. Whooping-cough comes next to scarlet-fever in the number of deaths attributable to it in this country, the proportional mortality from this cause being five or six per ten thousand of population, and nearly 2·5 per cent. of yearly deaths from all causes. Three-fourths of all the deaths from it are of children under two years of age. Sex has a marked influence on the fatality of whooping-cough. Girls suffer more than boys. While half the attacks of boys are severe, five-sixths of the attacks among girls are so; the deaths of girls being nearly one third more than of boys. Race and climate make little or no difference as to the liability to whooping-cough. Season has an influence on its epidemic extension; this in Great Britain is always in the spring. Cold indirectly adds to the intensity of the disease; it is increased by overcrowding, bad ventilation, and the confinement of the sick in close apartments. The bad effects of whooping-cough are most marked in the rickety.

The period of incubation is well-marked in all cases, and extends from four days as the shortest limit, to ten days or a fortnight as the longest; in the latter instance, a solitary one, no catarrhal symptoms were noticed till thirteen days after a single limited exposure, the whoop appearing ten days after that. Three weeks must elapse after exposure to infection before we can say the disease has been escaped. Usually some catarrhal and febrile symptoms, with or without cough, appear from the fourth to the seventh day after exposure to infection. The invasion, or catarrhal, stage lasts a week. The whoop mostly begins ten days from the ingress, unless accidentally delayed; it has been heard as early as the eighth day, or as late as the twenty-fifth and even later, or not at all. The complaint has not been directly produced by inoculation.

PATHOLOGY AND ANATOMICAL CHARACTERS. The course and duration of all the symptoms of pertussis are too constant and definite for the cough and other results of the disease to be deduced from the effects of any kind of local irritant on the mucous surfaces of the air-passages. A specific catarrh with hyperæsthesia is admitted by all. Is this located chiefly in the bronchi (Broussais and Guersant); limited in the first instance to the laryngo-pharyngeal mucous crypts (Gendrin); or confined within the larynx (Beau)? The last view is supported by the redness seen extending from the epiglottis to the vocal cords; and by the tumefaction, and viscid or puriform secretion, found in the larynx after death. But the larynx may redden only when the cough begins, and this may be excited by mucus rising into the trachea from below as well as by that touching the glottis from above, and the bronchi may be affected before the larynx. A fit of coughing may also be excited by bronchial or gastric irritation, and by emotional disturbance. As neither laryngitis nor bronchitis in children is attended with persistent spasm, a cause for this has been sought in the swelling of the bronchial lymphatic glands so often associated with spasmodic cough. This source of reflex excitement of the vagus is applied by the late Dr. Noël Guéneau de Mussy to explain the recurrence of spasm long after the usual term, rather than advanced as an explanation of the character of the cough throughout the disease; he suggested, however, that the absence of spasm from the first stage of the disease, or its delay, may be from the bronchial glands not being very much enlarged in such cases. The small lymphatic glands in the neck and along the trachea and bronchi are affected early, both in this disease and in measles; their enlargement is much less marked in adults than in children, yet adults have the same spasm in the second stage of whooping-cough; and in the serious pulmonary lesions after measles children have not the same kind of cough. The explanation of this difference is in the specific or contagious element. In ordinary catarrh or bronchitis the spasm yields when secretion begins. Here the same contagious matter that began the irritation not only keeps it up by local increase, but, multiplying vastly for a certain time, is thrown off by the surfaces where it proliferates, or to which it is carried, perhaps with added virulence and activity. A less permanent, less energetic, or less extended irritation of all the sensory terminations of the pneumogastric nerve would not so excite and increase the susceptibility of the nerve, while diminishing and exhausting its power, nor thus modify the nutrition and function of its centre; the change so impressed continues long after the original exciting cause has ceased. A special influence may from the first be attributed to the specific cause. A certain degree of hyperæmia would determine fever, distend the lymphatics, and excite cough by irritation of the peripheral nerves. But the nerve-centres, both of the respiratory and sympathetic system, are disturbed in the earlier stages, and the vagus is specially implicated before the enlarged bronchial glands or other local causes of excitation are established. The impaired function of the pneumogastric is shown by the rapid and weak pulse, epigastric tenderness, loss of appetite, weak respiration, and pulmonary congestion; this aids the impulsion of morbid products to the bronchial surface, hence a specific secretion and a further source of reflex irritation, hyperæsthesia, and the special characters of the cough. The spasmodic cough is sometimes suppressed during an intercurrent fever or pneumonia, and returns as these conditions subside. The element of contagion, whatever it may be, is reproduced abundantly in this catarrhal secretion for a definite time, after which it does not reappear; the cough or spasm may return for months, but no real relapse of the disease. One attack is protective against a recurrence.

The disease then is zymotic, and essentially neither a neurosis nor a bronchitis, though both of these conditions are excited by it. Zymosis may be either by a local proliferation, or a general infection, or both; it has been thought sufficient, by those who incline to view this and some allied diseases as local, for contagia acting upon the mucous membrane to entail all the consequences of the disease in the former mode only. On the other hand, bacteria, as seen by V. Potain, and micrococci described by Letzerich as infective, abound in the secretions, penetrate the cell-structures, and are found in the leucocytes of the blood and tissues. These differ little, if at all, from those of ordinary occurrence, except in their number and rapidity of increase. It is unlikely that the common forms could acquire special quality from accidental inflammation around them; but these, derived from a special source, may carry with them special qualities setting up the same action in a suitable medium, as that in the tissue from whence they were derived; they permeate freely, and the process has ceased to be local before the signs of disease are observed. The part taken by the white corpuscles of the blood, as carriers and destroyers of infective germs, cannot be overrated.

As in the exanthemata the rash shows impaired vaso-motor nerve-control in the skin, so in whooping-cough the irritability of the surface of the pharynx, glottis, and trachea is early evidence of disturbed innervation. There is no deep-seated congestion of the fauces; the catarrhal state is more marked below the glottis than above, the trachea is often pale, the bronchi are always congested, and the smaller lymphatic glands along their course and beside the trachea, as well as the larger bronchial glands, are constantly red and swollen, so as to be pathognomonic; later, these or the mediastinal glands may show centric softening. The bronchial membrane is thickened, red, and covered with sticky masses of secretion, in which groups of micrococci are found; the viscid secretion in the smaller bronchi is an almost constant condition, and some of this drawn into the pulmonary alveoli affords a prominent character of the disease; such blocked alveoli look like tubercles under the pleura; if punctured the contents will squeeze out. Ecchymoses are seen on the pleuræ, and sometimes in the pericardium. The œsophagus is pale, but the mucous membrane of the stomach is often swollen and red, with punctiform injection or petechial spots; effused blood has been found in the bowels; a follicular inflammation of the intestines is associated with gastric catarrh; and there is some enlargement of the mesenteric and retro-peritoneal glands. The liver is more often hyperæmic than the spleen, with some fatty cells; or is large, with yellowish-grey fatty charge in the tuberculous or rachitic. There is no definite kidney-lesion. Cerebral effusions, like chemosis or œdema of the face, are the accidents of cough and dyspnœa. Spasmodic cough is not merely a reflex from the upper laryngeal nerve. Shallow respiration and insufficient oxygenation excite respiratory efforts; but, as less air gets to the blood, expiration is accentuated, and goes on in a convulsive repetition, due to the stimulation of the medulla by the venous blood. This happens on any interference with the supply of oxygenated blood to the respiratory centre. From these severe efforts exhaustion results. When the centre recovers its excitability, inspiratory effort follows; and on the rapid alternations of these states much of the frequency, force, and duration of the paroxysms depends. Repeated distension of the right cavities of the heart in the fit causes various venous hæmorrhages. Obstructed air-cells, catarrhal pneumonia, and lobular collapse of lung, with surrounding emphysema, also occur as secondary phenomena. These, with cerebral congestion, result from futile cough. Impeded respiration leads to convulsions in children; epileptiform seizures have resulted from miliary aneurysms or hæmorrhagic spots in the brain and spinal cord; but most of the cerebral symptoms during the illness are indicative of some further mischief in the lung. In rickety subjects these complications, together with the greater tendency to spasm in this diathesis, produce bending-in of the ribs and contraction of the chest, often interfering greatly with healthy development in later years.

Symptoms.—The invasion of whooping-cough is insidious, rarely with chills. Some fever or cough is first noticed at night; the child is better next day, but loses appetite, is fretful, or looks pale and languid. The pulse is quick. and the respiration shallow. There may be sneezing or signs of catarrh, but these mostly appear after another night of fever, or of teasing, frequent cough, which may be croupy before secretion begins; the glandulæ concatenatæ are perceptible to touch. Instead of a freer secretion soon following and relieving the symptoms, as in ordinary catarrh, the cough increases; there may be high fever, with pulmonary congestion, or the fever subsides, and bronchial *râles* are heard on deep inspiration. This is known as the *catarrhal* or *premonitory stage.* It lasts eight or ten days, the whoop being seldom heard till the end of the second week. But the period is not definite, for the fever of this, as of the other two stages of whooping-cough, is marked by great irregularity, with intervals quite free from fever; in this stage it may be prolonged by various complications, or be very little noticeable. In the latter case the cough is sooner distinctive; it comes on in fits, mostly at night; in the day there are intervals without cough. When the cough is coming, the child's face reddens, as if trying to suppress it, till it bursts out in a series of short, quick, forcible efforts; then the breath is drawn in with a shrill whistling sound, again followed by the boisterous cough; after a short pause comes a less severe and shorter fit, and then another, til a quantity of whitish viscid mucus is expelled, some perhaps through the nose, and some swallowed, or the child vomits at the same time, ejecting the contents of the stomach.

When the secretion is free, the catarrhal stage merges into the *spasmodic stage*. At this time laryngoscopic observation has shown the mucous membrane pale to the lower third of the trachea; a little mucus secreted in the larynx has been seen to excite cough; or the entire surface of the larynx and trachea was catarrhal. Again, before the cough, whitish mucus has been seen to rise to the bifurcation of the bronchi; then cough begins; some time after it is over, the vocal cords have been observed to be redder than before. Bronchial catarrh is as much a feature of this stage as the spasm. When the cough seems to have come on without cause, the secretion has risen to the trachea; children are often old enough to describe a tickling in the throat before the cough, they show dread of its approach, and prepare for the attack, by steadying themselves, or clinging to others for support; they are glad when it is over, and seem afterwards cheerful in the day, and go to sleep again at night. Not so with younger children; before the attack the pulse quickens, the breathing is short and insufficient, *râles* are heard, spasm closes the glottis, the air is forced out in sudden jerks, and then enters with the loud long-drawn whoop; this is repeated till the face becomes livid and swollen, and the child exhausted or semi-conscious. Frequent attacks of this kind keep the face puffy; they force the tongue over the lower teeth, and produce small ulcers on the frænum linguæ, or make the eyes red and watery, often with small hæmorrhages into the conjunctivæ. In the paroxysm blood may start from the nose and mouth, or be seen in the matters vomited, while both urine and fæces may be passed involuntarily. In some cases diarrhœa and vomiting are serious symptoms. While the cough forces air from the lung, the percussion note is dulled, and becomes again resonant after the sibilant inspiration is heard. The heart's action is impeded, sometimes interrupted by the passive congestion reacting on its cavities during the cough, or from irritation of the vagus; neither endocardial nor pericardial lesion is found in whooping-cough, and nothing is found wrong with the heart after the fit is over.

Examination of the chest in the intervals of cough reveals the usual signs of whatever pulmonary complication is present. In most cases a mucous rhonchus is heard over the larger bronchi, and some finer rhonchi on deep inspiration, with weak respiratory sounds; moist or dry crepitation replaces these in places where the finer bronchioles or alveoli are affected; this may occur without much capillary bronchitis or pneumonia; hence at the same time very varied or 'patchy' thoracic signs are found, resonant or dull in parts. Violent spasm prevents air entering some of the smallest tubes; the epithelium thus loses its cilia, and, mixed with muco-purulent secretion, blocks a small lobule or fills an alveolus; this happens when the fits of cough are worst and most frequent; with closed glottis the forcible expiratory efforts compress the contents of the alveoli, and squeeze out the fluid parts, leaving the *débris* to caseate; a dry crackle, rather than moist bubbling *râles*, may be indicative of this. Meanwhile air in some peripheral lobules, compressed in the same way, gives rise to vesicular emphysema with partial collapse; this state of lung can recover itself sooner than the other. A more extensive capillary bronchitis or catarrhal pneumonia is shown by grave general symptoms, restless tossing, rapid breathing, dusky face, coma, and convulsions. Pleurisy is not rare, and may result in empyema.

Without these complications, the *third stage*, of subsiding spasm and loose expectoration, with returning health and strength, may be reached in from four to six weeks. The mildest cases may seem to be over sooner, with one week for the catarrhal stage, and two for the spasmodic; but any little want of care will intensify the symptoms; and relapses are common until six weeks are accomplished, even in cases where the second stage has not been prolonged beyond four weeks. The disease often lasts two months, and is followed by a tedious convalescence. The pulmonary deposits may lead to tuberculosis. The disturbances of nutrition and innervation are long in being restored.

DIAGNOSIS.—Influenza has dry, frequent cough, paroxysmal, and worse at night, with gastric and febrile symptoms, hardly distinguishable at first from those of the ingress of whooping-cough. But influenza prevails as a widely spread epidemic, not limited to children only and to a particular neighbourhood, but affecting persons of all ages; there is more coryza; it has a crisis in five days, and is mostly over in ten days, though relapses are frequent; the same persons are attacked more than once, sometimes even in the same epidemic. In children, if cough persists, it is without whoop; the conjunctivæ may be red, but have no blood-effusions; no small ulcers form under the tongue. Bronchitis comes on in cold weather directly after exposure or chill; the breathing is quickened from the first, while in the early stages of whooping-cough the respirations are often either slow or shallow. Infantile laryngitis also has no stage of incubation: laryngeal diphtheria has no remissions. Both alter the voice and cry. Some catarrhal attacks among children, coming on with fever, often with laryngeal irritation, and with fulness of the small cervical glands, are less readily recognisable; in either case if the breathing at first be less quickened than the pulse, this difference ceases as soon as lung-mischief begins. Children rarely spit up phlegm in common cough; the specific secretion of this one when freely expelled comes too late to be a useful guide. An opinion can only be given after some delay and caution, unless, as is also the case with measles, the child is known already to have had these diseases. A first question is, What infantile ailments are over? the next, What have been the chances of exposure? Hay fever occurs in the summer, mostly in adults; it attacks certain people only, and these every summer; if the first attack were supposed to be whooping-cough, the mistake could not be made a second time. The spasmodic cough of hysteria is incessant, and without whoop; it is only contagious by imitation.

Prognosis.—Young children under defective hygienic conditions, or the subjects of rickets, are least likely to make the favourable recovery generally expected in uncomplicated whooping-cough. Many young infants die from laryngeal spasm, sometimes in the earlier stages of this cough, but mostly in the second stage, when it is readily excited both by pulmonary causes and by bad ingesta. With good sanitary surroundings and individual care the youngest may escape, unless debilitated by previous illness, such as measles, or a defective state of nutrition at the time of the attack. The risks diminish with each year of childhood, excepting that the impaired resistance of the chest-walls in rickets may place a child of seven much in the state of another at two or three years old. Constitutional defects, or the accidents of nurture, may lead to wasting diseases which begin in the third stage, and prove fatal some time after, or at any age. High fever during invasion is a warning of severe complications in the subsequent stages. Convulsions in any stage of whooping-cough are of the worst significance; somnolence, or a listless condition between the attacks, and persistent high temperature, are bad signs. The danger of the second stage is in proportion to the severity of the spasm. It may be estimated by noting the number of attacks in the twenty-four hours, their intensity, and duration; in bad attacks the expulsive efforts are more rapid, and there is a shrill or repeated whoop; in mild attacks there is less spasm, and the whoop is not always heard, or perhaps only once. The duration may be from a few seconds to some minutes. The number of attacks may be raised from twelve to twenty in the twenty-four hours without danger, if the intervals are complete enough for the child to seem bright and take food in the day, and to get sleep by night; as many as 60 to 80, or even 140 have been counted; they may be so incessant as to interfere with both food and sleep, and are then very exhausting. When the nutrition is enfeebled, and the tongue often protruded over the teeth in violent cough, small ulcers are found; they are proofs of the severity of the spasm, and mostly indicative of a danger that is over. Capillary bronchitis and pneumonia are the complications most often fatal; œdema of the glottis or of the lung surely so, but these conditions are rare. Chronic pneumonia is apt to result in dilated bronchi, or in phthisis. Emphysema tends to disappear. Partial collapse may largely recover itself on air regaining admission to the lobule. Blocked alveoli set up a circumscribed pneumonia; their contents caseate; and tuberculosis results from these centres, or from degeneration of the enlarged bronchial and mediastinal glands. Tubercular meningitis and acute tuberculosis during or after the third stage are rapidly fatal.

Treatment.—We have no specific for whooping-cough: no drug to check its onset or stop its progress. The disease is of long duration; the patient a child. Hygienic conditions must be observed, and means used to prevent distress, reserving the more active remedies for special occasions. Rest and warmth, with much individual care, and the utmost attention to a sufficiency of pure air, are requisite from the first, and indeed throughout the illness. It is not merely exposure to cold, but fatigue and injudicious food, that determine the accessions of fever so frequent in the course of whooping-cough. These accessions have always with them an increase of the germs of the disease, more as a result than as a cause of the fever; they are better lessened or prevented by whatever aids the resisting powers of the child, than by close cosseting, or the use of special germicides, except as a means of freshening the air of the room; an aggravation of all the symptoms follows the confinement of one or two sufferers to a single chamber. The diet is to be light and nutritious, milk forming an important element in the meal, and some addition to the ordinary food has often to be sought, whilst all things hard of digestion or irritating are to be avoided. Broth should be made with vegetables and without condiments; stewed fruit, orange juice or lemon, and grapes are grateful; some extra diluent is always requisite. Each child wants a good deal of ready assistance; some one should be near to subdue fright when the cough begins, and to raise and hold the child till the fit is over.

In the *catarrhal stage*, if the ingress be febrile, a day in bed may be right. The child is better indoors till this stage and the next are over. Whatever moderates catarrh lessens the force of the attack, and fresh catarrh increases it. The room must be changed two or three times a day, so that one is thrown open and freshened while the other is occupied, and then closed and warmed, in its turn to be ready for use. Some simple saline, as solution of acetate of ammonium, may be required, or ammonia in any dilute form. A sip of cold water often relieves cough, but at night some ipecacuanha will be needed; a teaspoonful of the wine, mixed with an ounce or two of sweetened water for the night, can be given by spoonfuls till the cough either lulls or ends in sickness. The bromide of potassium or ammonium in repeated doses, gr. iij–v. to the spoonful of water, gives relief at night in this stage, though more suitable to the next, when antispasmodics, of which chloral hydrate is the chief, are most wanted. Neither opium, chloral hydrate, nor belladonna is to be used till the first stage is over, and secretion is free; nor while there is any local congestion or other source of irritation to be removed. A warm poultice of crushed linseed across the back of the chest is often of the greatest use when the cough is teasing, and should always be applied if fine *râles* be heard, or if there be deficient expansion over any part of the lung. The first extension of bronchitis to the finer tubes excites bad spasm, for which a few small doses of any antimonial may be proper, if the child be robust and plethoric. In most cases ipecacuanha can be continued in small doses for some time; the emetic dose at night often soothes by emptying the stomach; this relief must not be sought too frequently, though children's stomachs soon recover from this effect of ipecacuanha after a sleep. The bromides of potassium or of ammonium can be continued throughout all the first and second stages with advantage. A solution of carbolic acid, two or three grains to the ounce, may be beneficially given to children at the end of the catarrhal stage. When secretion is free the compound tincture of camphor can be added to the ipecacuanha wine, one part to two for young children, two parts to one with chloroform water in adolescence. Some of the soothing effect of spraying the solution of carbolic acid with a small steam vaporiser in a room may be from a part being absorbed. In very many cases of whooping-cough no medicinal treatment is needed, but there are others in which the child is obviously ill with more than the usual fever; or, just when amendment is expected and a freer secretion should come on, there is an increase of fever, with no marked complication. In these cases quinine should be given; one grain *per diem* in powder for each year of age, continued for two or three days only, answers best; double this quantity at a single dose, and that repeated, has been given with good effect during the first four or five days of the spasmodic stage. Some priority in the use of quinine and of chloral hydrate may be claimed by the writer. One great advantage in the use of both these remedies is that they can be given in enemata, either nutrient or stimulant.

Relief of spasm is the main object of treatment in the second or *spasmodic stage* of whooping-cough, the efficacy of the means employed being measured by the diminution in the number of daily attacks. By this test belladonna often proves to be useful if given in large and continued doses; with a child of three years old, one-sixth to a quarter of a grain of the extract, or ten to fifteen minims of the tincture, may be reached before the pupil is dilated; atropine, divided into doses of one-hundredth or one-eightieth of a grain with sugar of milk, or as drop doses of the sulphate-solution, is a more certain way of getting the effect required, and of regulating the quantity necessary to produce it. Minute doses of morphine (one-sixtieth of a grain given with the atropine, or small doses of any opiate with belladonna) answer better than if given uncombined; but this addition is only permissible when the secretions are free, and the means of relief do not require frequent repetition; opium is most useful near meals when food is ejected with the cough. The liquid extract of ergot, one drachm a day, given in divided doses to children for two or three days, is said to control spasm. Phenazone, cautiously given, is of service in some cases. Butyl-chloral hydrate, in doses of one or two grains in weak solution, or disguised in powder, given to children three or four times a day, lessens the force and frequency of the spasm. Bromoform has been recommended by Dr. Burton-Fanning, in doses of half a minim to three minims, cautiously, according to the age of the child, three times a day. Bromide of ammonium is often all that is required, but there may be need of chloral hydrate. Most of the remedies vaunted for cure of whooping-cough owe their repute to having been administered in the fifth or sixth week of illness, when other agents are said to have failed, and the disease is nearly over. Frictions across the back and chest with an oily liniment, to which oil of amber is often added, or with belladonna and opium liniments combined, are useful. Where cough persists from pulmonary complication, hot poultices repeated, perhaps with a little mustard added to one of them, give more relief than any frictions. All the more potent means of counter-irritation, such as croton oil or blisters, are to be avoided; so is the application of leeches to the head or elsewhere.

In the *third stage* of whooping-cough some astringents are often of great use; and restorative means are much wanted. Alum is of decided benefit when excessive secretion is troublesome, one grain to a drachm of liquid. Much harm is done by sending children out for play or change of air before convalescence is secure. Where the illness requires continued rest in bed, not only should the room be changed, but the one left is to be fumigated either with sulphur or cresolene before being made ready for the patient's return. A solution of carbolic acid, six or ten grains to the ounce, may be used in a steam vaporiser at intervals while the room is occupied. Resorcin, one grain to the drachm of water, can be used in spray or applied directly to the larynx with benefit. One or two grains of oxide of zinc may be given three or four times a day in powder; or half a grain of the sulphate in solution. An emetic may be required, to remove excess of mucus; sulphate of zinc, one to five grains, can at this time be added to the ipecacuanha, which alone is best for the earlier stages when emesis is more often required. Some aperient is often needed throughout the illness; strong purgatives are at no time advisable. A drop of laudanum before food stays sickness. The mineral acids make an agreeable aid to digestion. Cinchona bark or iron and cod-liver oil may be required. Minute doses of arsenic with meals, and iodine externally over small spaces on alternate days to back and front on either side, counteract obstinate adenopathy. Change of air has a remarkable effect in restoring appetite, and removing spasm, after the disease is quite over; it should not be sought before six weeks, and is often better deferred till two months from the commencement of illness. If the tubercular diathesis have been set up or evoked, the greatest care in nursing, and the most perfect quietude, are essential. Great risks, without benefit, have been run by taking children to gasworks during the course of the complaint. Attempts to cut short the disease by inhalation or insufflations of germicides fail. An equable, pure air around the patient shortens the illness and lessens its severity. Antiseptics added to the liniments used, or to the vaseline for the head, may do good in this way. Sanitas, or a solution of permanganate of potassium or of peroxide of hydrogen placed in the room, on cloths near the child's couch, or sprinkled about, are of use by purifying the air.

William Squire.

WIESBADEN, in Nassau, Germany.—Thermal salt waters. *See* Mineral Waters.

WIGHT, Isle of.—*See* Sandown; Shanklin; Undercliff; Ventnor; and Climate, Treatment of Disease by.

WILDBAD, in Würtemberg, Germany. — Simple thermal waters. *See* Mineral Waters.

WILDUNGEN, in Waldeck, Germany. — Earthy waters. *See* Mineral Waters.

WINDPIPE, Diseases of. — *See* Larynx, Diseases of; and Trachea, Diseases of.

WINKING, INVOLUNTARY.—*See* Facial Spasm.

WINTER-COUGH.—This expression is associated with those cases in which a patient is subject to more or less cough during the winter season, being free, or almost free, during the warmer portion of the year. It may come on at any period in the course of the winter, and is generally referable to some obvious cause, which produces 'a cold.' The attacks tend as a rule to become more aggravated and difficult to cure, as well as more easily excited, as time progresses. There is no valid reason why cases of winter-cough should receive any special designation. At any rate, this should not prevent them from receiving due attention, instead of being summarily dismissed as mere cases of 'winter-cough'; and it is important in every instance that satisfactory investigation should be carried out, so that the exact conditions which produce the cough may be determined, and the proper treatment pursued which these conditions indicate.

Without entering into details, it may be stated that cases of winter-cough belong chiefly to the following classes: 1. Not uncommonly it is merely due to a slight catarrh, affecting the throat and main air-passages. 2. Most frequently the cough depends on bronchial catarrh or bronchitis in various degrees, usually associated with more or less emphysema. 3. Winter-cough may characterise some chronic phthisical cases, this symptom subsiding during the warmer season. 4. There are certain forms of cardiac disease, of which winter-cough may be a prominent phenomenon.

Treatment.—The treatment of winter-cough must depend on the nature of the cause which gives rise to it, and will be found discussed in the special articles descriptive of the several conditions. *See* Cough.

Frederick T. Roberts.

WOMB, Diseases of.—Synon.: Fr. *Maladies de l'Utérus*; Ger. *Krankheiten der Gebärmutter*.

There is probably no department of practical medicine in which more progress has been made within the last twenty years than that comprehended under this article; and it was only after the invention of exact methods of physical examination, such as the speculum and the uterine sound, that its advance towards the prominent position it now holds commenced. Indeed, until these came into use the gynæcologist was much in the same position, with regard to diseases of the uterus, as the general physician with regard to diseases of the chest before Laennec's immortal discovery. In the one case, as in the other, the practitioner had of old to trust to general symptoms only, and these were very apt to mislead. As it is only by an accurate examination of the uterine organs that any certain knowledge of their condition can be acquired, the method of making such examination forms an essential preliminary to the study of uterine disease.

Methods of Physical Examination.

1. *Digital Examination.*—Of all methods of examining the uterine organs, the most important is by the finger alone, nor is the necessary *tactus eruditus* by any means easy to acquire. In this country the lateral position is generally adopted, and, except under special circumstances, is preferable, as involving less exposure than the dorsal. The patient should lie on her left side, with her hips as near the edge of the bed as possible. The semi-prone position is the most convenient. the patient lying more or less on her face, her knees being flexed, the upper one more so than the lower. A good position much facilitates a complete examination of the pelvic cavity, and attention to these details is never superfluous. The index finger of the right hand is now carefully introduced, at first in the axis of the vaginal outlet, and then in that of the pelvic brim. The unimpregnated uterus is suspended, as it were, at the top of the vaginal canal, with the cervix projecting into it. The latter is the part of the uterus which the finger first reaches. As the normal direction of the uterus corresponds with the axis of the upper part of the pelvis, or, roughly speaking, with a line extending from the umbilicus to the coccyx, the cervix, in a healthy state, projects into the vagina, and points backwards towards the sacrum. Its shape varies in women who have had children. and in the unmarried or nulliparous. In the latter it is conical or nipple-shaped, and the opening of the os uteri is felt at the apex of the cone, as a circular aperture about the size of a pea. The anterior and posterior boundaries of the os uteri are known as the lips of the cervix, and they are very liable to alterations in size, becoming congested or enlarged under various morbid states, one often to a greater extent than the other. In women who have borne children the shape of the cervix is altered, and it becomes shorter and less regularly conical. The os is also changed from a circular opening into a transverse fissure, which is often more or less nodular and irregular at its edges, from lacerations of its tissues during labour; and is sometimes sufficiently open to admit the tip of the finger. When healthy, the mucous membrane covering the cervix is smooth and velvety to the touch; and through the speculum it is seen to be of a uniform rose-pink colour. Under various morbid conditions it becomes rough, granular, stripped of its epithelium, and covered with hypertrophied papillæ, and these alterations are of much importance from a diagnostic point of view. Having ascertained the conditions of the cervix, paying particular attention to its size, shape, density, and sensibility, and to the shape of the os uteri, we may next proceed to examine the body of the uterus, passing the finger for this purpose past the cervix into the vaginal *cul-de-sac* behind, in front, and on either side of the uterus. In this way we feel whether the uterus is of normal size, or hypertrophied, as it often is; whether it is painful on pressure, or not; whether the uterus is freely movable by the finger, as it ought to be; or whether it is fixed and immovable in any part of its contour, as is often the case from inflammatory adhesion in its vicinity. Then again, in the same examination, we ascertain if any swelling exists in any part of the vaginal *cul-de-sac*, in front, behind, or at either side; and if so we try to determine its form, density, mobility, sensibility, and whether it is attached to the uterus, or is independent of it—all points of importance in arriving at an accurate diagnosis.

2. *Palpation.*—In this part of the examination we may often gain much assistance by combining *abdominal palpation* with vaginal examination. This method of bi-manual examination is always of great utility, and is sometimes indispensable for accurate diagnosis, and it is not so generally practised as it ought to be. It may be used to some extent while the patient is still lying on her side, the left hand being passed over her right hip. But to practise it thoroughly we must make the patient turn over on her back, and then by pressing down the abdominal parietes with the left hand, and acting in concert with the examining finger, we may thoroughly explore the pelvic cavity, and ascertain much more completely the form and relations of any tumour within it, than by vaginal examination alone. In some cases valuable information can be obtained by a rectal examination, especially when there is a swelling or tumour in Douglas's pouch, or attached to the posterior part of the uterus, which may often be more accurately examined in this way than *per vaginam*. Simple abdominal palpation is often necessary in investigating the nature of any tumour supposed to be uterine. This is best carried out by laying the patient on her back, with her knees elevated, so as to relax the abdominal parietes. Percussion may often be advantageously combined with palpation. By using one or two fingers of the left hand as a pleximeter, and percussing with the right, we get a dull or tympanitic sound. If the latter is marked where there is much abdominal distension, we know that it indicates bowel distended with gas, and that there is probably no

tumour. If there be dulness we can limit its area, and thus verify the results of palpation by mapping out any abdominal swelling met with. By these means also we discover the existence of fluid, either free in the abdomen, as in ascites, or contained in an ovarian cyst, the presence of fluctuation being often very readily determined.

3. *Use of the Speculum.*—We now proceed to consider the means at our disposal for examining the lower segment of the uterus with the eye; and from the re-invention of the speculum by Recamier, in the early part of the present century, we may date the commencement of the accurate study of uterine diseases. Numerous varieties of specula have been used. One very generally employed is Cusco's bivalve speculum (fig. 177). This has the advantage of being easy to introduce, and of being adapted for either a capacious or a narrow vagina. It exposes the cervix well. The objections to it are its expense, and the fact that the metal is apt to be affected by various applications made to the cervix. Personally the writer prefers the tubular (Fergusson's) speculum (fig. 178), made of glass and covered with caoutchouc; and that which is bevelled at the end is the easiest to introduce, and the best to expose the cervix. For cleanliness and brilliancy of illumination nothing can equal it. It is unaffected by any remedy used for local application, and has the advantage, which is wanting in all other specula, of embracing and steadying the cervix. In certain cases requiring local medication this is of great value. The objection to this form of speculum is its fragility, and the necessity of having instruments of various sizes, adapted to vaginæ of different dimensions. Practitioners, therefore, at a distance from surgical-instrument makers, will do well to provide themselves with the more expensive instrument. Another form of speculum much used of late years, and in some cases superior to all others, is the 'duck-bill' speculum (fig. 179). This acts on the principle of drawing aside the perinæum and posterior vaginal wall, so as to allow air to distend the canal, and thus expose the cervix. For certain operations it is invaluable, and is most valuable even in ordinary examinations if the practitioner be skilled in its use. Considerable practice is required, however, to employ it satisfactorily, and it has the further drawback of necessitating the assistance of a second person.

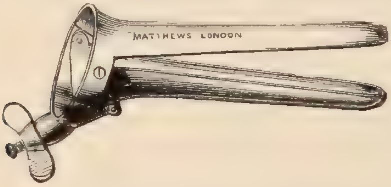

Fig. 177.—Cusco's bivalve speculum.

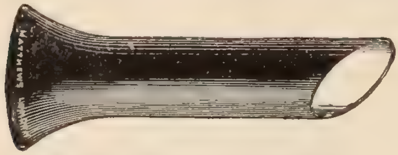

Fig. 178.—Fergusson's speculum.

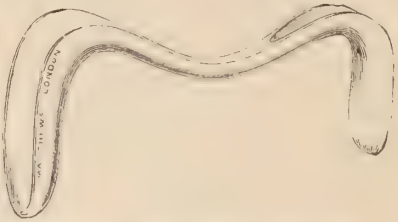

Fig. 179.—The Duck-bill speculum.

The passing of a speculum, without pain, is an operation requiring some little practice to perform skilfully. In using a tubular glass speculum we must first choose one corresponding to the size of the vagina. This is a point of some importance; for the attempt to pass a large speculum into a small vagina causes much suffering; and if, on the other hand, too small an instrument be used, the cervix is not properly exposed. The patient should lie in the ordinary lateral position. The speculum should then be taken in the hollow of the right hand, its bevelled extremity resting on the under-surface of the index finger, the point of which should project a little over its edge, so as to guide it through the ostium vaginæ. The point of the finger having been inserted into the vagina, the mouth of the speculum, the centre of which is grasped gently by the other fingers of the right hand, is held by the left hand, and the instrument, guided along the under-surface of the right index finger, is gently insinuated into the vagina, pressing back the perinæum as it enters. When it is fully introduced, it is turned gently round until the cervix is well exposed.

By the speculum we can speedily recognise any changes in the cervix and os uteri; we can see if the mucous membrane covering the former be pale or congested, smooth or abraded, or perhaps covered with granulations which bleed on being touched. The character and amount of discharge should be noted, and it may be wiped away with cotton wool held in the speculum forceps. If the discharge come in great measure from the interior of the cervix and body of the womb, it is glairy, transparent, and very tenacious, and it may often be seen oozing out of the os uteri like white of egg. This is a certain sign of some morbid state of the mucous lining of the uterus. If the discharge come from the surface of the cervix, it is yellow and purulent in appearance. We can also recognise any abnormal growth that exists about the cervix, as, for instance, small gelatinous polypi which have evaded the sense of touch.

4. *Examination with the Sound.* — In certain cases in which more accurate information regarding the state of the uterus is required, other accessory means of examination are used. One of these is the uterine sound (fig. 180), by means of which we can explore the interior of the uterus, measure its length, ascertain its direction, &c. The instrument is a thin rod of flexible metal, which can be bent into any desired shape, as it is sometimes necessary to adapt it to the altered curve of the uterine cavity. Its length is divided into inches by means of small notches in the metal, and at two and a-half inches from its point is a small knob, indicating the normal length of the healthy uterus. In introducing the sound, the index finger of the right hand is passed into the vagina until its tip rests on the opening of the os uteri, which can be felt as a dimple or depression at the extremity of the cervix. The handle of the sound being lightly held in the left hand, its point, previously warmed and oiled, is guided along the palmar surface of the index finger of the right hand, until it enters the os uteri. It is a good plan to pass the sound through the vagina with its concavity looking towards the perinæum, and after it has entered the os, to turn it gently round, so that its further progress may be in the ordinary direction of the uterine cavity. It is now gently pushed on, no force whatever being used, until its point is arrested by the fundus uteri. The tip of the right index finger is now placed at the os, and withdrawn in contact with the sound, so that the exact length to which it has entered may be ascertained. Considerable practice is required to pass the sound easily and without pain. Gentleness is necessary above all, and the sound should be coaxed to pass, being withdrawn if any resistance is met with, and never pushed on by force. Sometimes the sound will not pass in the ordinary direction, and then an endeavour must be made to adapt it to the curve of the uterine cavity, by bending it, or by passing it with its concavity backwards, as in the cases of retroflexion. The kind of information to be derived from the use of the sound will be best appreciated when treating of the separate diseases of the uterus.

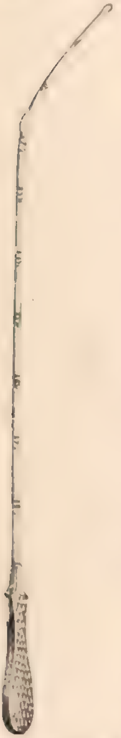

FIG. 180.—The Uterine Sound.

5. *Dilatation of the Cervix.* — Another mode of examination, sometimes of much use, is the dilatation of the cervix by sponge or laminaria tents, or by Hegar's dilators, so as to admit of the introduction of a finger, and complete exploration of the uterine cavity. This is of immense service in cases of profuse menorrhagia, when the existence of an intra-uterine polypus, or portion of retained placenta, is suspected. The tent is a mass of compressed sponge, or a cylinder of laminaria digitata, sufficiently small to enter the cervix, where it swells by the imbibition of moisture, and in doing so expands the surrounding tissues. A good way of effecting the desired object is by passing side by side into the cervix a bundle of laminaria bougies, sufficiently long to reach the fundus. These, if left *in situ* for twenty-four hours, dilate not only the cervix but the whole uterine cavity, and admit of its being thoroughly explored under an anæsthetic. In order to effect this easily, the cervix should be exposed by a duck-bill speculum. Hegar's dilators are a series of graduated uterine bougies, made of vulcanite, one of which is inserted into the uterus for about two minutes, beginning with No. 1, and gradually progressing to No. 23 or 24. By this means comparatively rapid and very effective dilatation can be produced. Careful antiseptic precautions are essential, and the operation must be performed under an anæsthetic. In the hands of an expert this is probably the best method at our disposal. Dilatation of the cervix is an operation that should not be undertaken without due consideration, as it is occasionally followed by considerable irritation.

General Ætiology and Pathology of Uterine Disease.—Much as is the attention which has been paid to uterine disease of late years, the opinions of the profession are as yet far from being decided on many elementary facts connected with it. It is beyond doubt that in this class of disease there are a series of symptoms common to all cases alike, such as pain in the lower part of the abdomen and back, inability to walk, leucorrhœal discharge, and disordered menstruation. If, however, modern writers on gynæcology are consulted, it will be at once seen how various and irreconcilable are the explanations given of these symptoms. Thus we have a school who teach that in inflammation and congestion, either of the cervix alone, or of the body or lining membrane of the uterus, we have the key to uterine pathology, and that all other changes detected in the uterus, such as displacements or flexions, are merely secondary results of the primary affection. On the other hand, there are many influential gynæcologists who refer all uterine disease to mechanical causes; who consider displacements to be the primary cause of nearly every morbid state of the uterus, inflammation and congestion being merely secondary results; and who naturally limit their treatment to an endeavour to replace and support the uterus in its normal position. The want of sufficient pathological study of morbid states of the uterus accounts for these varying opinions, which are much to be regretted; for, while one set of theorists apply themselves to an endeavour to relieve the inflammatory symptoms they find, and which undoubtedly generally exist, by leeches, rest, and suitable local applications, they are apt to undervalue and neglect the mechanical means by which the displaced organ may be supported and steadied, on which their opponents too exclusively rely, but the real value of which it is impossible to call in question. Hence it follows that these partial and one-sided views lead to neglect of really important measures in one direction or the other, and to an amount of uncertainty in the mind of the profession which materially impedes a due recognition of the true importance of uterine disease. The fact, no doubt, is that neither of these opposing views is entirely right, but that there is a large measure of truth in both. Of the importance of inflammatory conditions no one, who impartially studies the clinical history of cases coming under his care, can entertain any reasonable doubt. The large, tender, and congested uterus, with its thickened and hypertrophied walls, the inflamed and granular mucous membrane covering the cervix, and pouring out abundance of morbid secretion, are conditions too obvious to be overlooked, and which are very frequently indeed associated with displacements, resulting from alterations in portions of the hypertrophied and overweighted organ. In some of these cases treatment directed to the original inflammatory condition may, of itself, suffice to effect a cure; in others this fails, unless attention be at the same time paid to the secondary displacements. On the other hand, it is equally impossible to ignore the occasional remarkable influence of a simple displacement in producing disease. Who, for example, that has witnessed the long chain of distressing symptoms following a traumatic displacement, such as retroflexion from a fall, and the instantaneous relief sometimes following the introduction of a suitable pessary, can doubt this? In fact, all these conditions act and re-act on each other, and too excessive attention to one set of symptoms, based on theoretical dogmas, is as fallacious in uterine as in all other forms of disease.

The causes of uterine disease are very numerous. Among the most common may be mentioned errors in the mode of life consequent on the habits of modern society, such as tight-lacing, want of proper exercise, heated rooms, imprudence during menstruation, and the like. By far the most prolific source of uterine disease is to be found in the changes in the uterus consequent on parturition. Many accidental circumstances are apt to check and arrest the involution of the hypertrophied muscles, which normally occurs after delivery. Hence the uterus remains large, congested, heavy, tender, and in the condition known as sub-involution, its cavity, as measured by the uterine sound, being elongated. In such cases the symptoms of uterine disease creep on insidiously after abortion or child-bearing, and, in a large proportion of cases, it will be possible to trace its origin to this source.

In considering the diseases of the uterus, it will economise space if we divide them into four classes, namely: (1) Inflammatory and Congestive Diseases, with their results; (2) Displacements; (3) Malignant Diseases; and (4) Tumours.

1. **Inflammatory and Congestive Diseases.** — Under this heading we may consider together those morbid states of the uterus which are variously described under such terms as *acute* and *chronic metritis*, *chronic parenchymatous metritis*, *areolar hyperplasia*, *acute* and *chronic endometritis*, *endo-cervicitis*, *chronic uterine catarrh*, *granular degeneration of the cervix*, *ulceration of the cervix*, *congestion of the uterus*, and others.

This course involves the disadvantage of describing together diseases which, whilst they are very generally associated, and have much that is common in their symptomatology and treatment, may often, on the other hand, occur separately, and require important modifications in their management, according to the particular parts of the uterus affected. It is impossible, however, in so short an article, to discuss their individual peculiarities, as would naturally be done in a systematic treatise.

Acute inflammatory affections of the uterus, whether of its body or of its lining membrane, are of comparatively rare occurrence when unconnected with the puerperal state; and if a contrary opinion is expressed in many of our gynæcological works, it is probably because various other inflammatory diseases, especially localised inflammations of the peritoneum and cellular tissue near the uterus, have been confounded with inflammations of the uterus itself. No practical harm will result, therefore, if we limit ourselves to the consideration of the more *chronic* conditions which are of such common occurrence, and produce such important consequences. One of the most common is undoubtedly congestion of the uterus, associated with enlargement of its vessels, and very often leading secondarily to more important and lasting disease, such as inflammation of its lining membrane, and the condition described as *areolar hyperplasia* or *chronic parenchymatous metritis*.

ÆTIOLOGY AND ANATOMICAL CHARACTERS. The causes of such congestions are very numerous, and indeed they occur normally in connexion with every menstrual period, and may readily be perpetuated. By far the most important, however, is some interference with the proper involution of the uterus after delivery or abortion, to which a large proportion of such disease may be traced. If such congestion continue to be repeated, whatever be its cause, it very often leads to inflammation of the mucous membrane lining the cervix or body of the uterus; and then the diseases known as *endo-metritis* or *endo-cervicitis* are established, which are of much importance. In these the largely developed glandular structures of the mucous membrane are the parts chiefly involved. On microscopical examination they are found altered in character, dilated at their mouths, and pouring out abundantly the transparent spongy mucus which is so characteristic of these affections. The villi of the cervix, both those within the canal and on its exterior, become altered, stripped of their epithelium, and eventually hypertrophied. These enlarged and abraded papillæ on the surface of the cervix, when seen through the speculum, form the characteristic red, strawberry-like abrasions round the os, which, under the name of ulceration, have formed so fruitful a subject of controversy in uterine disease. The detection of this condition—which is in no sense of the word an ulceration, since the epithelium is the only structure destroyed —is of much importance from a diagnostic point of view, but chiefly as leading to a knowledge of the more deep-seated changes which have produced it as a secondary result, which are themselves beyond the sphere of observation, but which are truly at the root of the evil. Hence the granular and abraded state of the cervix must be looked upon as a mere indication of disease elsewhere, not as being in itself a primary disease. Moreover, it is to be noted, as specially pointed out of late by American gynæcologists, that many apparent abrasions of the cervix are really due to laceration of its tissue, and eversion of its altered lining membrane, a condition which can only be satisfactorily made out when the duck-bill speculum is used.

In more advanced stages of these inflammations of the mucous membrane deeper-seated alterations occur. The glands become obliterated or atrophied, and sometimes undergo cystic degeneration; and the whole mucous membrane may become adherent, stripped of its epithelium, covered with granulations, or finally converted into a layer of connective tissue covered with polymorphous cells (Klebs). In no long time, moreover, other morbid states of the uterus are developed. The organ becomes enlarged and tender to touch, and very often there is more or less forward or backward displacement. The cervix especially is apt to be hypertrophied, the os patulous, much leucorrhœal discharge is present, and all the distressing chain of symptoms accompanying confirmed uterine disease is established. Pathologically, this enlarged and tender state of the body and cervix of the uterus is, by most recent writers, believed to depend on excessive growth of the connective tissue, associated with vascular hyperæmia and hyperæsthesia of the nerves. It should be remembered, however, that it is identical with the condition commonly described as *chronic metritis*, the essentially inflammatory origin of which has long been an axiom in gynæcology.

SYMPTOMS.—The symptoms accompanying these morbid states of the uterus are, in a great measure, those which are common to a large number of uterine complaints. Pain in the lower part of the abdomen and back, increased by exercise of any kind; pain in defæcation or micturition, and, in married women, on sexual intercourse; profuse glairy, tenacious, or purulent discharge, in old-standing cases very abundant; disordered menstruation, either scanty or irregular, or more often profuse, and frequently very painful; and eventually, if the true character of the disease be not recognised, a long and distressing catalogue of general symptoms, such as dyspepsia, hysteria, sickness or vomiting, headache, and others too protean in their character to be described, are among those which are most commonly observed.

The conditions met with on physical examination vary with the duration and extent of the disease, and the tissues of the uterus chiefly implicated. In the simpler cases the uterus is merely somewhat heavy and enlarged, and tender to the touch. When there is endo-metritis or endo-cervicitis to any extent, the cervix is somewhat puffy and enlarged, and the external os patulous, so that the sound passes easily; and, in the same way, a dilated state of the cervical canal and internal os is recognised. Very generally also the surface of the cervix is rough, granular, and greatly abraded, bleeding on being touched, while strings of the characteristic gelatinous discharge are seen to exude from the cervix, and the cervix may be extensively fissured. Lastly, on bimanual examination, in the more chronic and confirmed cases, the whole uterus will be found to be distinctly enlarged, probably somewhat elongated when measured by the sound, and very commonly the subject of some of the forms of displacement to be presently described.

PROGNOSIS.—The prognosis of these diseases must, of course, depend on their extent and duration. In their earlier stages they are readily susceptible of improvement and cure. In old-standing cases, which have lasted for years, and produced all the local and general results above described, the treatment is surrounded with difficulties, and the prospect is far from encouraging. It is of such states that Scanzoni speaks when he says, 'We do not remember a single case in which we have cured an abundant uterine leucorrhœa of several years' standing'—a dictum which was doubtless true with reference to the methods of treatment generally employed, but which fortunately cannot be endorsed by those who have employed more radical means of cure, applied directly to the seat of the disease.

Treatment.—The treatment resolves itself into *general* and *local*. With regard to the former, the indications are to do all in our power to improve the nutrition and general health by ordinary means of treatment, such as attention to diet, fresh air, and the administration of appropriate remedies, of which such drugs as quinine, small doses of arsenic or strychnine, various ferruginous preparations, and bromide of potassium, either alone or in combination with other remedies, especially when there is much nervous irritability, are amongst the most generally useful. In old-standing cases resort to some of the Continental watering-places is occasionally of much service. These points, however, all depend on general principles, and cannot be further dwelt upon. Among the local measures one of the first and most important to attend to is *rest*. If moving about produce pain, repose in the recumbent attitude ought certainly to be enforced, and in recent and acute cases it should be absolute. In chronic cases continuous rest leads to the evils of deterioration of the general health, and the risk of acquiring habits of chronic invalidism. This must, then, be decided by the exigencies of the particular case, and the judgment of the practitioner. Generally, some daily gentle exercise, short of fatigue, should be advised, such as walking a little distance, driving in an easy carriage or bath-chair, or sitting in the open air. We may safely assume that exercise which does not produce or increase pain is doing good.

In cases of simple hyperæmia, especially when not of old standing, and when the uterus is tender to the touch, the local abstraction of blood is often of marked benefit. This may be effected either by applying from two to four leeches to the cervix through a cylindrical glass speculum, or, still better, by puncturing the cervix with a scarificator made for the purpose. Another very effectual means of relieving congestion and tenderness of the uterus is the use of pledgets of cotton wool, to which a string is attached, thoroughly soaked in glycerine. If one of these is introduced into the vagina at night, and removed by means of the string in the morning, it will be found to produce an abundant watery discharge which saturates the linen of the patient. Great relief is thus given, and there is hardly any form of congestive uterine disease which is not benefited by this treatment, which most women can apply for themselves. The glycerine pledgets may be used every night, and they do not interfere with other modes of treatment. Continuous irrigations of hot water at 110°, night and morning, are also most serviceable, but to be of use not less than from one to two gallons must be used, with a suitable cistern syringe. When properly applied these give immense relief. When the uterus is enlarged as well as tender, much benefit may be derived from the application of a pledget of iodised cotton to the cervix once a week. This should be passed through the speculum, and retained in position by a large pledget soaked in glycerine. It rarely causes pain; if it do, it should be at once removed; and it often remarkably reduces the size of the subinvoluted and hypertrophied womb.

When there is evidence of endo-metritis or endo-cervicitis other treatment is required. Now the desideratum is the application of alterative remedies to the diseased mucous membrane, not with the view of destroying it, but of so modifying its circulation and nutrition as to set up healthy action. The want of success so common in treating these cases may be traced to the fact that remedies have not been applied directly to the interior of the cervix or uterus, but that practitioners have contented themselves with treating the abraded or granular condition of the cervix, thus leaving the real seat of the disease untouched. Of late years much advance has been made, and we need not now talk of these chronic inflammatory affections of the lining membrane of the uterus in the same hopeless strain as before. One of the earliest modes of intra-uterine medication was the injection of fluids into the uterine cavity, such as tincture of iodine, or solutions of nitrate of silver. It was soon found that such injections, when the cervix had not been previously dilated, were apt to be followed by very alarming and dangerous symptoms; and it is now generally admitted that they are inadmissible, unless the cervix has been previously dilated with sponge or laminaria tents. This in itself is a procedure not to be lightly undertaken; and to repeat it frequently for a length of time—as would be essential in the treatment of these chronic cases—would be altogether out of the question. Some other method of attaining the desired object is therefore necessary, and this we obtain in perfection in the local application of the desired alteratives on suitable probes covered with a thin layer of cotton wool. By this means we can reach the mucous membrane at any part of the uterine cavity, and apply our remedies to it, without the necessity of any preliminary dilatation. The probes used by the writer are made of flexible metal (fig. 181), attached to a wooden handle, and of such a size that, when tightly wrapped round with a thin film of wool, they are not thicker than an ordinary uterine sound. They are covered by teasing out a small portion of wool, which is flattened between the palms of the hands. The probe is then dipped in water, to cause the wool to adhere, and by twisting round the handle, the wool being held between the forefinger and thumb of the left hand, the wool is smoothly and firmly wrapped round it. A little practice enables us to effect this with great neatness. The cervix being generally abnormally patulous, there is no difficulty in passing the probes through the os, previously exposed by the speculum, so as to reach the entire uterine cavity. The writer is in the habit of using a mixture of equal parts of crystallised carbolic acid and glycerine, as a local alterative, than which, he believes, there is no better application. Others, however, employ tincture of iodine, or strong solutions of nitrate of silver; or they even, as recommended by Courty of Montpellier, pass a solid piece of nitrate of silver into the uterine cavity, leaving it there to melt and flow over the mucous membrane. The writer first swabs out the uterine cavity with one or two probes covered with dry wool, so as to remove the glutinous discharge as much as possible, and then passes in another probe, covered with the carbolic solution, so as to paint over the lining membrane of the cervix and body of the uterus, the external abrasions on the cervix being subsequently swabbed over with the same solution. This rarely gives rise to any pain or discomfort, and may be combined with the other plans of treatment already mentioned. Intra-uterine medication is most useful in the week immediately succeeding menstruation, when the superficial layer of the mucous membrane has been shed. If used too near the advent of the next period it may prove too irritating, and may bring on menstruation prematurely. As a rule, two applications, at intervals of a few days, in the early part of the intramenstrual interval are amply sufficient, and it may be necessary to continue the treatment for many weeks or months. The writer of late has found the application of the continuous electrical current, through a carefully insulated sound, a still more efficient and much more rapidly effectual method of intra-uterine medication. Some three or four applications of about 100 milliampères will often effectually cure an intrauterine leucorrhœa of long persistence. Unfortunately this is a method of treatment that is not generally applicable, since it requires an expensive plant, and very considerable practical experience, in order that it may be safely and efficiently used. Should laceration of the cervix and ectropion exist, Emmett's operation of trachelorrhaphy may be indicated. In very severe and obstinate cases of this kind Recamier used to scrape the uterine mucous membrane with a curette, so as to remove the granulations, especially when there was much metrorrhagia, and where there was reason to suspect the existence of a granular condition of the intra-uterine mucous membrane. The Dublin physicians recommend the application of fuming nitric acid, the cervix having been first dilated with tents. This is a very strong measure, which we would not willingly adopt; but it is only fair to say that in the cases in which the writer has used it he has found it exceedingly useful. Scraping the uterine cavity with the dull wire curette also occasionally has an admirable result in such conditions; and, so far as the writer's experience goes, this is a perfectly safe procedure. Before concluding this subject, a word of caution is necessary. Valuable as intrauterine medication certainly is in suitable cases, it should never be rashly or indiscriminately employed, and the writer would strongly insist that, before resorting to it, we should satisfy ourselves that the uterus is likely to bear it with impunity. Whenever, therefore, there is much tenderness of the womb on being touched, even when the case is otherwise suitable, the writer deems it advisable first to remove the congested condition by rest, the local abstraction of blood, the use of glycerine pledgets, hot-water irrigations, and other appropriate means; and, above all, the slightest evidence of any concomitant mischief or irritation, recent or of old standing, in the neighbourhood of the uterus, as shown by tenderness on pressure in the region of the broad ligaments, or fixity of the uterus, should be an absolute contraindication.

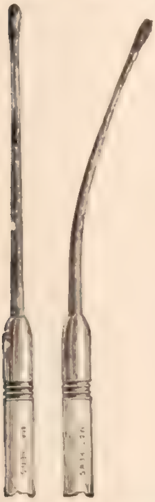

Fig. 181.—Uterine Probes.

2. **Displacements.**—Under this head we have to discuss a variety of diseases which have furnished a fruitful theme for controversy among gynæcologists. Practically, physicians have divided themselves into two great schools with regard to these affections. One of these schools teaches that deviations of the uterus, in whatever direction they occur, whether forwards, backwards, or to either side (for descent of the uterus is of a different character, and must be separately

discussed), form of themselves serious maladies accompanied by definite symptoms; and, as a logical deduction, that their treatment should primarily consist in the endeavour to replace the dislocated uterus in its normal position, and maintain its position by mechanical contrivances known as *pessaries*. The other, and much larger, school holds that versions or flexions are not *per se* the cause of the undoubted symptoms which are met with in the cases in which they are found to be present; that flexions may, and often do, exist without giving rise to any symptoms at all; that in all cases the symptoms may be traced to the uterine engorgements and congestions which accompany the deviations, and are their primary cause; and that, therefore, it is unnecessary to pay attention to the displacement, which may be left to itself, while associated conditions are remedied by appropriate treatment. As is generally the case in all such controversies, it is probable that neither side is entirely in the right, and that the truth is to be found between the two. It is certain that in some cases, and under certain peculiarities of constitution, flexions produce symptoms which cannot be explained by the accompanying condition of the uterine structures, which can only be relieved by mechanically supporting the dislocated womb, and frequently are so relieved in the most remarkable manner. It is unquestionable, however, that marked flexions often exist without producing any appreciable symptoms, and as these are only found out accidentally, when, from some other cause, an examination is made, it is not improbable that such cases are much more common than is generally supposed. Upon the whole, the writer is inclined to think that displacements are rather the result than the cause of the associated morbid state of the uterus, and that one of the chief elements of treatment is to get rid of the congested, hypertrophied, or sub-involuted state of the organ which produces them. But, even if this be admitted, it by no means follows that proper mechanical support is not needed. So far from this being the case, the writer believes it to be of the greatest possible value in supporting and steadying the overweighted and misplaced organ, thereby facilitating the removal of its morbid states, as well as relieving its most urgent symptoms.

Properly speaking, displacements of the uterus should be divided into two classes, *versions* and *flexions*. In the former the body of the uterus retains its normal shape, but not its normal direction, the entire organ being displaced either forwards (*ante-version*), backwards (*retro-version*), or to one side (*latero-version*). In the latter the shape of the uterus is altered, and its body is more or less acutely bent over the cervix in the form of a retort, producing the analogous conditions of *ante-flexion*, *retro-flexion*, or *latero-flexion*. But these states are very closely related to each other. Very often they are combined, they arise from similar causes, and they produce similar results. For the sake of brevity, therefore, they will be discussed together.

Ætiology and Pathology.—In order to understand how uterine displacements are produced, it is necessary to remember the means by which the uterus is maintained in its natural position. In the healthy state the uterus is situated high in the pelvic cavity, its fundus projecting somewhat above the plane of the pelvic brim, to the axis of which—that is, to a line drawn from the umbilicus to the coccyx—its own axis corresponds. It is maintained in this position partly by the muscular column of the vagina below, on which it is, as it were, poised; partly by the folds of the peritoneum forming Douglas's pouch behind, especially that portion of them called the utero-sacral ligaments; and partly by fibrous portions of pelvic fascia in front, attached to the pubes and passing by the side of the bladder. These are fixed to the uterus above the points of junction of the internal os with its body, which is, therefore, the part of the organ least liable to change of position, and that at which flexions almost invariably take place. The fundus and body are much more mobile, but their movements are somewhat controlled by the round ligaments in front, and the broad ligaments at the side. The shape of the uterus is further maintained by the well-marked inherent rigidity of its tissue, and when this is altered by disease, as by congestion, sub-involution, and the like, displacements are much more apt to occur. The axis of the uterus is naturally apt to alter its position under various conditions. Thus it falls less or more forwards, according as the bladder is distended or otherwise. The uterus is also so placed that it ascends or descends with more or less freedom, and, as it does so, its axis corresponds with the axis of the plane of that part of the pelvis in which it lies. This fact has been especially pointed out by the late Dr. Squarey, and it goes far to explain why similar causes should at one period produce a forward, and at another a backward, displacement. The causes of displacements are chiefly any conditions which weaken the supports, or the resisting power, of the uterus. They are, therefore, most frequently found in association with the results of parturition—sub-involution, congestion, hyperplasia, and endometritis—which all diminish the inherent tonicity of the uterine walls, as well as weaken its supports, and prevent its regaining its natural shape when accidentally altered. The displacement itself may be caused or favoured by a variety of conditions, such as blows, falls, tight clothing, fibroid tumours developed in the uterine walls, and many other analogous states. When a flexion has been produced, the venous capillaries at the point of flexion are more or less obstructed, and the return of blood through them hindered, while the arteries continue to supply blood. The fundus, therefore, becomes congested, and subsequent structural alterations are developed. This point has been insisted on by the late Dr. Graily Hewitt, and there can be no doubt of its accuracy. This explains the fact that, even when flexions are secondary, it is impossible to treat them satisfactorily by general means alone, and that, in course of time, a flexion, originally secondary in its causation, may require to be the chief object of treatment.

SYMPTOMS.—The symptoms of flexion of the uterus are in no way special. They are very much those which have already been described as accompanying the inflammatory varieties of uterine disease, and there are none which would enable the practitioner to foretell its existence with certainty. Amongst those most commonly observed are pain, weight, and bearing down, often decidedly increased by exercise of any kind, not infrequently rendering locomotion an impossibility; pain in one or other ovarian region; pain, and sometimes difficulty, in micturition; and various disorders of the menstrual function, more especially dysmenorrhœa and menorrhagia. After these have lasted some time the secondary derangements of the general health, so common in uterine disease, become established, and they lead to very serious consequences.

DIAGNOSIS.—The diagnosis of displacements is not difficult on vaginal examination. Supposing we have to do with a flexion, the cervix is found in its normal position; but either in front, behind, or, more rarely, at either side, is a rounded swelling about the size of half an orange, which can be pushed away by the examining finger. This might be confounded with various other conditions, such as small uterine fibroids, inflammatory exudation, hæmatocele, and small ovarian tumours. The diagnosis can, however, be readily cleared up by the sound, which will only pass in the direction in which the uterus is flexed; and, when it is turned gently and cautiously round, the flexed fundus is lifted with it, and can no longer be felt in its former position. In ante- or retro-version, in addition to feeling the body of the uterus in its abnormal situation, we also find that the cervix is lifted out of its usual central position, and points either forwards or backwards respectively.

TREATMENT.—In arranging a plan of treatment for uterine displacements, the concomitant conditions should be carefully attended to, and endometritis, congestion, and other complications relieved, if they exist. Unless this be done, the treatment may entirely fail, or may be very unnecessarily prolonged. Here we must limit ourselves to a very brief description of the best plans of mechanical treatment, strongly insisting, however, that they should not be too exclusively relied on. In backward displacements we have a very satisfactory means of supporting the misplaced organ in the well-known Hodge's pessary, numerous modifications of which exist. The important point to bear in mind is to select an instrument not too bulky, nor too long, for the individual case; the best material being either wire covered with soft indiarubber, vulcanite, or Britannia-metal. The treatment often fails from want of proper selection; since a pessary, to be thoroughly useful, should be fitted as accurately as a shoe to a foot. Before introducing it, the sound should be gently passed, and the uterus replaced and held in its proper direction for a few minutes; and this manœuvre should be repeated from time to time, until the uterus does not re-assume its abnormal position. Even then, however, the pessary should be worn continuously for several months, until we feel quite sure that the misplacement is permanently relieved. In many cases relief is instantaneous and remarkable; in others the fundus is too tender to bear the pressure of the pessary at all. When this is the case it should be removed, and an endeavour should be made to prepare the uterus for the use of this support by the local abstraction of blood, hot irrigations, the application of glycerine pledgets, or sedative pessaries. In introducing the Hodge's pessary, care should be taken to guide its upper part into its proper position behind the cervix, so as to press up the fundus; and, as the case improves, a larger instrument should be introduced, so as to follow up the retreating fundus. Re-position of the uterus must, of course, never be attempted if there is reason to think that the fundus is bound down by adhesions, or if the uterus is very tender. In suitable cases, however, it materially facilitates the cure.

Anterior displacements must be treated on the same principles. Unfortunately, we do not possess anything like an equally good means of mechanical support, and a thoroughly efficient ante-flexion pessary is still a desideratum. After trying a good many, the writer has come to the conclusion that the best is the late Dr. Graily Hewitt's vulcanite cradle pessary, of a size suitable to the case. It is, however, difficult to introduce and remove. Nor can it always be borne. A well-fitting abdominal belt—and the best is that known as the American belt—is often of great assistance, by removing the weight of the superincumbent intestines. When all other means of restoring a flexed uterus fail, an intra-uterine stem pessary may possibly succeed. Great caution, however, is necessary, and it should never be used unless the patient is under constant supervision, so that it may be removed on the slightest appearance of undue irritation. During the treatment of all flexions, rest is of paramount importance—not absolute, but as much as possible; and exercise should be very sparingly permitted, and only in a tentative manner. In this (and the same remark applies to every other form of uterine disease), care should be taken that local examinations should be as infrequent as the necessities of the case will allow. In all such cases there is a distinct danger that ill-judged and unnecessarily frequent local treatments may end in producing neurotic complications which may prove to be worse than the disease they profess to cure.

Prolapsus.—The only other displacement of the uterus requiring special mention is descent or *prolapsus*, for the corresponding condition of undue elevation is of little practical importance. Descent of the uterus is far from rare, and it sometimes causes much discomfort. In it the uterus descends from its normal position to a varying extent, so that the prolapsus may be only partial, or it may be complete. When the entire uterus lies without the vulva, along with the everted vagina, the mass is known as *procidentia uteri.*

Ætiology and Pathology.—Descent of the uterus depends upon a variety of causes which lead to a weakening of the uterine supports, either from above or below. These supports are chiefly, above, the various uterine ligaments, with the cellular tissue of the pelvis; below, the muscular column of the vagina. When from any cause, such as imperfect recovery after childbirth, senile absorption of adipose tissue, or rupture of the perinæum tending to prolapse of the vagina, they are no longer able to support the uterus efficiently, a comparatively slight cause may suffice to allow the womb to be pushed or drawn out of its place, as, for example, straining, lifting heavy weights, undue weight of the organ itself, and many other causes. As soon as the organ is prolapsed, to whatever degree this may occur, various morbid alterations are pretty sure to follow. The uterus becomes irritated, congested, and hypertrophied; and the everted mucous membrane of the vagina, which then covers it, becomes greatly altered, and assumes almost the appearance of skin. The most characteristic change, however, is generally elongation of the cervix, through traction from below, especially in cases in which prolapse follows previous descent of the vaginal walls. This elongation is due to yielding of the elastic tissue of the cervix, especially that portion above the roof of the vagina, which becomes greatly elongated, so that the sound introduced into the procident organ may pass for six or seven inches. When the uterus is replaced, the normal elasticity again comes into play, and the cervix rapidly contracts. This is the condition described by Hugier as *hypertrophic elongation of the cervix*, and it is rarely absent.

Symptoms and Diagnosis.—The symptoms of prolapse of the womb are mainly due to the mechanical discomfort attending it, such as weight, difficulty in progression, interference with micturition, and much general inconvenience. The diagnosis is a matter of no difficulty. In the greater degrees the procident organ, covered with the hardened and altered vaginal mucous membrane, is at once apparent. The only condition it is at all likely to be confounded with is old-standing inversion of the uterus, and from this mistake the presence of the os uteri at the apex of the tumour will at once guard us. In the slighter degrees the cervix will be felt low in the vagina, or even at its orifice.

Treatment. — The treatment comprises two principal indications: First, rest, and consequent reduction of the size and weight of the procident organ; thereby greatly facilitating the second indication, namely, re-position, and maintenance of the uterus in its normal position. The effect of mere rest in diminishing the size of a prolapsed uterus is often very remarkable. A week or ten days in bed will often, of itself, reduce the cervical elongation to a considerable amount. Re-position is generally easily effected, and the chief difficulty is in support. In devising mechanical contrivances for keeping the uterus in position, the chief thing to bear in mind is that we should strengthen the natural uterine supports, so that they may regain their lost power of keeping the organ in its place. Hence the old ring or ball pessaries, which greatly distend the vagina, are absolutely inadmissible. In the slighter degrees an ordinary Hodge's pessary may answer every purpose, an endeavour being, at the same time, made to give better support from below. This is generally best done by a perineal pad, and also sometimes by using an astringent to the vagina, so as to make it a more efficient column of support, such as alum or oak-bark injections. In the greater degrees the best kind of pessary is that known as the 'vaginal stem,' which is in the shape of the cup of the ordinary toy known as the cup-and-ball, on the extremity of which the cervix rests, the other end being attached to a perineal band. If this does not answer, the pessary known as Zwancke's may succeed. This has the advantage of supporting the uterus without unduly distending the vagina. These measures are merely palliative, and a more radical cure may be hoped for by various operative procedures, into the details of which it is impossible to enter. It may suffice to say that they consist of: First, the removal of a small portion of the elongated cervix, either by the galvano-caustic wire or by the ecraseur, in the hope of stimulating the remainder to contract, a procedure only occasionally required, but sometimes of undoubted utility. Secondly, the making of a new perinæum, in cases in which the prolapse seems secondary to undue descent of the vagina—a very valuable resource. Thirdly, narrowing of the vagina itself, for which a variety of operations are practised, which, like removal of a portion of the cervix, are rarely required.

3. **Malignant Disease.** — Malignant diseases are of common occurrence in the generative organs of females, and indeed they are more often met with in these than in any other part of the body.

ÆTIOLOGY. — Malignant disease of the uterus is most common about the middle period of life, the largest number of cases occurring between forty and fifty years of age. Occasionally we meet with it in old women who have long ceased to menstruate, or with rapidly advancing cases in younger women under thirty years of age. Hereditary predisposition apparently plays some part in its production, but not so much as was formerly believed. Frequent child-bearing has a decided influence in favouring its development, since the proportion of cases is larger in multiparæ. To this may be added any causes of constitutional debility, since malignant disease unquestionably occurs more often in weak and unhealthy, than in strong and robust women.

ANATOMICAL CHARACTERS.—All the recognised forms of malignant disease occur in the uterus, but some of them are more common than others. Scirrhus is that which is least frequently observed, and medullary carcinoma most often. Klebs, however, has pointed out that in the earliest stages of carcinomatous disease the fibrous element preponderates in the affected part; while, as the malady progresses, cell-growth rapidly advances, so that in old-standing cases, and at *post-mortem* examinations, the medullary carcinoma is that which is found, although, at first, the scirrhous form may probably have existed. Another common variety of malignant disease is the epithelial cancer, which chiefly affects the mucous membrane of the cervix. The so-called colloid cancer is rarely met with. In the large majority of cases the cervix is the part first affected, although, in exceptional instances, the disease may originate in the body of the uterus, the cervix being at first unimplicated.

At the commencement of the more ordinary variety the cervix is hard, somewhat nodular, and hypertrophied. It is comparatively rare for the disease to be seen at so early a stage, and, as the uterus is then quite movable, it is impossible to distinguish it from enlargement of the cervix due to congestive forms of disease. As the disease progresses, the carcinomatous degeneration advances rapidly; more and more tissue is involved; and the roof of the vagina becomes implicated, so that the uterus is fixed in a mass of new-growth. Before long a destructive process commences; portions of the growth slough and come away; hæmorrhage takes place from the opening of vessels; and, in advanced stages of the disease, the cervix may be entirely destroyed, and even the bladder or rectum opened, so as to form a common opening with the vagina. The epithelial variety of cancer commences on the mucous surface of the cervix by the growth of its villi into a papillary tumour, which, at first, it may be impossible to distinguish from similar growths of a benign character. It rapidly spreads, however, soon forming a fungating soft mass, not unlike the flower of a cauliflower in appearance; hence its popular name 'the cauliflower excrescence.' As in medullary carcinoma, destructive changes soon occur; ulceration progresses; and, as the disease advances, the neighbouring structures are implicated. When the disease involves the more deeply seated tissues, *post-mortem* examination shows that the malignant growth there assumes more of the character of medullary cancer.

SYMPTOMS.—The earliest sign that arouses suspicion as to the existence of malignant disease is generally the occurrence of hæmorrhage, at first merely an excessive menstrual flow, subsequently loss of blood, sometimes very great in amount, at irregular intervals. Sometimes it is brought on by trivial causes, and a not infrequent complaint is that it always occurs after sexual intercourse. Excessive hæmorrhages, which are sometimes very alarming in amount, do not, as a rule, occur until advanced stages of the disease, when destruction of tissue is taking place. Another marked symptom is profuse discharge, often having a peculiar and pathognomonic fœtor, from the admixture of minute portions of sloughing tissue. In scirrhous carcinoma the discharge is not usually abundant, but it is sometimes very ichorous in character, producing excoriations, intense pruritus, or other disagreeable symptoms, in consequence of its irritating property. In epithelioma it is often very abundant, watery in character, and tinged with blood. Pain is sometimes excessive. The writer has often, however, seen cases terminate fatally without any pain at all. General constitutional disturbance soon results; the peculiar cachexia of malignant disease is developed; and the patient becomes sallow, emaciated, and extremely debilitated.

DIAGNOSIS.—In advanced cases manual examination at once clears up the nature of the case. The cervix and roof of the vagina are infiltrated with the characteristic hard growth, and the uterus is quite fixed. If ulceration is advanced, the ragged broken edges of the cervix are apparent, bleeding on being touched, and breaking down under the finger. In a case of this kind mistake is hardly possible. In the earlier stages, before fixation and ulceration have advanced, error is easy, and it is far from uncommon to find non-malignant alterations of the cervix which have been mistaken for cancer, and even the reverse. Nothing but time will clear up such doubtful cases, and care should be taken not to give a positive diagnosis, unless the character of the case is marked and undoubted. The most difficult cases to diagnose are those in which the body of the uterus is alone affected. Here hæmorrhage, fœtid discharge, and recurrent attacks of spasmodic pain (probably caused by the efforts of the uterus to expel discharge collected in its cavity) may arouse suspicion; but nothing except dilatation of the cervix, and thorough exploration of the uterine cavity, can clear up the nature of the case. On account of the friability of the tissues, this must always be done with great caution. In epithelial cancer the soft, fungating, bleeding, and easily broken-down mass can hardly be mistaken for anything else.

Prognosis.—The prognosis is, of course, most unfavourable. There are, no doubt, a few authentic cases on record in which the patients have recovered after amputation of the cervix, but these are of the utmost rarity. In the vast majority death takes place, in a time varying from a few months to one or two years. Probably the disease advances most rapidly in younger patients, but few last longer than two years. Death takes place either from exhaustion, hæmorrhage, septicæmia, or some other complication. The writer has seen it on one or two occasions result from uræmia, the consequence of occlusion of the ureters through extension of the cancerous growth.

Treatment. — In the large majority of cases seen for the first time at an advanced stage, treatment must, of necessity, be palliative only. Here there are two chief indications — the maintenance of the general health; and the relief of pain, fœtor, or other distressing local complications. For the former we must rely mainly on a suitable diet, and the administration of some tonic which may be found to agree with the patient. The preparations of arsenic, as a rule, answer better than either iron or quinine. For the relief of pain the use of opiates, either in the form of morphine suppositories or administered subcutaneously, must be our sheet-anchor, and, when the pain is severe, it may be necessary to exhibit them in large doses. Fœtor may be best arrested by the local use of antiseptics. The plan which the writer has found to be most successful for the purpose is to introduce at night into the vagina a pledget of cotton wool, soaked in the glycerine of tannic acid, to which a small quantity of the glycerine of carbolic acid has been added, in the proportion of about one ounce of the latter to eight ounces of the former. This effectually destroys fœtor, while the astringent property of the tannic acid serves to check unduly rapid cell-growth, and prevent hæmorrhage. In the morning the vagina may be syringed out with a weak solution of permanganate of potassium. Iodoform pessaries are also extremely useful for this purpose. When hæmorrhage is excessive, local hæmostatics, such as the diluted solution of perchloride of iron, must be used, and, if necessary, the vagina plugged. Surgical treatment may be adopted in the hope either of entirely removing the disease, or of lessening the hæmorrhage and discharges, and so retarding its progress. Either indication is most easily fulfilled in epithelial cancer. When this is limited to the cervix, when there is a fair margin of healthy tissue between the diseased portion of the cervix and the body of the uterus, supra-vaginal amputation or amputation by the galvano-caustic wire or wire écraseur should be resorted to, the actual cautery being subsequently freely applied to the stump, to destroy, as much as possible, any infiltrated cancer-cells. Even when this fails to prevent the recurrence of the disease, it will certainly prolong the life of the patient, and increase her comfort. In other cases destruction of the exuberant growth, both in epithelial and medullary cancer, may be advantageously effected by local caustic applications, such as strong solutions of chloride of zinc, nitric acid, or bromine. The same object has been sought by excising the diseased tissue, or by scraping it away as much as possible by peculiar scoop-shaped curettes made for the purpose, after which one of the above-mentioned caustics, or the actual cautery, may be applied. It is in the epitheliomatous form of malignant disease that this procedure is most valuable, and a carefully performed operation may prolong life for months or years. Of late years vaginal extirpation of the uterus has been largely practised, and with fairly good results. This is, however, an operation of the greatest gravity, and it is only possible at an early stage of the disease, when the uterus is still mobile. It is clearly impossible to discuss its merits in an article of this description.

4. **Tumours.**—(1) *Fibroid Tumour.*—By far the most common variety of uterine tumours—so common that, according to some authorities, it is found in 60 per cent. of women who die after middle age—is the so-called fibroid tumour (myoma, fibroma).

Ætiology. — Fibroid tumours are most common after twenty years of age, and in certain races, the African especially, they occur with great frequency. Beyond this nothing is known of the causes which produce or favour their growth.

Anatomical Characters.—Fibromata are limited hypertrophies of the substance of the uterus, existing in the form of more or less globular tumours, contained loosely in a capsule of fibro-cellular tissue. Structurally they are homologous with the tissue of the uterus itself, consisting of connective tissue, mixed with unstriped muscular fibres. They are found of every size, varying from dimensions scarcely larger than a millet seed, up to enormous masses weighing as much as fifty pounds. Most generally they occupy the fundus and body of the womb, and they are conveniently divided into three classes, according to the position they occupy, namely, the *sub-peritoneal*, occupying chiefly the outer surface of the uterus; the *intra-mural*, chiefly developed in the substance of the walls; and the *sub-mucous*, which project into its cavity; and these may be either completely sessile, with a broad base of attachment, or they may have become more or less pedunculated, and then approach in character to the fibroid polypi.

When once formed, the future progress of fibroids of the womb varies much. Generally they are of very slow growth, and although malignant degeneration of their structure has been observed in rare instances, they most commonly exist for the rest of the patient's life, without giving rise to any troublesome effects, beyond those resulting from mechanical pressure, provided they are not accompanied by hæmorrhage. They are, however, subject to certain occasional alterations, such as inflammation and even sloughing, when mechanically injured, fatty and calcareous degeneration, and even to complete absorption. The possibility of their entire spontaneous disappearance has been strongly questioned. The writer has published several instances coming under his own observation, and the fact is now pretty generally admitted, the explanation probably being that on account of similarity of texture to that of the tissues of the uterus, they are subject to a process of involution like that which the tissue of the uterus undergoes after delivery.

Symptoms.—The symptoms of fibroids of the womb depend to a great extent on their position. The sub-peritoneal and interstitial varieties, when not very large, are often unaccompanied by any symptoms whatever, and those that exist are chiefly the result of mechanical pressure, such as weight, difficulty in walking, irritability of the bladder, constipation, and the like. In the sub-mucous variety, the prominent symptom is hæmorrhage, which sometimes occurs to a very alarming extent, and may even put the patient's life in danger. The source of the hæmorrhage is probably, in the majority of cases, minute capillary vessels in the mucous membrane covering the tumour, which keeps up irritation and congestion in its neighbourhood. It is similar in its origin, therefore, to the discharge in menstruation, and is greatest in amount at the menstrual period. The more severe hæmorrhages are probably caused by openings in various vessels developed in the periphery of the tumour, where the vessels are increased in size, just as they are in pregnancy.

The physical signs vary with the size and situation of the tumours. If large enough to be perceptible on abdominal palpation, they have generally a more or less rounded or lobular outline, and a hard, firm feel, without any fluctuation, which serves to distinguish them from other varieties of abdominal growth. Small tumours, however, growing from the sides of the uterus, may be easily confounded with other conditions, especially flexions of the uterus, and deposits or exudations in its vicinity, such as hæmatocele, or pelvic cellulitis or peritonitis. The mobility of the uterus, which in the latter conditions is generally impaired, and the use of the uterine sound, which shows, in tumours, that the cavity of the uterus is considerably elongated, ought to enable us to avoid such mistakes.

Treatment.—The treatment resolves itself into *medical* and *surgical*. The former may be said to be powerless, all the so-called absorbents—iodides, bromides, preparations of calcium, Kreuznach and other waters, being admitted to be of no reliable value whatever. The subcutaneous injection of ergotin, in doses of half a grain to a grain daily, is said by Hildebrandt to be of great value, and is favourably spoken of by Atthill and other authors. It is, however, not reliable, and has often to be discontinued on account of the irritation produced by the injections. Of late years the treatment of such tumours by the electrical current, chiefly advocated by Apostoli, has been much discussed. It is claimed that electro-negative puncture has a decided effect in promoting absorption. The writer believes this to be frequently the case, but the procedure is not without risk, and it seems to him to be only permissible where the tumour is producing serious pressure-symptoms, such as retention of urine or the like. Surgical methods of treatment are chiefly called for when the hæmorrhages are excessive and exhausting. To discuss them at length is impossible in so limited a space, and the writer can do little more than merely enumerate them, referring the reader to systematic works for complete details.

(*a*) The hæmostatic effect of the electro-positive current applied to the uterine cavity by an insulated platinum or carbon sound the writer believes to be of great value. He has now seen numerous cases in which the most severe hæmorrhages have been controlled by this means. It apparently acts by hardening the mucous covering of the tumour. The writer is of opinion that the severe surgical procedure for hæmorrhagic fibroid is justifiable until this method has had a full and fair trial.

(*b*) Injection of *styptics* into the uterine cavity, such as tincture of iodine, or diluted tincture of the perchloride of iron, is valuable when the hæmorrhage is excessive, but is a plan which should not be tried unless the cervix has been previously dilated.

(*c*) *Incision of the cervix* is decidedly beneficial when the hæmorrhage is frequent and severe, and is supposed to act by allowing the uterine fibres to contract upon the tumour.

(*d*) *Incision of the capsule of the tumour* itself is useful in certain sessile tumours projecting into the uterine cavity, certainly diminishing the hæmorrhage, and facilitating subsequent enucleation.

(*e*) *Removal* of as much as possible of the tumour, with the écraseur or galvano-caustic wire, may be undertaken, when it is so situated as to be within reach.

(*f*) *Enucleation* is very valuable when the tumour is projecting into the uterine cavity, and is already partially separated from its attachments. Under such circumstances, it may be shelled out from its capsule *en masse*. The operation, however, is difficult and severe, and must be reserved for very urgent cases.

(*g*) *Gastrotomy*, with the removal of the mass of the tumour, and even of the entire uterus, is one of the most formidable of all operations, but one which has frequently been successfully performed, and which is justifiable when the patient's life is seriously endangered from uncontrollable hæmorrhage.

(*h*) The artificial production of the menopause by *removal of the uterine appendages* is an operation which has been highly recommended, and is chiefly valuable when the tumour is of small size.

(2) *Polypus.*—Polypus of the uterus may be considered in connexion with this subject, since the large majority of polypi are merely *fibroid* tumours, to a great extent enucleated from their capsules, and attached to the uterus by a narrow pedicle. There are, however, two other varieties described, the *glandular*, and the *cellular* polypi.

Anatomical Characters.—The *glandular* polypus is a localised hypertrophy of connective tissue, rarely larger than an egg, and generally attached to the cervix; the *cellular* is a hypertrophy of some of the glandular structures of the cervix, either of the Nabothian follicles or the utricular glands, and it is generally of small size. *Fibroid* polypi, like fibroid tumours, may be of any dimensions, but they are commonly met with about the size of a small pear.

Symptoms and Diagnosis. — Polypi are only important because of the hæmorrhage which so frequently accompanies them. When extruded from the cervix, or growing from it, they offer no difficulty in diagnosis. Nor is there any condition apt to be mistaken for them, except a chronic inversion of the womb, which can be readily differentiated by tracing the pedicle through the os, and finding that the sound enters the uterus to its usual depth. Intra-uterine polypi are much more difficult to discover, and here the only plan is complete dilatation of the cervix, and thorough exploration of the uterine cavity. This procedure is essential in all cases of severe hæmorrhage resisting ordinary hæmostatic treatment.

Treatment.—When once a polypus has been detected, the only treatment is its removal. In cases in which the polypus is chiefly in the vagina, this is easy enough, the wire of an écraseur being passed round the pedicle, which is separated in this way from its attachment. It is not essential that the wire should touch the base of the pedicle, since the part left, after the bulk of the polypus is removed, always shrivels up and disappears. In intra-uterine polypi it is sometimes difficult to pass the wire round the pedicle, but by thoroughly anæsthetising the patient, and using a single wire, it can generally be managed. No other method of removing polypi is so good. Excision may give rise to hæmorrhage, and the old method of ligature is dangerous from the risk of inducing septicæmia.

(3) *Fibro-cystic and Sarcomatous Tumours.*—The only other uterine growths requiring mention are the fibro-cystic tumours (cysto-fibroma, cysto-sarcoma), and the sarcomatous tumours.

The *fibro-cystic* tumour is specially important on account of its great resemblance to cystic tumours of the ovary, and the extreme difficulty of differential diagnosis, which is so great that probably there is no ovariotomist of any experience who has not mistaken the one for the other. The fibrocystic tumour is a fibroid tumour of the uterus, generally of the sub-peritoneal variety, which has grown to a large size from the development of cysts in its substance. This is most usually effected by degeneration of its tissue, which becomes liquefied and transformed into an albumino-serous fluid. Thus we have a tumour partially solid, partially fluctuating—although rarely so distinctly so as an ovarian tumour—from which fluid can be drawn by an exploratory puncture, and which may attain dimensions, and produce constitutional effects, not less marked than those of ovarian cystic disease. The differential diagnosis may well baffle even the most expert gynæcologist. The sound may possibly enable us to ascertain the uterine character of the growth, as it enters for a considerable length, and on moving it the connexion of the tumour with the uterus may be demonstrated. Atthill has laid stress on the character of the fluid removed on puncture as diagnostic, since, unlike ovarian fluid, it coagulates spontaneously on standing, and on microscopic examination elongated fibre-cells, similar to those of the uterus itself, are found in it. The prognosis of these growths is unfavourable, since they produce all the evil effects of ovarian tumours, and the risk attending their removal by operation, which is the only available method of treatment, is much greater than that of ovariotomy.

Sarcomatous tumours of the uterus have been but little studied. They are in many respects like fibroid growths, but have a marked tendency to fungate and ulcerate, and to return after removal. Hence, they hold a place midway between the benign fibroid and the malignant cancerous growths, and they generally spring from the uterine tissue, like the sub-mucous fibroids, but without any distinct capsule. The symptoms are chiefly those of fibroid in that situation, namely, hæmorrhage; profuse watery discharges, and sometimes pain, probably the result of uterine contractions. The treatment must consist in the removal of as much as is possible of the tumour by the écraseur or galvano-caustic wire; and, if the nature of the tumour be ascertained, its attachment should be thoroughly cauterised with strong nitric acid.

W. S. Playfair.

WOMEN, Diseases of.—Synon.: Fr. *Maladies des Femmes*; Ger. *Frauenkrankheiten.*

The intention of this article is to indicate what is comprehended under its title: to define the proper limits of the subject; to show broadly the relations of the subject to general pathology; and to set out some connected points and general principles which could hardly be so usefully stated in the special articles into which the subject is necessarily subdivided.

It is impossible to draw an arbitrary line that shall clearly separate what are commonly regarded as the special diseases of women from the domain of general pathology The study of the diseases centred in the sexual system of women is no more than the application of general pathology to this particular system. Any disease occurring in a woman will almost certainly involve some modifications in the work of her sexual system. On the other hand, the ordinary or disturbed work of her sexual system will influence the course of any disease which may assail her, however independent this disease may seem to be in its origin. Still, bearing in mind the foregoing fundamental facts, it may be stated broadly that the diseases of women embrace more especially those morbid processes and mechanical deviations of which the principal seat is in the sexual system, that is, in the ovaries, uterus, and breasts. Yet even this is a narrow and misleading view to take. It is no more possible to imagine an isolated pathology of the ovaries or uterus, than of the liver, kidney, or heart. If any one of these organs be damaged or working imperfectly, the blood, the nervous centres, the other organs, the whole body, suffer. No one organ can withdraw itself from its solidarity with the rest. And it is often an impossible task to analyse what appears at first sight to be a simple case, say of disease of the kidney, into its component elements, and to bring home to the kidney the initial fault. The controversy concerning arterial fibrosis, heart-disease, and Bright's disease, is a striking, but by no means exceptional, illustration of this proposition. The same thing is equally true of many apparently special disorders of the ovaries or uterus. The disturbance in function of these organs may be so obtrusively prominent that attention is concentrated upon them; and thus we may be led to regard them as the exclusive or principal seat of morbid action, and so to expend upon them our remedial care. The physician, in search of a diagnosis, is greatly guided by the observation of function. Disturbed function raises a presumption that the organ disturbed is itself at fault, and we are instinctively inclined to help that organ in its difficulty. But the primary or efficient cause may be elsewhere. This is as true of the ovaries and uterus as it is of the heart, kidney, or any other organ. One illustration will suffice. A woman suffers an abortion. There is the uterus obviously disturbed in its function, acting, in fact, in an improper manner. But we cannot in all cases affirm that the uterus is diseased. The causes of abortion are multitudinous. An efficient cause may indeed be found in some mechanical or structural fault of the uterus; but more often it will be found in the impeded work of some remote organ, or in an empoisoned state of the blood. Nor is any case often simple. Commonly several causes concur, local conditions acting and reacting upon each other. Thus, when the immediate cause is found in some alteration of tissue in the uterus, we may still have to look for the original cause in some antecedent constitutional disorder, for example, struma, or syphilis, inherited or acquired, or perhaps in some long-past transient morbid process, whose action can only be traced back—if traced at all—through the fallacious records and conjectures of history. Nor even then shall we be justified in concluding that we have discovered the whole secret of the abortion, that we are masters of the situation, able to take a right view of its clinical significance, and competent to deal with it on rational principles. Abortion is not seldom a conservative process, a remedy adopted by Nature to avert urgent distress in the circulation or in vital organs. There may be no appreciable disease in the uterus or embryo; but the embryo is cast out, the uterus is emptied, in order to relieve the system of a source of danger. Here, then, is proof of the danger of treating disorders of the sexual organs as a detached bit of pathology.

Here we may make particular application of a general law. The case may be formulated aphoristically. An organ so made to work against obstruction in excess, or in an unnatural manner, is prone to organic disease. This is remarkably true of the uterus. It may be said, indeed, that a very large proportion of the structural abnormalities of the uterus arise in this way. Hence the importance of looking at disturbed function, not necessarily as evidence of disease of its correlated organ, but always as a warning that disease of that organ is in course of induction or of aggravation. This applies most strongly to the history of dysmenorrhœa, in which the transition from physiology in difficulty into pathology is often conspicuously manifested.

The widest and perhaps the best definition of the subject is expressed in the word 'gynæcology.' It embraces, indeed, far more than is expressed in the term 'diseases of women.' In its full etymological meaning it is comprehensive beyond the strict domain of medicine; but experience and thought will show that it does not go beyond the philosophical conception of the care of the 'health of women.' Without accepting the doctrine of Michelet, that the life of woman is a history of disease, it is undeniable that to appreciate justly the pathology of woman we must observe her in all her social relations, study minutely her moral and intellectual characteristics—that we must, in short, never for a moment lose sight of those physical attributes which indelibly stamp her as woman, which direct, control, and limit the exercise of her faculties. This collateral study is of infinitely more importance in the pathological history of woman than it is in that of man. A very large, perhaps a preponderating, proportion of all the diseases to which women are subject, arise out of, or are in intimate reactive relation with, the play of her sexual system. The key to many of the disorders of women, especially of the nervous system, will be found here. The essence of her mental life is responsiveness; the emotional, the reflex, or diastaltic functions play an infinitely more active part than in man. It may further be said that the reciprocal action of the brain and spinal cord and ganglionic nerves is quicker and more intimate than in man, especially that the brain is more strictly subservient to the animal functions. Abstraction from corporeal impulse, initiation, enterprise, are masculine faculties.

There is one *primâ facie* limitation of the subject. The proper diseases of woman occur during her sexual life; that is, during the functional activity of the ovaries, uterus, and breasts. Before this epoch sets in, the female is not a woman, but a child; and when this epoch is over those organs shrivel up and no longer affect the system as before. Practically, however, the physical defects of the sexual organs in course of development, as in girls, and in course of atrophic degeneration, as in old women, are so closely related by continuity of history with their state in the epoch of functional activity, that all three epochs are but linked chapters of the same history. To cut out arbitrarily the consideration of the child and the old woman must needs invalidate our knowledge of the physiology and pathology of the woman proper. But for the gynæcologist this study need not embrace more than the development and diseases of the sexual organs. In the child, and up to the advent of puberty, these diseases are few, and may be regarded as accidental. The developmental faults even rarely acquire importance until the advent of puberty. Then, if the organs are faulty, and their relations to surrounding organs are abnormal, the performance of their functions may be so hindered that distress may ensue in the organs themselves, in their immediate surroundings, or in distant organs; or disorders of hæmatosis, nutrition, or other general processes may be induced. In the old woman the sexual organs, having fulfilled their functions, undergo what may be called senile atrophy. The ovaries, the uterus, the vagina often, and the breasts, shrink; they are no longer the centres of active nervous and blood distribution; they become inert, and henceforth exercise but feeble influence upon the general organism. Unhappily this normal course is not always observed. Towards the climacteric there is too often developed a tendency to certain morbid processes in the ovaries, uterus, vagina, and breasts, which compel the attention of the gynæcologist. Instead of undergoing what may be described as the normal process of quiet extinction, their tissues exhibit aberrant forms of nutrition and degeneration, as fibroma or cancer, and then again the pelvic organs become active foci of blood-distribution and growth, entailing local distress, and general, it may be life-imperilling, disorder. And even when no morbid tissue-change occurs, when the organs yield to the process of extinction, various phenomena commonly show themselves, always more or less distressing; and which often assume pathological import. The sexual apparatus no longer dominating the system, the balance of healthy action and reaction being lost, the nervous force not finding its long-accustomed use, wanders off in strange paths, and in its erratic play reveals various nervous phenomena, not seldom mistaken for special neuroses—as neuralgia, hysteria, syncopal attacks, or vertigo, or even convulsive attacks simulating or even merging into epilepsy, hemianæsthesia, or hemiplegia, single or combined, and mimicking apoplexy or paralysis; and various mental aberrations more or less rebellious to the will, a very common phenomenon being enfeebled memory and unsteady volition. Associated or not with some of the foregoing phenomena are various subjective phenomena of sensation. Illusive pregnancy—the *pseudocyesis* of Mason Good—is one of the most familiar. Others are certain peripheral sensations, as tingling, pricking, numbness of the limbs, chills and flushings, sometimes profuse perspirations, and itching—when occurring in the pudenda assuming the character of pruritus, in many cases associated with, and apparently dependent upon, irritating discharges from the uterus and vagina, the expression often of organic disease; in other cases with glycosuria, but in all probably with some perturbation of the glandular system. Here we see proof of the intimate connexion of innervation, nutrition, and glandular action. This origin of glycosuria is but one example of the influence of perverted or diverted nerve-force, in altering the constitution of the blood, and disturbing the work of the glandular organs. To trace these and their allied physiologico-pathological processes with any approach to completeness—and the theme is tempting—would lead us far beyond the narrow scope necessarily assigned to this article. Here we can only afford to give them a passing glance. One remark to emphasise the lesson the philosophical contemplation of them conveys is, that these phenomena, taken together, are integral parts of the play of the female economy, linking the climacteric and senile epochs of woman with that of her sexual vigour; that, occurring as they do in subjects of known sound organisation, at a definite time and under conditions exceptionally easy to trace, they may be regarded as clinical experiments devised by Nature. An independent and strong light is thus thrown upon the genesis and nature of like disorders in the male, thus showing how what is called special pathology may help to solve many of the problems of general pathology. If we were to extend this reasoning so as to embrace illustrations from the processes of pregnancy and childbed, the argument would be greatly strengthened. We should see the strongest evidence that, since such affections as glycosuria and albuminuria may begin in subjects whose liver and kidneys are sound, and disappear leaving them sound, we may certainly infer in many cases, and so, presumably, in more, if not in all, that these and other aberrant processes do not depend for their origin upon change in the organic tissue of the organs which appear to be their immediate and necessary seats. These affections may be defined as evidences of disturbance in the work of the system. To regard them as disease is arbitrary and unphilosophical. It may then be safely affirmed that the study of gynæcology, pursued in a liberal spirit, bears the most instructive testimony to the law which declares that there is no proper boundary between physiology and pathology; that pathology is but a chapter in the history of physiology; a proposition which may be otherwise expressed by the aphorism: *Pathology is simply physiology in difficulty*.

We must bear in mind that all the great pathological processes may assail the ovaries, uterus, or breasts; that all the diatheses may stamp their work upon these organs. And this they may do apparently primarily or with especial activity; or secondarily, in the course of the development of the morbid process in other organs, or in the system at large. Thus we are familiar with cases of cancer starting to all appearance in the uterus; the disease from this centre or focus invading the surrounding structures, and empoisoning the blood. To form a just appreciation of these cases, it is obvious that a clear knowledge of the general history of cancer, as well as of its special local history, is necessary. A similar proposition may be affirmed with regard to struma, although the general and local relations may be more obscure. But the gynæcologist is familiar with the clinical fact that in a considerable proportion of cases of endometritis, of hyperplasia, and subinvolution of the uterus, and of perimetric inflammations and effusions, cure is extremely difficult—difficult beyond what his experience of simple uncomplicated cases of nominally the same kind would lead him to expect. He may safely assume that in a large proportion of these cases there is an underlying diathesis, frequently the strumous, which stamps its mark upon the tissues, modifying the progress of the morbid action, and challenging general as well as local therapeutical aid. In this connexion an incidental observation may be made. Some of the most obstinate cases of endometritis and hyperplasia the writer has met with were in women who had resided in the East, and whose constitutions had been damaged by endemic disease. These women had in fact acquired a diathesis deeply affecting the nutrition and the tissue-constitution of the body, which revealed its influence most conspicuously in the uterus, an organ whose integrity had been severely tested by pregnancy and the other conditions of married life.

Another law is of deep import, from a scientific as well as from a clinical point of view. Almost all the constituent elements of the body are represented in the uterus, modified of course in arrangement, and assuming certain peculiar characters in order to subserve the particular functions of the organ. But the modifications so acquired do not deprive these fundamental elements of their original and essential properties. By these fundamental properties these elements are attached indissolubly to general pathology; by these specially adapted modifications these elements become the seat of our so-called special pathology. Thus the fibromuscular tissue of the uterus is liable to all those departures from the healthy type, as fibroma, myoma, fibro-myoma, hyperplasia, hypertrophy, and the degenerations to which like tissues elsewhere are liable. They may indeed assume special importance because, occurring in the uterus, they almost necessarily disorder the proper functions of the organ. They belong to the domain of general pathology nevertheless. But in this special disturbance of function we find the special aspect of the tissue-change. The retention of the essential properties of the component tissues of the body is strikingly manifested in the vascular, lymphatic, mucous, and connective tissues of the uterus. They are not only subject to the like physiological and pathological changes which the same tissues elsewhere are subject to; they link the pelvic organs to the general system partly by continuity of tissue, as especially in the case of the vascular, lymphatic, and connective tissues; but they carry morbific elements from the uterus into the general system by absorption. They thus are '*poison-routes*'—channels by which poison or noxious matter, forming in, or inoculated in, them, enters the blood, and thus empoisons the entire organism. It will not escape attention that the mucous membrane of the vagina and uterus is in pre-eminent degree exposed to contamination from external sources. It is needless to do more than refer to the direct infection from the gonorrhœal and syphilitic poisons. The gonorrhœal poison implanted on the mucous membrane of the vagina or cervix uteri sets up *in loco* its specific inflammation, and may spread along the mucous tract through the cavity of the uterus and the Fallopian tubes; and the empoisoned secretion, escaping into the abdominal cavity, may set up a severe form of pelvic or even general peritonitis. The syphilitic poison in like manner, first attacking the mucous membrane, may from this point of departure invade the general system. Then there are the more subtle instances of local and general syphilisation, through an ovum impregnated by the tainted male. The connective tissue again is of far more than merely local importance. Like the same tissue elsewhere, it is a most active poison-route, mainly, no doubt, through its relations with the lymphatic system.

There is a therapeutical corollary from this law that deserves earnest practical attention. A great part of the treatment of uterine diseases in which there is change of tissue, as hyperplasia of the mucous membrane and muscular wall, is surgical—that is, it consists in the topical application of caustics, absorbifacients or antiseptics, as iodine, mercury, carbolic acid, bromine, and so forth. These no doubt act in the first place directly *in loco* upon the tissues touched, modifying their state. But what is not so well known, and is rarely if ever designed or contemplated, is that some remedies so applied—notably iodine—are absorbed, and thus may affect the system. Under some conditions, as where the mucous surface is large, or when the epithelium-investment is lost, or where the quantity of the agent is large, and more especially when the absorbing function is in a state of peculiar activity, the general intoxication may be excessive, even dangerous. The writer has seen the most intense iodism produced in this way, and cases are recorded of poisoning by mercury and chromic acid. But if this law and the conditions under which it acts are borne in mind, remedies can generally be so applied as to draw from them both local and constitutional benefits in the happiest manner.

There are four modes in which iodine, for example, may invade the system: first, by imbibition or endosmosis, the tissues becoming permeated or soaked by the fluid; secondly, by absorption into the lymphatics and veins. There is a local iodism and a general iodism. By analysis we may resolve the complex action at work into the following factors: first, there is the direct mechanical or chemical action of the iodine upon the surface touched by it; secondly, there is the action upon the sub-mucous and muscular tissues of the uterus, the effect of their permeation; thirdly, there is the constitutional action upon distant organs, upon general tissue-nutrition, in which the tissues of the uterus share, the remedy being brought round again to it by the circulation; and fourthly, there is an action little thought of, from which the most useful effects have been often unconsciously drawn—namely, the antidotal action of the remedy topically applied upon certain septic matters originating in the uterus, and thence invading the system. The same channel that gave entrance to the poison is made to serve as a channel for the antidote. Thus the poison-route is in turn made a remedy-route, the antidote closely chasing the poison. The application of this principle is seen most strikingly in the treatment of syphilis and cancer, but it may be turned to useful account in the treatment of other morbid conditions.

Pregnancy and childbed constitute the most indisputable part of the territory assigned to the gynæcologist. In the careful study of the parturient process, we shall discover the secret of many of the disorders of menstruation, and arrive at a clearer understanding of the relations, physiological and pathological, of the sexual organs to the general system, than could otherwise be attained. This is to say, that the study of obstetrics is inseparable from the proper study of the diseases of women. Parturition is the culminating point in the functional work of the ovaries and uterus. All the other points in this work are subservient to parturition. It is true that in many cases this ultimate aim is not reached. But it is not the less true that this is the aim which Nature is always striving at. She may fail at any stage of the journey. Every menstrual nisus is truly a mimic or missed pregnancy. The points of analogy, or homology, are striking. Descending from the observation of parturition at term to the observation of premature delivery and abortion, we shall find strictly related and similar phenomena in ordinary menstruation; and then, passing from the ordinary or healthy type of parturition to the so-called abnormal types, again we shall find reproduced homologous processes in the various forms of paramenia, especially in dysmenorrhœa. And this is so true that the most effective principles of treatment flow from this comparative study. Many cases of nervous disorder, as vomiting, convulsion, neuralgia, such as we see in the most definite relation to pregnancy and childbed, have their exact counterparts in some forms of dysmenorrhœa; various blood-diseases, as anæmia, septicæmia, thrombosis, embolism, which we have so many sad opportunities of observing in childbed, are produced in the non-pregnant state from disturbed menstruation, or uterine disease, notably from cancer; blood-poisonings associated with glandular disorder or disease, as glycosuria, albuminuria, jaundice, simple and malignant, of which the most striking types occur in pregnancy and childbed, find their representation in the non-pregnant state.

Making liberal allowance for the proverbial difficulty of framing definitions that shall be proof against criticism, and against the infinite complications of natural history, we may cite the following as presenting a minimum view of the work of the gynæcologist. It embraces the study and treatment of the disorders and diseases of the female generative organs and their immediate surroundings—including pregnancy and parturition, and the disorders and lesions, general and local, which result from these processes.

We may set out some of these heads more particularly, as follows :—

Scheme of the Diseases of Women.

1. In infancy and childhood. Faults of development of the sexual organs; and the accidents from injury or disease to which they are liable.

2. At puberty and during the virginal state. Some of these are consequences of the developmental faults of the first order; others arise from functional difficulties, from diatheses, or accidental complications.

3. The normal and abnormal history of pregnancy and parturition.

4. The injuries and diseases consequent on parturition and childbed.

5. Mechanical or strictly surgical affections of the ovaries, uterus, and vagina, original or acquired. These include displacements or malformations of the uterus, and diseases of the ovary and broad ligaments.

6. The disorders of senility, subdivided into two classes: (*a*) Those of the climacteric, more immediately attending and following the menopause. (*b*) Those of senility proper.

7. Those general diseases which are strictly associated with error of function of the ovaries and uterus; and those cases of general disease, of which the chief action is expended upon these organs. The former will include cases of chloro-anæmia; and the latter cases of struma, syphilis, or cancer, affecting the ovaries, uterus, and vagina.

8. The diseases of the breast, as mastitis, and the conditions immediately connected with pregnancy, childhood, and lactation. Most of the other diseases of this organ have fallen by a natural process of selection to the surgeon.

The special diseases of women will be found fully discussed in other parts of this work, under their respective headings.

ROBERT BARNES.

WOODHALL, in Lincolnshire.—Common salt waters, containing iodine and bromine. *See* MINERAL WATERS.

WOOLSORTER'S DISEASE.—A form of anthrax. *See* PUSTULE, MALIGNANT.

WORD-BLINDNESS.—*See* APHASIA.

WORD-DEAFNESS.—*See* APHASIA.

WORMS.—This is a popular term, which in medical practice is applied in a restricted sense, as embracing only certain forms of entozoa or internal parasites that reside in the intestines. The word, as thus employed, originated from an entire misconception in regard to the supposed affinities subsisting between the round-worms or lumbricoids and common earth-worms. Structurally these kinds of creatures, though both vermiform, are essentially distinct. In a wider and purely technical sense, however, many distinguished zoologists (Gegenbauer, Rolleston) retain the term as an expression of high group value, embracing all sorts of annulose animals, parasitic and free. By some practitioners the employment of the term 'worms' merely signifies that a patient is suffering from ascarides or thread-worms. *See* ENTOZOA.

T. S. COBBOLD.

WRIST-DROP.—A form of paralysis, chiefly affecting the extensors and supinators of the wrist, and due almost exclusively to chronic lead-poisoning. *See* LEAD, Poisoning by.

WRITER'S CRAMP.—SYNON.: Scrivener's Palsy; Fr. *Crampe des Écrivains*; Ger. *Schreibekrampf.*

This disease may be taken as the most common form and most typical representative of a class of diseases which Duchenne has called 'functional impotences.' In them we find the patient complaining of inability to execute some complicated act, the power to perform which had taken him perhaps years (in the case of writing) to acquire. As a rule there is no other trouble, and, as far as the patient's observation goes, all muscular acts, however delicate or however complicated, are accomplished without difficulty, with the exception of one, which unfortunately is usually that with which the patient earns his living. Not only have cases of 'writer's cramp' been described, but English and foreign physicians have furnished accounts of 'piano-player's cramp,' in which an inability to strike chords with correctness is present; of violinists who have lost the power of holding the violin, and fingering with the left hand; of violoncello-players who have become powerless to 'make the nut' with the phalangeal joint of the left thumb; of tailors who can no longer use the needle; of dairymen who fail in milking; of bricklayers who cannot wield the trowel; of smiths who cannot use the hammer; of compositors who cannot place the type; and lately we have had accounts of telegraphists who have become unable any longer to work at their calling. 'Writer's cramp,' however, is by far the most common of these diseases, and while the others mentioned must be regarded as the rarest of medical curiosities, the one which has been chosen to illustrate the class is tolerably often met with.

SYMPTOMS AND COURSE.—The symptoms and course in a typical case of writer's cramp are as follows: A clerk, who from his painstaking and energetic habits has been tempted by his employers to work over-time or possibly against time, and who perhaps (as the history of these cases often shows) is harassed by domestic troubles, discovers that he does not write quite as easily as he did, that his hand possibly aches after prolonged writing, and he finds it convenient to adopt some new method of holding his pen. At first the trouble is hardly noticeable, and then he finds himself obliged to grasp his pen with unusual tightness to prevent its becoming unsteady. Then his handwriting begins to suffer; perhaps his forefinger refuses to remain steadily upon the penholder, and while he is making every effort to control it, the pen somehow or other eludes his grasp and falls from his hand. If he persevere—probably he is one of those who would sooner die than give in—his progress downhill is rapid and certain. Every possible method of holding the pen is adopted by turns, such as interlacing it between the fingers, grasping it firmly with the whole hand, using only the first and second fingers without the thumb, or the thumb and second finger without the first; but these subterfuges quickly fail to be of service. He cannot steady the pen by means of them, and he finds that the arm rolls possibly inwards or outwards, and that he can only form his letters by moving the whole arm from the shoulder, or lastly by fixing the arm to the side and swaying the whole body to and fro. The handwriting soon becomes illegible; and lastly the patient is almost unable, even by the most strenuous efforts, to make a mark upon paper. To write a word legibly in extreme cases is impossible, and there are few spectacles more distressing than to see a patient, whose handwriting was perhaps his means of livelihood, drip with perspiration while making an ineffectual effort to sign his name. His loss of writing power may be his only symptom, as was the case with an American sufferer who wrote thus to the writer: 'that fingers which could guide razor and needle, wield oar and musket, and, though numb with cold, knot and cast off reef-points on a wet sail, should yet strike work when called on for the familiar character of their owner's name, seemed utterly beyond comprehension.' Patients should be closely questioned as to their ability to perform acts other than writing. In the writer's experience it is usual to find that some other act or acts is affected. If the patient be asked if he can wind up his watch, carry a full teaspoon steadily to his mouth, or perform some similar act requiring a *delicate* use of the thumb and forefinger, it will very commonly be found that he has lost his deftness in performing such acts, although in using a knife or wielding a hammer, and other work requiring a coarse use of muscles other than those used in writing, he may find no difficulty whatever. Frequently there are neuralgic pains, or a sense of extreme fatigue in the hand and arm; and in some cases the effort to write has been followed by pain in the back, or severe headache. In some cases the mental distress caused by the loss of power has produced a condition bordering on melancholia. Slight tremor of the hand is not uncommon, and these tremors sometimes occur independently of writing. Tenderness of the nerve-trunks (median, ulnar, or musculo-spiral) is very often present, and should always be carefully looked for, as indicative of congestion of the nerves, or neuritis. Occasionally there is objective spasm of some of the muscles of the arm when the effort to write is made; and one case has been reported by the writer, in which the symptoms, at first those of simple loss of writing power, terminated in a general clonic spasm of all the muscles of the arm, occurring at last independently of any writing effort.

Although the above is a fair statement of what occurs in a typical case of 'writer's cramp,' other cases are by no means uncommon, in which impairment of writing power supervenes quite independently of any unusual writing effort, and even in persons who have done rather less than an average amount of writing. These latter cases are not usually so severe as the former, since they are not obliged, as is the professional scrivener, to goad the unwilling hand to make those efforts which are so detrimental. It has been the writer's experience, too, that in this latter class of cases it is more usual than in the former to find that the trouble is not very strictly limited to the act of writing, but that there is a certain amount of inability or clumsiness in the performance of other acts requiring minuteness and nicety.

A difficulty in writing is, in fact, a symptom of many conditions, and it is doubtful whether 'writer's cramp' can be regarded as a morbid entity. When patients come complaining of loss of writing power, it is always essential to examine them with great care, with a view to discover any changes in the nervous system, whether central or peripheral. The writer has found that difficulty in writing may be part of a scarcely noticeable hemiplegia (congenital or otherwise) depending on the usual brain-lesions, or an early symptom of general paralysis, or paralysis agitans, or disseminated sclerosis; he has found it depending upon mischief in, or connected with, the spinal cord, such as sclerosis of one or other of the columns (anterior, lateral, or posterior), meningeal thickenings, tumours, or disease of the bones; he has known it caused by an aneurysm pressing on the brachial plexus, by neuritis affecting either the large nerve-trunks or the small terminal twigs that run in the palm of the hand; he has known it caused by rheumatic thickenings of muscular attachments, by injury or disease of the muscles themselves, or by gouty deposits in the sheaths of the tendons. It is therefore necessary to examine these cases with very great care, and to remember that the act of writing may be hampered by the failure of any muscle between the scapula and the hand.

Pathology. — The morbid anatomy of writer's cramp is unknown, and consequently the pathology of the disease is a matter of speculation. Dr. Reynolds says: 'It cannot be doubted that some changes take place in the nutrition of the parts through which the lines of nerve-action regulating the secondarily automatic movements run. It seems probable that the association of movements is effected by ganglia which are common to fibres passing through distinct but contiguous nerve-trunks, and that it is owing to some nutritive change in them, the result of persevering and forced effort, that the perfection of movement is produced; associations at first caused by the will are at length produced unconsciously. What happens, then, in such maladies as writer's cramp is a perverted nutrition of these parts.' Duchenne believes that the change is in the nerve-centres first, because locali-ed faradisation applied to the hands has no good effect on the trouble; and he is confirmed in this opinion because the malady very quickly affects the left hand if it be used to supply the place of the right. The writer has ventured to suggest that the lesion is, in typical cases at least, situated at the periphery, either in the muscles themselves, or in the terminal motor nerves supplying these muscles. In real cases of writer's cramp (the loss of writing power occurring in an overworked scrivener) it is rare to find any sign of central change; neither wasting or true paralysis of muscle, nor fibrillary tremor, nor general tremor of the limb, nor pain, nor spasm (except during, or immediately after, the attempt to write). It is generally observed that the disease progresses from the periphery towards the centre; that the muscles of the fingers are the first to fail, then those of the forearm, then those of the arm, and lastly, in extreme cases, those of the trunk. It is probable that the muscles of pen-prehension, as opposed to those of pen-movement (consisting of the adductor pollicis, first dorsal interosseous, &c.) drift into a condition of 'chronic fatigue' owing to the *prolonged strain* to which they are subjected when holding a pen for long periods at a time. When these normal muscles of pen-prehension are exhausted, others are used to supply their place, such as the superficial and deep flexors in the forearm, which in their turn give out, and thus the trouble steadily progresses. The writer has had no small experience of this disease, and he has rarely failed to find that a careful electrical investigation of the muscles has shown a certain diminished irritability to faradisation in the muscles of pen-prehension on the diseased side, when compared with those of the sound side. This loss of irritability is due, in many cases, he believes, to sheer over-use of the muscles, the intervals of relaxation between the long periods of contraction not being sufficient to allow of their proper nutrition. In many cases of 'writer's cramp' no over-use of the muscles has taken place, and in such cases we must suppose that, from some condition, either constitutional or situated locally in the nerves, the muscles are so deficient in 'staying power' (notwithstanding their ability to contract forcibly for a short time) that they become useless, or nearly so, when called on for prolonged steady contraction. It is obvious that the failure of one muscle (however small) which had been taught, by years of laborious education, to act in harmony with many others for the accomplishing of a complicated and delicate act, such as writing, would produce a true want of coördination. In other words, muscles which have been induced *to work in order together* no longer do so if one of them fails, and the failure of one must be fatal to the accomplishment of the coördinated act.

Diagnosis.—Diagnosis is of great importance, since failure of writing power is often an early symptom of disease the prognosis of which is very different from that of 'writer's cramp.' Evidence of chronic alcoholism is often afforded by the handwriting. So again paralysis agitans and disseminated sclerosis of the spinal cord may very early give a want of steadiness to the pen. Dr. Reynolds records a case of lead-palsy, which was sent to him as a case of writer's cramp. Paralysis of any of the nerves supplying the hand or forearm, such as the ulnar, median, or musculo-spiral, will make writing difficult; and the writer has seen cases of progressive muscular atrophy, in which the shrunken and quivering interossei had made a firm grasp of the pen impossible.

Treatment.—The chief remedy is rest. Without it nothing can be done; and if rest be taken in the earliest stages of the disease, complete recovery not infrequently results. For such writing as is absolutely necessary, the patient should be advised to use a pencil or soft quill pen, so that any violent grasp becomes impossible. In many cases the writer has found the rhythmical exercise of those muscles whose irritability is impaired, together with the employment of a mild galvanic current, of the greatest service, and he has recorded a few cases treated in this way which rapidly improved after having resisted every other known method of treatment for years. Injection of morphine is of no use, but in America some good has been said to result from the injection of atropine. Systematic massage is of decided service in many of these cases, but neither massage nor electrical treatment must be employed so long as the nerve-trunks are tender. The first object in the treatment of such cases is to remove the nerve tenderness by rest and blistering. The administration of a very small dose (gr. i) of iodide of potassium combined with arsenical solution is often useful to this end; and when the tenderness has disappeared, the systematic rubbing of the muscles, especially the muscles of the hand, is most valuable. No patent penholders are of any permanent use in these cases, although they may do apparent good by shifting the burden of writing on to a new group of muscles, which are sure, if writing be persevered with, to break down in time. 'Type-writers' are, of course, invaluable to sufferers from writer's cramp, but only those forms of type-writers which are worked by a piano-like keyboard are admissible. Those which necessitate a prolonged grasp of a handle are dangerous for sufferers from this disease.

G. V. Poore.

WRY-NECK. — Synon.: Torticollis; Fr. *Torticolis*; Ger. *Steifer Hals*.

Definition.—A twisting of the neck to one side.

Ætiology. — Wry-neck is a symptom which may be produced by very different conditions; and it is usual to distinguish between the varieties of this disease, which may either be *congenital* or *acquired*.

The *congenital wry-neck* arises either from faulty development of the muscles on one side of the neck (in which case there are not infrequently evidences of faulty development in other regions of the body, and notably in the neighbouring parts, such as the face); or from contraction of the muscles on one side, often due to accidental injury during labour. Dr. Herbert Spencer found no less than sixteen cases of hæmatoma of the sterno-mastoid in 200 bodies of still-born children, and Mr. D'Arcy Power has insisted upon the connexion between such congenital tumours and wry-neck. In these cases the head is fixed in its abnormal position. *Acquired wry-neck* may be a mere passing condition, due to 'muscular rheumatism,' brought on by exposure to cold, and under the name of 'stiff-neck' it is familiar to everybody (*see* Rheumatism, Muscular). The most formidable variety is *spasmodic wry-neck*, which makes its appearance, usually in persons otherwise healthy, about the middle period of life. The muscles on one side of the neck are the seat of spasm, sometimes tonic, but usually clonic, in character. The muscle chiefly affected is generally the sterno-cleido-mastoid, and its constantly recurring contractions have the effect of turning the head away from the side which is the seat of spasm; drawing the occiput slightly downwards, and the chin slightly upwards. Other muscles, such as the scaleni, splenius, and trapezius, are not infrequently affected also; and then, in addition to the rotatory twisting of the neck, we get a lateral downward bending, and an elevation of the shoulder. At the commencement of the disease the trouble may be slight, and cause but a trifling amount of inconvenience, the impressions produced on a bystander being that the patient's movements are caused by some mal-arrangement of the dress, which he is seeking to remedy. In its advanced form the disease is a very terrible one, and may make life hardly supportable. The writer has seen one case in which the spasm was so violent, that the constant forcible impinging of the chin upon the shoulder of the sound side had produced a sore place as big as a shilling. The spasm ceases during sleep; and when the patient is undisturbed, and his mind pre-occupied, it is not unusual, even in the worst cases, for considerable remissions of the symptoms to occur. In the presence of others, especially strangers, the spasm is usually intensified, and in this it presents a striking similarity to stammering and writer's cramp.

PATHOLOGY.—The pathology of spasmodic torticollis is very doubtful. It must be regarded in almost all cases as a true neurosis, and must take its stand alongside of histrionic spasm of the face, writer's cramp, and stammering. It must often be a question as to whether some of these cases are not definitely of cerebral origin. The rotation of the head to one side is affected by muscles on *both* sides of the body. Thus the right splenus capitis and the left sterno-mastoid, acting in concert, rotate the head to the right; and in many cases of clonic torticollis it is found that muscles on opposite sides of the body are both conspiring to produce the rotation. The writer has recorded one case in which extreme torticollis was associated with a history of injury to the head close to the upper end of the Rolandic area, combined with a history of syphilis. This case was practically cured by the free administration of mercury. That it is due in many cases to an irritable condition of the spinal accessory nerve there can be no doubt, but how this condition of nerve is brought about we are unable to say. In many cases, especially in women, there is a large element of what is called a pure neurosis. Want of proper antagonisation is another factor which is always present, for without it the symptoms could not occur. In certain nervous constitutions a weakened action of one sterno-mastoid would seem of itself to be almost sufficient to excite irregular contractions in its fellow. The writer has seen one case in which it seemed tolerably clear that the sterno-mastoid and trapezius on one side had become weakened by overwork, and had drifted into a condition of chronic fatigue, while their antagonists were constantly in a state of clonic spasm, twisting the neck to the weakened side. An electrical examination of the muscles may show that, while those which are the seat of spasm have their irritability greatly increased, their antagonists are below their normal state as to irritability. Torticollis is usually, but not always, uncomplicated. That condition known as 'irritable spine' has been observed in some few female patients; histrionic spasm, or spasm of the limbs, has occurred as a complication, and it is not a little remarkable, as showing connexion between the two diseases, that Dr. Reynolds has recorded three cases of torticollis in which the patient had suffered previously from writer's cramp. A difficulty of deglutition was observed in one of Dr. Reynolds's cases; and in another there was swelling of the arm, from pressure upon the subclavian vein.

PROGNOSIS.—The prognosis of these cases is bad, it being very unusual for recovery to take place after the disease has become well established.

DIAGNOSIS.—The diagnosis of wry-neck, as a rule, is not difficult, but care must be taken that simple torticollis is not confounded with cases of caries of the cervical spine, in which there is frequently a tendency for the head to twist to one side. It should be borne in mind, also, that in some few cases of organic brain-disease, in which synergic movements of the eyeballs have occurred, a spasmodic rhythmic movement of the neck has also been observed. The other symptoms of brain-disease, however, would usually prevent any such mistake.

TREATMENT.—This necessarily depends upon the cause of wry-neck. In those cases in which the head is fixed by contraction or faulty development of the muscles, tenotomy has been of service. Tenotomy has been practised also in those cases in which there has been definite clonic spasm; but notwithstanding that temporary relief has in some cases followed, it has been found that the deep-lying muscles are almost certain to take on a spasmodic action, and that in the end the patient's discomfort is increased rather than diminished. A tenotomised muscle is liable to shorten; and it has appeared to have been the case that, although tenotomy gives temporary relief, it really aggravates the trouble in the long run.

The removal of a piece of the spinal accessory nerve in the neck, as practised by Mr. Campbell de Morgan and others, will completely paralyse the sterno-mastoid and upper part of the trapezius, and is not open to the objection urged against tenotomy. This manœuvre is stated to have given great relief even in those cases where muscles other than those supplied by the spinal accessory have been implicated. Various mechanical contrivances for steadying the head have been devised, but few patients are able to bear the constant pressure of the apparatus, and the remedy has been found in most cases worse than the disease. The stretching of the spinal accessory, the ligature of the same nerve (Collier), and the suspension of the patient by the head, are all measures which are calculated to relieve. Some good has resulted from the long-continued use of hypodermic injections of morphine, and the exhibition of large doses ʒi. and over of the succus conii. Electricity has not been particularly serviceable in the treatment of torticollis. The galvanic current has been used to control the spasm, while the weakened antagonising muscles have been stimulated by faradisation; and although improvement has been produced by these means, it has generally been of very short duration. The writer some years ago had a very severe case under his charge, which was successfully treated by the employment of the continuous galvanic current, combined with the rhythmical exercise of the affected muscles. The positive pole being placed behind the ear, the negative pole was applied over the sterno-mastoid and trapezius, and at the same time the patient was made to exercise these muscles by shrugging the shoulder, twisting the head, and other movements. The result was very rapid and permanent improvement. Another case, also, was successfully treated by the writer by faradising the antagonist muscles, which were somewhat wasted and decidedly deficient in irritability. This patient completely recovered; although tenotomy of the sterno-mastoid, which was the seat of spasm, had afforded only temporary relief.

G. V. Poore.

WYNBERG, a suburb of Cape Town, in Cape Colony.—*See* Africa, South.

X

XANTHELASMA (ξανθός, yellow; and ἔλασμα, a lamina).—A yellow growth in the superficial layer of the skin, assuming the form of a lamina or plate, and more frequently met with in the eyelids than elsewhere. *See* Xanthoma.

XANTHOMA (ξανθός, yellow).— Synon.: Xanthelasma; Vitiligoidea; Fr. *Molluscum Cholestérique* (Bazin); Ger. *Fibroma Lipomatodes* (Virchow).

Definition.—A rare disease, characterised by a peculiar kind of yellow growth, in the form of plates or raised tubercles, in the skin, and sometimes subsequently in areolo-fibrous tissue elsewhere.

Ætiology.—The presence of xanthoma is frequently associated with megrim or other neuralgiæ, with gouty conditions, and with disorders of menstruation. It occurs in such frequent connexion with those morbid functional conditions or actual organic diseases of the liver which lead to the presence of jaundice, that the influence of this as an ætiological factor cannot be gainsaid, although the nature of the relationship is not apparent. These conditions are, in order of probable relative frequency, chronic catarrh of the bile-ducts, hypertrophic cirrhosis, biliary calculi, atrophic cirrhosis, hydatids, and carcinoma. Chronic dyspepsia, lithæmia, and other conditions attributed to hepatic disturbance are also often present. In the great majority of cases jaundice precedes xanthoma by a prolonged period—usually a year or more—and is generally present when it develops. In a certain number of instances, however, all signs of jaundice may have disappeared, while in others—noted especially by French writers—a persistent yellowish tint of skin (*xanthochromia*), not identical with jaundice, and unaccompanied by other evidences of bile-absorption, has been noted. On the other hand, xanthoma is frequently seen in persons apparently healthy in every other respect.

The female sex is much more frequently affected than the male, in the proportion, according to Hutchinson, of three to two. Xanthoma generally begins about or above the age of forty years, but a dozen cases or more are recorded in children below puberty. These have never been in association with jaundice, but many have been either congenital or hereditary, while the existence of the disease in several members of the same family, and even in successive generations, is sometimes striking. 'Probably slight developments of xanthoma are not so rare as is generally supposed, but give rise to no trouble, and are generally overlooked' (Crocker). Such cases are often unilateral.

Anatomical Characters.—The following description of xanthoma is based upon the examination of growths in the skin alone.

The upper epidermic layers are healthy, but there is usually a small quantity of granular pigmentary deposit in the rete Malpighii. The changes in the papillary layer are slight, but in the middle and lower layers of the derma there is a good deal of yellowish-brown pigment, both free and in cells. The most prominent and characteristic feature, however, is the involvement of these latter layers by a new-growth of connective tissue, the amount of which is small in the flat, and great in the tuberous, variety. In the meshes of the fibres there are numerous round, oval, or polygonal, multinuclear or granular, epithelioid cells, which vary greatly in size. Often they are arranged in masses surrounding blood-vessels or sebaceous glands. These cells, which may be considered as characteristic 'xanthoma cells,' contain many cholesterin and tyrosin crystals, as well as yellowish pigment and fat, the latter being also abundant in the connective tissue.

There is much difference of opinion as to whether the diseased process ought to be considered a purely neoplastic or a low inflammatory one, but the presence of large endothelial and giant cells, as well as of the changes in the arterial walls usually associated with chronic inflammation, described by Chambard and others, seems to turn the balance in favour of the latter view. The papules are not due to a collection of sebum within the follicles, as Hebra suggested.

SYMPTOMS AND COURSE.—Two types of xanthoma, (1) the *flat*, and (2) the *tubercular*, are usually recognised, but as the differences between them are mainly of degree, and do not turn upon essential characters, they are separately described only in accordance with custom.

1. *Flat or localised xanthoma* (*x. planum*) is the much more frequent form, and the great majority of cases do not call for medical relief. It generally occurs in middle-aged or older women, especially in those of dark complexion or who suffer from neuralgia or 'any conditions capable of producing dark areolæ round the eyes' (Hutchinson). In the immense majority of cases the disease is situated upon the eyelids, where it generally begins on the left side, above and a little outside the inner canthus. Thence it extends slowly outwards along the upper lid and more slowly downwards to and along the lower lid, so that in extreme cases the eye may be surrounded by a xanthomatous ring. After a variable time the right side becomes similarly affected, and the disease pursues the same course as on the left side. The patches when first noticed vary in size from a pin's head to a pea; they are deeply embedded in the skin, which undergoes no alteration in consistence and suppleness; they vary in colour from the palest yellowish-white—to recognise which the blood of the part must be expressed by the finger—to a bright orange or dark brownish buff; and have been not inaptly described as like pieces of chamois leather 'let into' the skin. With a lens the patches can be seen to be composed of fine yellowish granules. At the spreading margin they are sometimes well defined, sometimes they are irregularly serrated, while at other times their colour gradually merges into that of the surrounding skin. Occasionally slight irritation is present, and when the eyes are encircled there may be some *gêne* in the movements of the eyelids; with these exceptions no subjective symptoms are present. Single patches of flat xanthoma have in rare cases been noted on the ear, neck, chest, penis, prepuce, and tongue.

2. *Tubercular or multiple xanthoma* (*x. tuberosum, multiplex*) is of greater rarity and more serious import than the previous type. It is also much more frequent in women than in men, especially in those who suffer, or have suffered, from jaundice. Although it may occur independently, it usually shows itself in persons suffering from flat xanthoma of the eyelids, and not infrequently the first step towards its establishment is the appearance of flat lesions on the face, other than those on the eyelids, especially about the nostrils, mouth, or external auditory meatus. The most characteristic and tuberous lesions are situated on the extremities, especially on their extensor surfaces and on points much subjected to pressure, such as the tips of the elbows and knees, buttocks, shoulders, and backs of the fingers. The colour of the tubercles varies within the same wide limits as that of the lesions of the plane variety, but often they have tufts of dilated blood-vessels round or over them. In size they vary from a hemp-seed to a pea, but, by their coalescence, swellings as large as a hen's egg, or even larger, may be produced. The epidermis over these is, however, intact, and they are usually only slightly tender to touch and manipulation; occasionally they itch or tingle a little. In most cases a few flat lesions exist here and there over the chest and abdomen, and are present in greater numbers over the palms and soles, where they are ranged in rows along the naturally deep lines of the parts, which they exaggerate. Sometimes they are similarly arranged in concentric circles round the anus. On the trunk they occasionally have the unilateral nerve-distribution of a zoster. The development of the lesions is usually very slow—extending over years; and ultimately flat xanthoma may show itself in the mucous membrane of the lips, cheeks, gums, tongue, fauces, pharynx, œsophagus, stomach, bile-ducts, intestine, peritoneum, conjunctiva, larynx, trachea, bronchi, pleura, on the endothelium of the heart or great arteries, and on tendons.

Xanthoma in children presents some such well-marked peculiarities as to merit a few words of special mention. It has never been known to be associated with jaundice, but is often so with gout or rheumatism, while it is frequently hereditary, may affect several members of the same family, and is occasionally congenital. The lesions are generally a symmetrical, often unilateral, markedly tuberose; and the eyelids are comparatively seldom attacked.

DIAGNOSIS.—Flat xanthoma may be confounded with *milium* if the little, projecting, whitish masses of inspissated sebum which characterise that disease are thickly grouped together so as to form a conglomerate plaque. Almost invariably, however, a few characteristic outlying lesions are present. In any case the sebaceous contents of a milium can always be squeezed out after a shallow incision has been made, whereas in xanthoma the lesions are deeply situated in the corium, and cannot be expressed. It will suffice to mention the possibility of errors in diagnosis with *flat warts* and *colloid degeneration of the skin.*

In the diagnosis of multiple xanthoma the presence or history of jaundice is an important factor. The dermatosis which most closely simulates it is *urticaria pigmentosa* (hence called *xanthelasmoidea* by Tilbury Fox), but the history, distribution, and subjective symptoms of the two diseases easily serve to distinguish them.

Prognosis.—In the great majority of cases xanthoma progresses slowly but steadily for months or years, and afterwards persists unchanged. In at least four instances, however, very gradual spontaneous recovery has been known to occur, the skin regaining its normal characters. In a very small number of cases death has been attributed to patches on the endothelium of the heart or great arteries.

Treatment. — Treatment is seldom resorted to except for the removal of disfiguring plaques from the eyelids. This can only be accomplished by excision, and great care is necessary not to cut too deeply, and thus give rise to subsequent ectropion or epiphora. A 10 per cent. solution of perchloride of mercury in collodion has been successfully used by Stern for the cauterisation of painful masses on the elbows; while Kaposi states that he has removed xanthoma tubercles from the palms and soles by repeated vigorous washing with soft soap, and making the patients wear indiarubber gloves and socks. Internal treatment is of no use.

J. J. Pringle.

XANTHOMA DIABETICORUM.

Synon.: *X. Glycosuricum*; *Lichen Diabeticus.*—Although this lately recognised and rare condition—the identity of which was first clearly established by Malcolm Morris in 1883—is now by universal consent considered as a member of the xanthoma group, it presents several points of distinction which entitle it to separate description, in which its chief clinical characters may conveniently be contrasted with those of ordinary xanthoma. The following conclusions have been arrived at from a study of the seventeen indubitable cases on record, a considerable majority of which (fifteen to two) have occurred in males, the age of the persons affected ranging from seventeen to forty-eight years.

Course and Symptoms. — The disease almost invariably occurs in people actually passing sugar in the urine, although generally they have been noted as stout and apparently in good health. In the majority of the cases the presence of sugar in the urine has been transitory, and unaccompanied by the other phenomena of true diabetes mellitus. In one case, moreover (Cavafy's), there was only a history of antecedent glycosuria; while in another (Besnier's), who was an obese man without glycosuria, the father of the patient was diabetic. The eruption evolves quickly, and, after a variable stationary period extending over months or years, diminishes with considerable rapidity, to ultimately disappear without leaving any trace of its existence. Sometimes its course is intermittent and successive outbreaks occur, while occasionally fresh lesions develop during the retrocession of older ones. As a rule the parts first affected are the extensor surfaces of the limbs, especially of the forearms; subsequently the lesions usually appear on the elbows and knees, where they have a great tendency to become confluent and form raised plaques. They are commonest on extensor surfaces, the buttocks, back, face, scalp, mucous membrane of the mouth, and bends of the ankles, but they do not generally affect the flexures. They have only once been observed on the eyelids, and the presence of jaundice has never been noted. The constituent tubercles are much firmer and denser than those of ordinary xanthoma, are well defined, rounded or obtusely conical at the apex, and may present a yellow point like pus at the summit, but are in reality solid; often there is a bright zone of congestion round their base. In some cases the tubercles are very pale, while in others their colour is pink rather than yellow. Itching and tingling are always troublesome, and occasionally there is great tenderness, while neuralgic pains sometimes precede the eruption.

Anatomical Characters. — Recent researches establish the close relationship between ordinary and diabetic xanthoma; 'discrepancies in the recorded appearances being fully accounted for by variations in the rate of the inflammatory process and differences in the methods of hardening and staining employed' (Morris). Typical xanthoma cells are present, albeit in less abundance than in flat xanthoma, while the inflammatory changes are more marked, especially in connexion with sebaceous and sweat glands. They also extend upwards to involve the papillary layer, and the passage of fat even into the epidermis has been noted.

Treatment.—Mild tarry or lead lotions, separate or combined, generally suffice to allay or moderate the itching. If sugar disappear from the urine under the influence of dietetic or other measures (codeine, salicylate of sodium, &c.) the eruption usually soon disappears.

J. J. Pringle.

XERODERMA PIGMENTOSUM.

Synon.: *Atrophoderma Pigmentosum.*

Description.—This is a very rare disease, which almost invariably commences in the second year of life. Without any previous symptoms or apparent cause, but sometimes preceded by a morbiliform or patchy erythema, a copious outbreak of freckle-like pigmentation appears on the face, neck, and upper extremities, in the uncovered parts, in short, reaching about halfway up the upper arms, the legs being sometimes slightly involved. Other lesions follow, namely, telangiectases, white atrophic areas, pigmented flat warts, ulcerations—on which papillomatous growths form, and, if not removed, become even epitheliomatous, and thus lead to the patient's death. Conjunctivitis and pterygium are nearly always present, and the discharge is largely responsible for the onset of the ulcers. Cicatricial contraction of the various lesions produces much disfigurement. The ætiology and pathology are unknown. The ultimate prognosis is bad; but the disease progresses very slowly, and if the eye affections are effectually treated from time to time, the ulcers scraped with a sharp spoon, and all soft papillomatous growths promptly removed, the cancerous stage may be averted for an indefinite period. Internal treatment is unavailing.

H. Radcliffe Crocker.

XEROPHTHALMIA (ξηρός, dry; and ὀφθαλμός, the eye).—Synon.: *Lippitudo arida*, Cels. vi. 6. 29; *Xerosis Conjunctivæ*. This term signifies a dry ophthalmia, or chronic inflammation of the conjunctiva without much (if any) watering or discharge. The conjunctiva is thick, dull, opaque, and often skin-like. In severe cases it is shrunken, and the oculo-palpebral folds may be obliterated. The epithelium of the cornea may also be involved. The morbid changes may be the result of injury, especially burns; or it may follow trachoma, diphtheria, pemphigus, and other severe forms of conjunctivitis; or it may be due to insufficient covering of the eye in the various forms of lagophthalmia. A peculiar form of xerosis conjunctivæ occurs in association with night-blindness (*see* Nyctalopia). On the ocular conjunctivæ are dry, scaly-looking patches, which by gentle friction of the lids may be worked into a fine foam which abounds in bacilli.

J. Tweedy.

XEROSIS CONJUNCTIVÆ.—*See* Xerophthalmia.

Y

YAWNING (A.-S. *gánian*).—Synon.: Fr. *Bâillement*; Ger. *Gähnen*.—Yawning is one of the physiological expressions of fatigue. It consists, when fully developed, of the following phenomena: 1. A deep inspiration, with elevation of the uvula and palate. 2. A forcible spasmodic depression of the lower jaw. 3. A flow of tears. 4. A clicking sound in both ears. 5. A tendency (sometimes irresistible) to stretch the limbs, especially the arms. 6. An expiration, often accompanied by a sound, the character of which has probably given the name to the act.

Ætiology and Pathology.—This strange and complicated act suggests many reflections. Why, when we are tired, should we take a deep breath? It may be that the need of oxygen experienced by the fatigued tissues, laden with waste products, prompts the instinctive and forcible descent of the diaphragm; but, on the other hand, the facts that yawning is common when we are merely *ennuyé* and not genuinely fatigued, and that it is decidedly infectious, are both unaccountable on such a theory. Why should the lower jaw be spasmodically depressed when we are fatigued? The elevators of the lower jaw are the temporal, masseter, and internal pterygoid muscles, and it is probable that the external pterygoid (whose main functions it is to move the jaw forward) has also some share in keeping the teeth in contact. These muscles are constantly in action, having to support the jaw against the force of gravity; and it is not surprising that, as in other cases of prolonged muscular action, they should be prone to evince fatigue by failure of function. Were it not for the fact that this work of supporting the jaw is divided amongst eight muscles (four on either side), it is probable that the jaw would fall more often than it does. When one set of muscles is fatigued, it is quite in accordance with experience that their antagonists should take on a spasmodic action, and we may fairly look upon the spasm of the depressors of the jaw, when the elevators are fatigued, as the physiological expression of an occasional pathological phenomenon. These considerations again do not apply to those instances of infectious (emotional) yawning, in which we are impelled to imitate what we see in others.

A fact of considerable interest in connexion with yawning is the great extent to which its phenomena are limited to the area of the fifth nerve. The four muscles mentioned above, as concerned in the negative phase of yawning, are all supplied by the fifth; and the anterior belly of the digastric and the mylo-hyoid muscles, which are connected with its positive phase, are also supplied by the fifth. The flow of tears and the 'click' in the ears, which is probably due to a contraction of the tensor tympani, are referable to the influence of the same nerve. The tensor palati is likewise in action; so that we may say that every muscle supplied by the fifth is concerned in yawning. Possibly yawning may be regarded as a reflex phenomenon, of which the most ordinary stimulus is the fatigued condition of the elevators of the lower jaw. The reflex effects are largely manifested in the area of the fifth nerve, but they clearly spread beyond it, and produce contraction of the diaphragm, palatal muscles, depressors of the hyoid bone and larynx, and sometimes of the muscles of the body generally, but mainly of the extensors. That the contraction of the body muscles at least is a purely reflex phenomenon, may be gathered from the interesting fact which has been often observed in cases of hemiplegia, namely, that when a hemiplegic arm is entirely beyond the control of the will, and its flexor muscles are contracted, this contracted helpless hand will often open during yawning, the stimulus having reached the extensors of the fingers, not through the ordinary path of the will, but through the spinal cord by a reflex action travelling along some other path of nervous energy.

In these days when so much is heard of 'hypnotism' and 'suggestion' it is perhaps profitable to bear in mind the common act of yawning, which when performed in public not only compels the spectator to perform a similar act, but definitely begets in him that mental condition of fatigue and *ennui* which is almost inseparable from the physical condition.

Treatment.—Yawning is generally only a passing phenomenon, which is removed by rest. An undue tendency to yawn may indicate that the body is too easily fatigued; and then it may be necessary to inquire whether the demands upon it (mental, physical, or sexual) are too great. These may have to be removed or avoided. At the same time the bodily health should be carefully attended to. Iron tonics may be given; the foul atmosphere of crowded assemblies should be forbidden; the diet should be nutritious and digestible; and the amount of alcohol should be carefully restricted to that physiological minimum which may be necessary to aid digestion. G. V. Poore.

YAWS.—*See* Frambœsia.

YELLOW FEVER. — Synon.: Fr. *Fièvre Jaune*; Ger. *Gelbes Fieber.*

Definition. — A pestilential contagious fever of a continuous and special type; originally developed in tropical and insular America; occurring only in regions between 45° N. and 35° S. lat.; and dependent for its origin and spread upon a temperature not lower than 70° F. Yellow fever presents two well-defined stages. The first extends from 36 to 150 hours, according to the severity of the disease, and is marked by rapid circulation and elevated temperature. The second is characterised by depression of the nervous and muscular powers and of the circulation, with slow and often intermittent pulse; jaundice; suppression of urine, albuminuria, and desquamation of the renal epithelium; diminution of the fibrin of the blood, capillary congestion, passive hæmorrhages from the mucous surfaces, and black vomit; fatty degeneration of the heart and liver; and convulsions, delirium, and coma. The fever is not dependent for its origin or propagation on those causes and conditions which generate malarial paroxysmal fever, from which it differs essentially in symptoms and pathology. As a general rule it occurs but once during life.

History.—The origin of the American plague, or yellow fever, is involved in doubt, in consequence of the prevalence in regions in which it occurs, both amongst natives and foreigners, of severe forms of malarial fever, often attended with jaundice, passive hæmorrhages, and black vomit. In the eleventh century a disease closely resembling yellow fever, known as the Matlazahuutl, made great ravages amongst the Mexicans, but it was peculiar to the aborigines, never attacking white people; whilst, on the contrary, Mexican Indians seldom suffer from yellow fever. According to authors, the first trace of yellow fever was observed at the end of the fifteenth or beginning of the sixteenth century, at San Domingo and Porto Rico; and Columbus, landing at the former place in 1493, lost the greater number of his men, within a year after their arrival, from a disease described as being 'yellow as saffron or gold.' From 1544 to 1635, when it appeared at Guadeloupe, there is no record of any outbreak, but thenceforward it occurred at irregular intervals. In the seventeenth century it spread along the east coast of America, as far as 8° S. lat. and 42° N. lat., appearing for the first time in the United States at Boston in 1693. In the eighteenth century it appeared on the west coast of South America, and extended even to Europe and Madagascar; the great commercial and military activity of this time doubtless favouring its spread, and increasing the frequency of the epidemics, eighteen being recorded as having occurred in San Domingo within the century. Early in 1700 it reached New York. At the beginning of the present century it reached 47° N. lat. in America, and also prevailed in the Canary Islands, in Leghorn, and in the maritime cities of Spain and Portugal. In 1853, 1867, 1873, and 1878, it spread to a large number of cities, towns, and villages in the interior of the American continent, being transported by railroads and ships. During this century it appears to have relinquished its hold upon the northern cities of the Atlantic coasts, and has been concentrated chiefly along the southern borders of the Atlantic and Gulf coasts. Yellow fever has prevailed almost annually as an endemic at Havana from April to December; and from time immemorial it has been endemic at Vera Cruz.

GEOGRAPHICAL DISTRIBUTION.—At an early day it was established that yellow fever is emphatically the disease of strangers in the warm, moist climates of insular and tropical America. It is endemic in the West Indies, and is rarely, if ever, absent, the seasons of the year having but little influence in eradicating it, though the disease is most fatal from May to August. On the other hand, the history of the settlements along the shores of the Gulf of Mexico and Atlantic Ocean has demonstrated that in the more temperate regions it is a disease of occasional occurrence, and not in the strict sense of the term endemic. Since the disease is dependent in a great measure upon an elevated temperature, its occurrence is limited to tropical and subtropical regions, or to countries having a tropical climate, or a summer of sufficient length and heat. Within these prescribed limits the exciting cause seems to exist, but still the fever has seldom, if ever, shown itself except in maritime regions, elevated but a few feet above the sea. From Brazil to Vera Cruz in one direction, and from Barbadoes to Tampico in another, the exciting causes are in constant though unequal force, depending on differences of season, locality, and constitution. On the Atlantic coast it has extended as far north as Boston, Massachusetts, and Portland, Maine; while in the Mississippi valley it has three times appeared as high as Memphis, Tennessee, in latitude 35° N. In an eastern direction, but within the same parallels, it has extended to Cadiz, Xeres, Carthagena, Malaga, Alicant, Seville, Barcelona, and other cities on the coast and in the interior of Spain. It has prevailed several times at Gibraltar, once at Rochefort, twice at Lisbon, and once at Leghorn. It prevailed at Monte Video, lat. 34° 54′ S. in 1857 and 1872; in Buenos Ayres in 1858 and 1871; once at Panama and Callao, and at Lima and Cuzco in Peru, in 1854 and 1856. In America it reaches from lat. 36° S. to 45° N. on the Atlantic coast, and to 35° N. in the Mississippi valley. On the Pacific coast it extends from 15° S. to 9° N. Its longitudinal limits in the same country are 60° to 97° W. In the eastern hemisphere it occurs within the limits of 42° N. and 8° S. It is said not to appear in the East Indies or China.

Perpendicular distribution.—The older statements, that yellow fever never extended beyond the height of 2,500 ft., are shown to be incorrect; for it has prevailed in the elevated tablelands of Caracas, 3,000 ft. above the sea-level, on more than one occasion; and in 1854 and 1856 it committed fearful ravages in Cuzco at an elevation of 11,378 ft., and even in other places in the Andes at 14,000 ft. Great variety, however, exists in this respect, for at Xalapa, in Mexico, in the same parallel with Vera Cruz, 4,330 ft. above the sea, it has never prevailed as an epidemic; and the hills in Jamaica and San Domingo are free from the pestilence which rages in the low lands.

ETIOLOGY AND PATHOLOGY. *Relation to population.*—A certain degree of density of population appears to be essential to the production of yellow fever, which never originates in country districts, but is a disease of crowded cities on the shores of the ocean or large rivers, and of ships. Its origin and spread are favoured by the congregation of persons born in a cold climate; and where developed in strangers who have landed in a port in which it is not prevailing, it appears to be referable to the action of endemic causes upon highly susceptible individuals.

Relation to temperature.—However violent the disease may be at any place, yellow fever is arrested from the day on which the earth is frozen, and such localities may then be visited with impunity by strangers. The singular occurrence of the disease at the high elevations in the Andes above mentioned, appears to be due to the fact that, whilst in those regions the night and morning are excessively cold, intense heat prevails in the afternoon.

Incubation.—The period of incubation appears to vary in different epidemics, and in different individuals in the same epidemic, and may extend from twenty-four hours to weeks or even months. In this respect yellow fever resembles diseases of malarial origin, and differs from the well-defined contagious maladies. Whilst in some a few hours' exposure to an infected atmosphere is sufficient to determine the disease, others may remain unaffected until the end of an epidemic, or even through several epidemics. Cases have been known to occur in the winter, weeks after it appeared that the disease was entirely checked, the poison being looked upon as lying dormant in the system. Like many other contagious diseases, it may be communicated to the fœtus, and this is supposed to partially explain the immunity enjoyed by the natives of localities in which it is endemic.

Essential cause.—The various opinions on this point fall under three heads: 1. That yellow fever is a disease induced essentially and solely by contagion. 2. That it is essentially of endemic origin. 3. That being of endemic origin, it afterwards becomes contagious.

The idea has been extensively entertained that intermittent, remittent, and pernicious paroxysmal malarial fevers, as well as yellow fever, assume more or less, according to circumstances, the type of each other, and are essentially the same, modified only by the intensity of the cause, and by the prevailing constitution. The marked exemption from the disease of the natives of districts where yellow fever is endemic, with their liability to mild intermittent and remittent attacks, is regarded as supporting this view.

The following facts have been cited to sustain the opinion that yellow fever arises from miasmata. 1. It always appears simultaneously with bilious remittent. 2. A high range of temperature is essential to the generation of its cause. 3. Its first appearance is almost always in the lowest and most filthy parts of towns; and in localities favourable to the production of miasmata. 4. The supervention of storms, heavy rains, or cold weather puts an immediate check to its progress.

With some writers it is still even a disputed question whether certain fevers which have, or are supposed to have, their source in vegetable miasmata, or in effluvia from marshes, or from infusoria or fungi, developed and propagated under certain combinations of heat, moisture, and putrefying vegetable and animal matters, are subsequently spread by contagion; whilst other writers contend that within the tropics yellow fever may at any time, under certain conditions of moisture and temperature, arise *de novo*, in the impure atmosphere of the crowded and filthy ship or city. Others, again, as strenuously uphold the doctrine that yellow fever is a specific, contagious, pestilential disease, which, like small-pox or measles, may be transferred and communicated from one ship or city to others, thus following the great avenues of commerce. A third class adopt and advocate a doctrine which embraces the main features of both propositions. Some who hold that yellow fever may be engendered *de novo* in the holds or atmosphere of ships navigating in the warm, moist, tropical regions, have coupled with this view the doctrine that if this poisoned atmosphere be allowed to escape at the wharves of cities situated beyond the yellow-fever zone, those only who come within the sphere of its influence will be affected, and its subsequent spread will depend upon conditions of filth and crowding of such localities, the disease never spreading endemically, but falling harmless among the inhabitants of a salubrious locality. According to this view, the development of this malignant fever requires the conjoint operation of both local and general causes, constituting an endemico-epidemic which is insusceptible of propagation by specific contagion; and in the summer atmosphere of a city lying beyond the yellow-fever zone there must exist some peculiar combination of circumstances, or some peculiar agency, favourable to its development. In these cases it is affirmed that there is generally found an infected district, which slowly and regularly extends its boundaries, rendering all who come within its limits subject to this form of fever.

It has been said that the experience of several centuries leads to the view that the cause of yellow fever is perennially present in the tropical and subtropical cities of America; that it maintains the same relation towards the human system as the other malarial emanations of swamps and lowlands; and that it is liable to be developed at any time, in different degrees of intensity, by the combined operation of heat and other agents. Amongst the most striking circumstances in the ætiology of yellow fever are the marked geographical boundaries within which it is confined, and the circumscribed localities in which it prevails; its more frequent prevalence in the western than in the eastern hemisphere; its almost universal limitation to commercial seaports elevated but a few feet above the level of the sea, although it occasionally spreads to towns and cities in the neighbourhood of the latter, situated in the interior of the country, on the banks of navigable rivers; and the fact that it is very frequently circumscribed within certain limited and well-defined portions of the locality or city in which it prevails. To these may be added the vastly greater susceptibility of strangers over the natives of regions in which the disease is endemic, although this susceptibility is liable to diminution by residence in the proscribed regions.

Possibly the specific infectious agent in yellow fever is a living micro-organism which, under favourable meteorological conditions, multiplies external to the human body in insanitary localities, when it finds a suitable pabulum for its growth. But the correctness of this inference has not as yet been established by an experimental demonstration, and we are still ignorant of the morphological and biological characters of the yellow-fever germ.

Anatomical Characters. — In cases of death from yellow fever the features are frequently bloated; the skin of the face and upper part of the trunk is of a golden-yellow colour; whilst dependent parts present a mottled purple, and a yellow ecchymosed appearance. Considerable quantities of dark fluid blood escape on section of the muscles, becoming bright scarlet on exposure. Putrefactive changes set in early, commencing sometimes even before death.

The *nervous system* presents no characteristic appearances beyond general congestion. Urea, bile, and leucin have been obtained, by analysis, from the brain.

The *heart* is in a condition of acute fatty degeneration, of a pale yellow or brownish-yellow colour. This degeneration is more extensive and more rapid than in any other disease. The cavities are usually filled with dark fluid blood, which contains an excess of urea, ammonia, and extractives, with a great diminution of fibrin. No such appearances are found in the heart in malarial fever.

The *lungs* present extreme congestion of dependent portions, and sometimes circumscribed hæmorrhages into the pulmonary tissue.

The mucous membrane of the *stomach* is frequently intensely congested, softened, and eroded, often containing large quantities of black vomit of an alkaline reaction, from the presence of ammonia, resulting from *ante-mortem* decomposition of the urea. Microscopically the vomit is seen to contain red blood-corpuscles, gastric epithelial cells, dark masses of hæmatin, and sometimes vibriones and other organisms.

The *intestines*, as a general rule, are dark-coloured and distended with gas, sometimes containing large quantities of dark altered blood, of an alkaline reaction. Bile is always absent from the intestinal contents. Intussusception of the bowels is by no means infrequent.

The *liver* is yellow and bloodless, and the stroma and secreting cells are infiltrated with fat, though the organ is firmer than is the case in ordinary fatty degeneration. None of the pigment deposited in the portal capillary system in malarial fevers is found in yellow fever. When yellow fever has been preceded by or engrafted on malarial fever, the liver presents the appearances of both these diseases, and hence some confusion has occurred in the recognition of the normal pathological appearances proper to each. The golden-yellow colour of the yellow-fever liver can be extracted both by alcohol and water. A similar decoction of the malarial liver is of a brownish-yellow colour; in the latter case also the organ is softer, contains more blood, and is readily dissolved by liquor potassæ, forming a solution of the appearance of venous blood, which is not the case in yellow fever. Large quantities of urea and fat, as well as glycogen and glucose, may be obtained from the yellow-fever liver, whilst, as a general rule, grape-sugar is absent from the malarial form.

As a general rule the *gall-bladder* is contracted and flaccid, and contains but very little bile; but sometimes it is distended with dark grumous blood, and occasionally an albuminous mucoid liquid, without a trace of bile. In malarial fever, on the contrary, the gall-bladder is usually full of dark greenish-black bile.

The *spleen* is but slightly enlarged as a rule, and is frequently normal in size and appearance, internally as well as outside.

The *kidneys* are of a brownish-yellow colour, and loaded with fat. The Malpighian corpuscles and tubuli uriniferi are filled with granular albuminoid and fatty matter, detached epithelial cells, and oil-globules.

The *urinary bladder* is almost always empty; the little urine that it may contain is of a light yellow colour, free from crystalline deposit, and loaded with albumin.

SYMPTOMS.—*Invasion.*—The symptoms of yellow fever at this stage are uncertain and ill-defined. Attacking a community, as this disease does, without discrimination of age, sex, or state of health, those only being exempt who have already suffered from the malady, it of necessity offers the greatest variety of manifestations. The onset, as occurring suddenly in apparent health, is marked by intense headache, rigors, pain in the limbs and back, rapid rise of temperature, eyes glistening and suffused, congested countenance, intense thirst, anorexia, uneasiness at the epigastrium, nausea, and vomiting.

Stage of chill, or primary depression.—Here, also, the symptoms are not uniform. In some cases, and even in those of the greatest violence, chills are entirely absent, or amount only to a sense of coldness. In others they are deep, penetrating, and stupefying, or alternate with flushes of heat and crawling sensations; or the constriction of peripheral vessels may be extreme, causing a shrivelled appearance of the skin. In some cases, again, the disease is ushered in by giddiness, and in others with convulsions. Neither the presence nor absence of chills, therefore, can be regarded as characteristic. The chills, when they do occur, differ from those occurring in true malarial fever, and rather resemble those which may take place at the onset of such diseases as small-pox or pneumonia.

Stage of reaction.—The stage of active febrile excitement follows the chills, or the premonitory symptoms of uneasiness, prostration, and languor, with severe pain in the head and limbs, in the form of a rapid elevation of temperature. This ranges in the first day of the disease, according to its severity, from 102° to 110° F. in the axilla; and it is probable that the internal organs attain in some cases a temperature of 112°. As a general rule, from the third to the fifth day it falls to the normal standard and even below it; in some fatal cases it rises again towards the end, rarely, however, exceeding 104° F., and never attaining the high degree reached at first. The supervention of any inflammatory condition, or the occurrence of an abscess, will also cause a rise of temperature, with slight evening exacerbations; but as a rule the secondary elevation thus caused never equals the maximum of the stage of active febrile excitement. When malarial paroxysmal fever is engrafted upon yellow fever, in its later stages, or during the period of convalescence, the temperature during the hot stage may even exceed the maximum of that of yellow fever, but it will be characterised by sudden periodic depressions and elevations recurring at definite intervals. The pulse, when reaction has set in, is rapid, strong, tense, and full, though occasionally feeble and compressible. The increase of the frequency of the pulse does not, however, as a general rule, continue to correspond with the elevation of the temperature; and in many cases the remarkable phenomenon is witnessed of the pulse progressively decreasing in frequency, and even descending below the normal standard, while the temperature is maintained at an elevated degree. This singular circumstance is of great diagnostic value, as serving to distinguish yellow fever from other diseases, and especially from malarial paroxysmal fever, and also as indicating the presence in the blood of a poison possessing a specially depressing influence on the heart. On the other hand, the pulse may increase in frequency, but diminish in force, near the fatal issue, with a fall in temperature, particularly if there have occurred free hæmorrhage from the stomach.

The stage of febrile excitement is not of fixed duration, and may in some of the gravest cases appear to be comparatively mild and unimportant. At the same time the pains may be so slight, and there may be such an absence of delirium and but small failure of strength, that both patient and physician may be deceived, and yet the former may die without taking to his bed. In most of these so-called 'walking cases,' the kidneys have been involved from the inception of the disease, and complete suppression of the urine has supervened before death. This latter symptom is almost invariably fatal, and is a chief cause of the hæmorrhages from the stomach and bowels, and also of the marked blood changes, leading to severe nervous disturbances, and frequently to sudden death. There is no doubt but that the fever-poison directly interferes with the nutrition of the gastro-intestinal mucous membrane, liver, and kidneys, loading thereby the already vitiated blood with the abnormal products of their disintegration, whilst the circulation of the impure blood necessarily affects all the tissues of the body, and intensifies the morbid changes in those organs primarily attacked by the specific poison. The action of the poison of yellow fever, during the stage of acute febrile excitement, is manifested not only by intense pain in the head and back, and the florid congestion of the eyes and skin, the anorexia and nausea, the pyrexia and increased frequency of pulse, but also by the albuminuria, which is rarely entirely absent in severe cases, and may make its appearance on the first day of the febrile state.

The congestion, so marked upon the conjunctiva and skin, extends also to the internal organs, and is well seen in the injected nares, crimson lips, scarlet tip and edges of the tongue. As a general rule, in the stage of febrile excitement, the tongue is pointed, red at the tip and edges, and coated with thick white and yellow fur in the centre and over the roots. After the febrile excitement has continued for over three days, in some cases the tongue may present a corrugated, cracked, and bloody appearance. We never observe in specific yellow fever the broad tongue with indented edges, which often characterises the prolonged action of the malarial or paludal poison. The gums are red, spongy, and often bleed upon pressure, and the fauces brilliantly congested. The fact that mere examination of the throat and depression of the tongue are sufficient to cause nausea and retching, is an important diagnostic sign.

Stage of depression and exhaustion.—In cases which terminate favourably, the deleterious substances generated during the stage of febrile excitement are gradually eliminated, and the organs especially affected by the poison resume their healthy actions. In those cases which end fatally at this stage, the issue appears to be mainly determined by heart-failure from acute fatty degeneration, as well as the profound blood-changes induced by the specific poison, and the retention of the secretions of the liver and kidneys, the functions of which are arrested. There appear to be no just grounds for the subdivision of this fourth stage, in accordance with the presence or absence of hæmorrhage, coma, jaundice, uræmic poisoning and convulsions, for these are simply effects and aggravations of the preceding symptoms, and must be regarded as the maximum phenomena of the stage. Neither is this stage to be regarded as similar to, or identical with, the intermission or remission of malarial fever, or as an abortive repetition of the febrile stage, in which the disease ends from adynamic incompetency to carry out the phenomena.

The black vomit.—The ejection of altered blood from the stomach—black vomit—during the period of depression, although not absolutely characteristic of yellow fever, is still of such frequent occurrence as to demand special consideration, both of its nature and origin. The character of the matters vomited varies in different stages of the disease, as also with the degree of its severity. Whilst yellow fever is characterised, in common with several other diseased states, by an irritation of the gastric mucous membrane, the peculiar nature of the vomited matters does not rest entirely upon this irritation and congestion, but is influenced to a greater or less extent by the changes in the blood, liver, kidneys, and nervous system. The vomiting also may be regarded as, to a certain extent, salutary, and as an effort for the elimination of excrementitious materials from the blood. For in some cases distinct improvement follows the vomiting, as seen in the abatement of the pyrexia, and the cleaner condition of the tongue; and it would almost seem that, were it not for the profound changes in the blood and organs lying at the back of this almost universally fatal symptom, recovery might start from its occurrence. The first ejections generally consist of the ordinary gastric secretions, followed by a mucoid fluid, which is frequently at first tinged with bile, sometimes of an acid, sometimes of an alkaline reaction. The acidity is not due to the presence of any peculiar acid, but to hydrochloric or lactic acid, and is mainly determined in intensity by the nature of the ingesta. After the first vomiting the stomach may remain tolerably quiet until the subsidence of the fever on the third, fourth, or fifth day, when, without any premonitory symptoms of nausea, the stomach, on any trifling provocation, may eject a quantity of clear, pale, almost limpid, and slightly acid, opalescent fluid. At this period the disease may terminate, as if this excretion were similar to the perspiration of intermittent fever. If the vomiting continue, it becomes first streaked with dark flocculi of altered blood, and acquires an alkaline reaction, due to carbonate of ammonium, arising from the decomposition of the urea, which is eliminated from the gastric mucous membrane. The black vomit varies in specific gravity from near that of distilled water to that of blood; and it consists of the secretion of the mucous membrane, mixed with food, altered blood, epithelial cells, and excrementitious products, such as urea and carbonate of ammonium.

The urine.—The reaction of the urine is invariably acid, even in the gravest cases. As a rule, the specific gravity ranges from 1,009 to 1,028. In those specimens of the highest density the increase appeared to be due to the amount of albumen. During the early stages of the disease, the urine is normal in colour, clearness, and quantity; as the disease proceeds, it becomes of a deep yellow colour, from the admixture of bile; and on the fourth or fifth day appears turbid, from the presence of renal epithelial cells, tube-casts, and yellow granular albuminoid matter. The colour may deepen to orange-red, or even to reddish-brown; and the urine sometimes presents an oily appearance. The quantity may be much diminished, up to complete suppression. As a general rule, the amount is diminished in the active stages of the fever. If the case advance favourably the urine is copious, and the colour progressively increases in depth even to almost black. In grave cases it is much less abundant, and at the same time of a much lighter colour. Albumin is an almost invariable constituent, and may appear as early as the first day of the disease, but most generally from the second to the fifth. When convalescence is protracted, the albuminuria may continue long after all symptoms but debility have left the patient. When precipitated by heat or nitric acid, the albumin appears of a golden yellow or light brownish colour. As much as one ounce of dried albumin has been excreted in twenty-four hours, representing the albumin of nearly one pound of blood. Associated with the albumin are renal epithelial cells, and casts of tubules, but the albuminuria must not be wholly referred to an acute desquamation of the excretory cells, nor to mere capillary congestion, being equally due to chemical changes effected by the poison of yellow fever in the albumin and fibrin of the blood. The albumin appears in large amount in the urine, in cases where there is no apparent failure in the excretory action of the kidneys, and in which the urine is abundant, and laden with urea as well as bile. The presence in the urine of red corpuscles and the colouring-matter of the blood is not so characteristic in this disease as in the so-called malarial hæmaturia, where renal casts and epithelium may occur in considerable amount, but with only sufficient albumin to correspond to the exuded blood; whilst in yellow fever, when blood does appear in the urine, the amount of albumin is much greater than could thereby be accounted for. In the former disease, also, the urinary casts contain red corpuscles, and are of a brownish colour, in place of the golden-yellow tint which these oil-laden bodies present in yellow fever.

Throughout the disease, when there is no suppression, the amount of urea is much increased, reaching as much as a thousand grains *per diem.* There is a similar increase in the phosphoric and sulphuric acids, up to as much as fifty and sixty grains respectively.

PATHOLOGY. The various manifestations of yellow fever, as the intense capillary congestion, cardiac depression, delirium, coma, and convulsions, vomiting, hæmorrhage, urinary suppression, and jaundice, may all be referred to the action of the specific poison, and should not be erected into distinct types of disease, however prominent any one of these symptoms may be, and however much cases may differ from each other. The action of the yellow-fever poison is the same in all cases, whether mild or severe; the progress and termination, and the manifestation of the various symptoms, depending on the degree of action of the poison, the condition of the system at the time of its introduction, the peculiarities of constitution, the various agencies to which the patient is subjected during the course of the disease, and the supervention of other maladies.

Yellow fever, according to this view, partakes of the nature of a continued pestilential fever, presenting two well-defined stages. The first is characterised by active chemical change in the blood and organs, attended with elevation of temperature, which may constitute the entire malady, and prove fatal in a manner similar to other acute specific fevers. The second, or stage of depression, results from the action of the poison, and the blood-changes induced by the suppressed functions of certain organs.

From a consideration of the foregoing symptoms, it is manifest that the blood must have undergone profound changes, which seem to consist chiefly of the following:—

1. Such an alteration of the chemico-physical properties of the fibrin and albumin as leads to the transudation of the latter, through the excretory structures of the kidney.

2. Various degrees of diminution of the fibrin, in some cases amounting to almost entire disappearance; and this apparently due more to the direct action of the specific poison, than to the retained urea, bile-acids, or other substances. As a result, the blood coagulates imperfectly; and the clot is soft and bulky, exuding but little serum, and often breaking down into a grumous fluid on standing.

3. Whilst the red blood-corpuscles are not specially diminished, they are much altered in appearance.

4. Increase of fatty and extractive matters.

5. Accumulation of the biliary constituents, as shown by the golden-yellow colour of the serum.

6. Accumulation of the urinary constituents, especially the urea, carbonate of ammonium, chloride of sodium, and phosphoric and sulphuric acids. The alkaline reaction of the blood during life rapidly changes after death to acid.

7. Rapid dissolution of the red blood-corpuscles, with corresponding diminution of their oxygen-carrying power.

8. Rapid putrefaction after its abstraction from the body.

The various causes of black vomit may be thus summarised: 1. The irritation and structural alteration of the gastric mucous membrane, which is a part of the general tissue-degradation, consisting of granular and fatty degeneration of the secreting cells, and of the walls of the smaller blood-vessels and capillaries, as well as the general congestion of the stomach. 2. The changes in the blood, especially the marked diminution of the fibrin. 3. The suppression of the action of the kidneys, and the retention in the blood of urea and similar bodies. It may be noted that black vomit rarely occurs in those cases where the kidneys act continuously and freely. 4. The direct irritation of the urea and its derivatives, which are eliminated vicariously from the gastro-intestinal mucous membrane. 5. The irritant, nauseating effects of the bile retained in the blood.

In yellow fever, acute atrophy of the liver, and acute phosphorus-poisoning – diseased states which have many symptoms and pathological lesions in common—it would seem that the oxidation of albuminoids is not so complete as in health, and besides the formation of leucin, tyrosin, and other similar bodies, a large amount of fat is produced, which may extensively infiltrate the tissues. It is clear that one effect of suppression of urine is to determine the retention in the blood of a large excess of urea. This may in part be eliminated by the gastro-intestinal mucous membrane, and the black vomit may be intensely alkaline from carbonate of ammonium derived from this substance; and it is further evident that in many cases of yellow fever the fatal issue is determined chiefly by the retention in the blood of the constituents of the urine. To the same cause must be attributed, to a great extent, the nervous irritation, delirium, convulsions, and coma which characterise the stage of depression. Certain of the blood-changes may be also referred to this cause.

Duration.—The several stages of yellow fever which have been described are not uniform in their duration, and there may be a marked diversity in the manifestation of the symptoms in individual cases, some presenting apparently but the stage of febrile excitement, whilst others, overwhelmed as it were by the poison, at once pass into a condition of hopeless prostration. In mild cases, especially in children, the disease may be so slight as barely to attract attention, and convalescence may be established in two or three days. The stage of febrile excitement may continue from two to six days, rarely beyond three or four, and the patient may pass almost imperceptibly into convalescence during the stage of depression. The severest cases may prove fatal in two or three days, with an axillary temperature of 110° F.; or later from hæmorrhage, urinary suppression, general prostration, or an adynamic state, accompanied with parotid abscess, revival of old complaints, or the supervention of some other disease, such as malarial fever. The fourth stage may be of long duration, extending over weeks and even months. It is, however, true that convalescence is usually comparatively rapid, and in striking contrast to the tedious recovery from malarial fever. In some cases vomiting may be the prominent symptom; in others hæmorrhage from the stomach and bowels, or from the gums, eyes, and ears; in others, again, the cerebral symptoms may be most marked.

Terminations and Mortality.—In fatal cases death may be referred to a variety of causes, namely: 1. The direct action of the fever-poison upon the blood and nervous system. 2. The disturbance or suppression of function of certain organs, as the kidneys and liver. 3. Syncope from cardiac degeneration. 4. Profuse hæmorrhages from the stomach and bowels. 5. Blood-poisoning from absorption of putrid black vomit in the stomach. 6. The formation of abscesses with sequential pyæmia.

The mortality occasioned by yellow fever appears to be as great as that caused by any known epidemic or endemic disease, and varies in different localities and epidemics from 10 to 70 per cent. of those attacked.

Prognosis.—Continuous observations of the temperature should be made, as by that means prognosis and treatment may best be regulated. If the axilla temperature rise in the first stage above 105°, the patient is in imminent danger; and if it reach from 109° to 110° death is almost inevitable. Cases, however, have recovered in which the temperature has reached the latter point. When the temperature rapidly rises to 106° and upwards, death sometimes occurs suddenly, and apparently solely from the effects of the high temperature upon the blood, heart, and nervous system, as in sunstroke.

Treatment. — 1. *Prophylactic.* — Experience has established the possibility of excluding yellow fever from localities in which it has prevailed as an epidemic, subsequent to introduction from other regions, by means of an absolutely strict quarantine. But hitherto it has been almost impossible to arrive at any definite conclusions as to the value of quarantine in those regions in which the disease is endemic and indigenous.

Much difference of opinion has existed as to the value of disinfectants, such as chlorine, carbolic acid, and sulphurous acid. In arresting the spread of the fever it is very doubtful whether much of the benefit that has been attributed to them is not rather to be ascribed to other causes; and, in estimating the value of any such sanitary measures, the following facts in the history of yellow fever should be considered:—

(*a*) Yellow fever may prevail in one or more cities, and at the same time be entirely absent from other cities in the same zone, and subjected to very nearly the same hygienic conditions. The mere absence of yellow fever from a particular city, whilst it is prevailing elsewhere, proves nothing as to the mere sanitary condition and measures of the city enjoying the immunity.

(*b*) One of the most essential elements for the origin and spread of yellow fever within and immediately around its recognised geographical limits, is the influx of strangers and immigrants, or an unacclimatised population.

(*c*) It is not probable that a [illegible] epidemic would ever arise in a city within the recognised zone in which the vast proportion of the inhabitants are acclimatised, and have been subjected to the action of the specific poison.

(*d*) Yellow fever has been entirely absent from many cities, where serious epidemics have occurred, during long series of years; and at other times has prevailed to a very limited extent, and with but slight mortality, when no disinfectants have been used.

2. *Curative.*—Yellow fever is a 'self-limited' disease, and cannot be arrested by drugs. Every case should be regarded as serious, however slight the symptoms may appear; and, on account of the structural alterations in the blood and organs, the closest medical attendance and most careful nursing are required. Since so many of the symptoms are due to arrest of the functions of the skin and kidneys, efforts should be directed to promote the activity of these organs during the progress of the disease. Stimulant diuretics should, as a rule, be avoided; but benefit often follows the free use of hot mustard foot-baths, vapour baths, and sometimes warm baths. Diaphoresis and diuresis may be further promoted by large draughts of lemonade, decoctions of orange-leaf and sage tea, and water charged with carbonic acid. Absolute rest in the recumbent posture must be maintained as far as possible. The necessity for this is especially indicated by the cardiac weakness, fatal results having followed rising from bed and walking during the period of calm.

The maintenance of free ventilation, and the avoidance at the same time of sudden changes of temperature, by proper coverings, are essential. Experience shows that many fatal cases from urinary suppression have followed sudden changes and falls of temperature. Each case of yellow fever should have at least 2,000 cubic feet of space; and hospitals, where practicable, should be constructed on elevated situations. All discharges should be immediately removed from the sick-room; the bedding frequently changed; and the soiled clothing boiled, or baked at a temperature of not less than 230° F.

The practice of covering patients with heavy blankets, and at the same time giving large quantities of hot drinks, with the object of inducing profuse sweating, frequently appears to be injurious, not only from the debilitating effect, but also from the greater susceptibility of the skin, and the increased tendency to renal congestion thereby induced.

The diet should be light and nutritious. Beef-tea, chicken-tea, corn-flour and rice gruel, barley water, iced milk, and milk and lime-water are the best forms of nourishment, and should be continued at regular intervals throughout the active stages of the disease. Solid food and even bread should be avoided.

In many cases the preceding measures, accompanied by absolute rest in bed, and the careful and continuous attention of an experienced nurse, will be all that is required.

Alcoholic stimulants should be used with caution. They have proved beneficial in cases attended with great prostration, champagne appearing to be the best form.

The treatment for hyperpyrexia consists in the giving of such cardiac sedatives as aconite, veratrum viride, or gelsemium; the injection of large quantities of ice-cold water into the rectum; sponging the surface with cold water, or with water, acetic acid, and alcohol; and blood-letting. It appears also that an active purgative, such as calomel (gr. x.) or castor oil, followed immediately by one or two full doses (gr. x.) of quinine in the first twenty-four hours of the fever, may reduce the temperature.

Efficient but gentle purgation in the early part of the first stage may be beneficial. Mercurials should not be given later than the second day for an adult; eight to twelve grains of calomel or blue pill, or an ordinary dose of castor oil, will be sufficient. Purgatives, as a general rule, should not be administered in the stage of depression. An emetic may be useful at the very beginning, if the stomach be loaded. Local blood-letting, whilst of occasional benefit for the relief of congestion in the first stage, is most injurious later. Dry-cuppings and sinapisms are usually sufficiently effective.

The internal administration of the mineral acids or the tincture of the perchloride of iron, from their supposed beneficial effects upon the jaundice and black vomit respectively, is of doubtful propriety, and sometimes directly injurious.

The value of quinine in yellow fever is not nearly so great as in paroxysmal malarial fever; and, notwithstanding statements to the contrary, the writer fails to discover any facts or cases by which the power of large doses of quinine to abort this disease can be fully and unequivocally established, though its efficacy, not only in arresting, but in warding off paroxysmal fever, is undoubted. It is rather as an antidote to the effects of the poison, than to the poison itself, that quinine is of use.

Opium, in whatever form, should be administered with great caution, from its poisonous effects when the kidney-action is arrested, but may be of advantage when sleeplessness and restlessness are prominent. Arrest of the function of the kidneys, owing to the grave alterations in their structure, is beyond relief by drugs. The tincture of ergot, which has been recommended, has often failed; but much good has been accomplished, and the function of the kidneys restored, by the injection, at regular intervals, of a pint or more of ice-cold water into the rectum.

When there is a threatening of black vomit, ice should be swallowed, and bags of the same applied to the epigastrium. Septic poisoning has been known to follow decomposition of the blood effused into the gastro-intestinal tract, and to prevent this, scruple doses of sulpho-carbolate of sodium, repeated every three or four hours, have been given with advantage.

During the period of calm, active medication, beyond what has been indicated, should be abstained from. The diet should still be of the simplest, most nutritious, and most digestible character. In this stage there is often a morbid craving for food, and in some instances relapse and death have been the result of the unrestrained indulgence of the appetite.[1] JOSEPH JONES.

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[1] In the epidemic of yellow fever in New Orleans during 1878, when, in a population of 210,000, the deaths numbered 4,056, the writer had an extensive experience of the disease, himself treating 256 cases, of whom 18 died. The plan of treatment was based upon the preceding principles. The alimentary canal was cleared at the outset by an emetic of ipecacuanha, and a powder of 10 to 20 grains each of calomel and quinine, followed by a full dose of castor oil. The action of the skin was excited by hot mustard foot-baths and mild diaphoretics. The function of the kidneys was maintained by the regular use of cold water, by attention to the covering of the patient, and avoiding cold currents of air. Absolute rest, in all cases, in a well-ventilated room, for from eight to fourteen days, or even longer, was strictly enforced, supplemented with careful nursing night and day, and the most exact record of the progressive state of the patient. During the period of febrile excitement the patients were confined to barley water. When the initial temperature was high, 2 to 4 drops of tincture of green hellebore, or 5 to 10 drops of tincture of gelsemium, were administered every two or four hours, combined with friction with a liniment composed of from 1 to 2 drachms of the sulphate of quinine mixed with 3 fluid ounces each of soap liniment and olive oil. Ten grains of sulpho-carbolate of sodium in orange-leaf tea were given every four hours. Where the head was very hot and there was much nervous irritability, cold applications were employed. Gastric irritation was treated by sinapisms to the epigastrium, with carbonate of calcium and creasote internally. Except in cases attended with great nervous excitement, without urinary suppression, opiates and chloral were not given; but in such cases they were apparently beneficial. Cupping over the loins and bromide of potassium were used when the urine was diminished in quantity. After the subsidence of the febrile excitement, iced champagne and beef-tea were administered in small quantities, at regular intervals. In cases which assumed the 'typhoid state,' attended with tympanites, ice-cold enemas, containing small quantities of tincture of asafœtida and oil of turpentine, were found to be beneficial by reducing the temperature, stimulating the bowels to expel the flatus, and promoting the action of the kidneys. When secondary fever ensued, and presented an intermittent or remittent type, the sulphate and hydrobromide of quinine were freely used. And when the stomach would tolerate nourishment and stimulants, beef-tea, chicken-tea, beefsteak, and port wine or brandy were administered. When convalescence was prolonged, or life endangered by abscesses or

YELLOWSTONE NATIONAL PARK, in the Rocky Mountains, United States of America.—A tract of country, 65 miles long and 55 miles wide; altitude 6,000 feet. Remarkable for its thousands of mineral springs, containing principally salts of calcium and silicon, with a temperature of 160° to 200° F.; and for its fifty geysers or hot springs, throwing up columns of water 50 to 500 feet in height. Largely utilised in chronic rheumatism and gout. *See* MINERAL WATERS.

Z

ZINC, Poisoning by.—SYNON.: Fr. *Empoisonnement par le Zinc*; Ger. *Zinkvergiftung.*

Poisoning by compounds of zinc is rare, if we except poisoning by the chloride (Sir W. Burnett's fluid), which acts as a corrosive poison, like the mineral acids (*see* POISONS). Zinc sulphate (white vitriol) is the only other salt of zinc of importance from a toxicological point of view; this salt has proved fatal in a few instances.

ANATOMICAL CHARACTERS.—These are of the same nature as those of the mineral irritants—gastro-intestinal inflammation, ecchymoses, and softening. Ecchymoses have also been observed in the pleura.

SYMPTOMS.—The symptoms of poisoning by zinc are similar to those produced by tartar emetic. They include an astringent, metallic, and burning taste in the mouth; early and violent vomiting; pain in the abdomen; purging; great prostration and anxiety; a small and feeble pulse; shallow respirations; cold perspirations; and collapse and exhaustion, ending in death. The intellect is unaffected.

When taken in small doses, zinc produces a chronic form of poisoning, the symptoms of which are derangement of the digestive organs, and peripheral neuritis.

DIAGNOSIS.—In the absence of any history of the administration of zinc sulphate, the diagnosis cannot be made between this and other forms of irritant poisoning, such as by blue vitriol, except by the aid of chemical analysis.

PROGNOSIS.—The prognosis of zinc-poisoning is generally favourable.

TREATMENT.—Demulcent drinks, sedatives, and alcoholic stimulants should be immediately given. The administration of a solution of the common phosphate of sodium, largely diluted, is advisable. It acts as an excellent precipitant of zinc, in the form of an insoluble phosphate. Opiate enemata may prove serviceable.

THOMAS STEVENSON.

carbuncles, iron and other tonics were given, together with a nutritious diet, and the local application of carbolic acid, tincture of iodine, &c. Relapses were avoided by confining the patient to bed until the heart had regained its usual vigour.

ZONA or ZOSTER (ζώνη, ζωστήρ, a girdle).—SYNON.: Shingles; Fr. *Zona*; Ger. *Zoster*; *Gürtelrose*.

This term was originally applied only to that form of herpes which runs round one half of the trunk of the body, usually in the region of the waist. Subsequently, however, the term 'zoster' crept into our dermatological literature as a generic appellation, and we read of *Zoster facialis*, *brachialis*, &c., names which philologically are evidently inaccurate. *See* HERPES.

ERASMUS WILSON.

ZYMOTIC: ZYME (ζυμάω, I ferment; ζύμη, a ferment).—SYNON.: Fr. *Zymotique*; *Zymase*; Ger. *Gährungsfähig*; *Gährstoff*. The terms *zyme*, *zymine*, *zymotic*, and *zymosis* were introduced by Dr. William Farr, in a Letter to the Registrar-General in 1842, and employed by him to denote in a general way the poison (and pathological processes excited by it) of 'epidemic, endemic, and contagious diseases.' In using the word ζύμη, he was careful to point out that he did not consider the morbific process to be absolutely identical with the ordinary phenomena of fermentation, and that he wished the terms *zymosis*, *zymotic*, &c., to be employed in English, 'not in the sense which they have in Greek, but as general designations of the morbid processes and their exciters.' With this qualification clearly expressed, the use of the root-form ζυμ- has become general, not only in scientific literature, but also in the public press—almost invariably, however, in the adjectival form *zymotic*.

Fourteen years later (1856), in the *Sixteenth Annual Report of the Registrar-General*, Dr. Farr described the diseases of the zymotic class as conveniently referable to four groups. These are: 1. The *Miasmatic*, diffusible through the air or water, attended by fevers of various forms; the matter by which they are communicated is derived from the human body, as in small-pox, or from the earth (as in ague). These two diseases are types of this class. 2. The *Enthetic* diseases, which may properly be called *contagious*, being communicated by contact, puncture, or inoculation. Syphilis and glanders are types of this class. 3. The

Dietic diseases, which arise when the blood is supplied with improper or bad food. Scurvy and ergotism are the types of this class. 4. The *Parasitic* diseases, which attack especially dirty populations, and infest the skin, the intestinal canal, and all the structures of the body.

This classification, which does not now hold good, is quoted here because it continues to be spoken of. Modern pathology has necessitated its revision.

Recently, indeed, the word 'zymotic' has been restricted to the acute specific diseases, included under the first group (miasmatic) in the above classification; and at the present time it is in this limited sense that it is most commonly used.

Corresponding with the adjective *zymotic* is the substantive *zyme*. This is a useful name, by which we refer to the poisonous cause of zymotic diseases. It is simpler than the word *zymine*, originally proposed by Dr. Farr; and (what is much more important) to speak of the contagious poison as 'a zyme' does not imply the acceptance of any particular theory of disease; while, on the other hand, the use of the word 'germ' distinctly conveys the idea of some organised structure, itself the cause of the disease by subsequent growth and multiplication. *See* CONTAGION; GERMS OF DISEASE; and MICRO-ORGANISMS.

The necessity for employing the word *zymosis* does not seem to be felt as yet; but the same reasons that lead us to speak of the agent as a zyme should also guide us to use *zymosis* in place of the more usual periphrases.

VICTOR HORSLEY.

APPENDIX.

McCARTHY'S MINERAL SPRINGS.—Two calcic s's, flowing 60 gallons per hour, containing 146·61 grains of salts, principally calcium and magnesium sulphates, per gallon, near Saltillo, Huntingdon Co., Pa. A local resort.

McCORKLE'S SPRING.—A chalybeate s. near Waterloo, Lauderdale Co., Ala.

McDANIEL'S MINERAL SPRINGS.—Saline, sulphureted s's near McLeanasborough, Hamilton Co., Ill. Unimproved.

McELROY'S SPRING. — A chalybeate s. in Westmoreland Co., Pa. A local resort.

McHENRY'S THERMAL SPRING.—A s. the water of which has a temperature of 68° F., and contains calcium and magnesium carbonates and sodium and calcium sulphates. It is located in Scott Co., Va.

McVITTY'S SPRING.—A calcic s. flowing 125 gallons per hour, containing 13·69 grains of salts per gallon, near Saltillo, Huntingdon Co., Pa. A local resort.

MACHIASPORT SPRING.—A saline s. in Machiasport, Washington Co., Me.

MACROPHAGE.—A large uninucleated cell derived from the fixed subcutaneous connective-tissue elements. See PHAGOCYTOSIS, p. 385.

MADISON SPRING.—A chalybeate s. in Madison Co., Ga. Once used as a resort.

MADRONE MINERAL SPRING.—A carbonated s. near Gilroy Hot Springs, Santa Clara Co., Cal. A resort.

MÆEUSIOPHOBIA.—Dread of childbirth.

MAGNESIA SPRINGS, VA. — Four chalybeate s's, flowing 400 gallons per hour, in Ash Grove, Fairfax Co., Va. Unimproved.

MAGNESIA SPRING, W. VA. — A calcic, saline s. near White Sulphur S's, Greenbrier Co., W. Va.

MAGNETOTHERAPY.—That form of hypnotic therapeutics in which the metallic magnet is applied over a painful region. It has been highly commended for the treatment of certain neuroses, but F. Peterson has shown that the most powerful electro-magnets exercise no influence on the nervous system of men or animals, and it is generally accepted that any therapeutic effects are the result of auto-suggestion.

MAGNOLIA SPRING.—A sulphureted, chalybeate s., flowing 3,000 gallons per hour, in Plains of Dura, Sumter Co., Ga,

MAJOR SHEVER SULPHUR SPRINGS. — Sulphureted s's near Jasper, Walker Co., Ala. A local reputation.

MALLEATION.—A frequently repeated contraction of a muscle, resembling rapid blows with a hammer; it is observed in neurasthenia, hysteria, chorea, and other nervous diseases.

MAMMOTH HOT SPRINGS. — Seventy-eight saline, calcic s's, the waters having temperatures from 63° to 165° F., in Yellowstone National Park, Wy.

MAMMOTH SPRING.—A calcic s. in Fulton Co., Ark.

MANGANUS SPRINGS.—Two sulphureted and chalybeate s's near Chapel Hill, Orange Co., N. C.

MANHATTAN ARTESIAN MINERAL WELLS.—Two saline springs, flowing 800 gallons per hour, one containing 117·94 grains, the other 64·55 grains of salts, per gallon, in Riley Co., Kan. A resort.

MARION ARTESIAN WELL. — A chalybeate w., the water containing 27·85 grains of salts per imperial gallon, in Grant Co., Ind.

MARK WEST SPRINGS.—Ten thermal, sulphureted and chalybeate s's, flowing 90 gallons per hour, in America, Sonoma Co., Cal. A resort.

MARTIN SPRING.—A chalybeate s., flowing 400 gallons per hour, in Grayson Co., Tex. Unimproved.

MASSANETTA MINERAL SPRINGS.—Two calcic, alkaline s's, flowing 30,000 gallons per hour, containing 25·76 grains of salts, principally calcium and magnesium carbonates, per gallon, near Harrisonburg, Rockingham Co., Va. A resort.

MASSENA SPRINGS.—Two saline, sulphureted s's, flowing 700 gallons per hour, containing 191·88 of salts per gallon, in St. Lawrence Co., N. Y. The principal salts are sodium chloride 76·79 grains, calcium sulphate 60·03 grains, magnesium chloride 29·93 grains.

MASSOTHERAPEUTICS — MASSOTHERAPY.—The use of massage as a curative agent.

MATILIJA HOT SPRINGS.—Twenty-eight sulphureted s's, flowing 8,000 gallons per hour, with temperature from 35° to 100° F., near Nordhoff, Ventura Co., Cal. A resort.

MATTHEW ORIAN'S WELL. — See Wyandot Magnetic Well.

MATTHEW'S WARM SPRINGS.—Two alkaline, saline s's, the waters having temperatures from 114° to 122° F., near Bozeman, Gallatin Co., Mont. Improved.

MATTOCK'S SPRING.—A sulphureted saline s. near Princeton, Dallas Co., Ark.

MATTOID.—Of C. Lombroso, a person on the borderland of insanity; one in whom there is decided mental instability, or whose mind is the product of culture and a high degree of civilization but who is a monomaniac or crank.

MAULSBY'S SPRING (WELL).—A saline s., flowing 400 gallons per hour, near Dexter, Dallas Co., Iowa. It has a local reputation.

MAYBURY SPRINGS.—Over fifty saline s's, west of Hot Springs, in Montgomery Co., Ark. A resort.

MAY'S SPRINGS.—Two chalybeate carbonated s's, containing 17·8 grains of salts, principally calcium and magnesium carbonates and sulphates, per gallon, in Milligan's Cove, Bedford Co., Pa.

MEAL, EXPERIMENTAL. — A m., consisting of certain food stuffs, that is eaten for the purpose of determining the duration and character of digestion in gastric diseases. Leube's experimental m. consists of a plate of water gruel, a piece of beefsteak, and wheat bread; lavage seven hours after this m., if nothing is eaten *ad interim*, shows in normal digestion that little if any of the food remains in the stomach; the meal may then be repeated and the stomach washed out in five, four, or three hours after eating, and an examination of the washings will reveal the character of the digestion. Ewald's m. consists of a dry roll and lukewarm water or dilute tea; lavage may be practiced one hour after this is eaten, though Vierordt calls attention to the fact that this m. makes too slight a demand on the stomach. Jaworski's m. consists of the albumin of two boiled eggs with three ounces of water; it has not met with great favor. The washings are examined for the digested food, for bile, blood, pus, free muriatic acid, lactic acid, pepsin, and peptones.

MECHANOTHERAPY. — The treatment of disease by mechanical agencies. Various ingenious apparatus have been contrived to apply massage or motion to the several parts of the body. The method was particularly elaborated by Ling, who used it for the treatment of deformities, and by Zander, who used it in various neuroses, disorders caused by nutritional defects, circulatory troubles, etc.

MEDICAL LAKE.—An alkaline, saline lake in Spokane Co., Wash. A resort.

MEDICINE CREEK SPRING.—A saline s., containing 64·37 grains of salts, principally sodium sulphate, per gallon, near Pierre, Hughes Co., Dak.

MEGALOCARDIA. — Cardiac hypertrophy.

MEGALOGLOSSIA.—See Macroglossia.

MEGALOSPLENIA. — Hypertrophy of the spleen.

MELANCHOLIA, VARIETIES OF:

Affective Melancholia.—M. in which the emotional or affective sphere is chiefly at fault.

Agitated Melancholia.—See M., Acute, p. 35.

Alcoholic Melancholia.—M. as it occurs among inebriates. It is usually of brief duration and terminates favorably.

Amenorrhœal Melancholia.—M. associated with the organic disturbances that have produced amenorrhœa, and that is erroneously attributed to the latter.

Cataleptic Melancholia.—A form of stuporous m. described by G. H. Savage; in which there is more or less complete catalepsy.

Climacteric Melancholia.—M. supervening at the climacteric.

Convulsive Melancholia.—M. associated with Jacksonian epilepsy; the mental, motor, sensory, trophic, and vasomotor functions are involved.

Nostalgic Melancholia.—M. caused by nostalgia.

Organic Melancholia.—M. that accompanies some gross organic lesion of the brain.

Panphobic Melancholia. — M. in which there is dread of everything.

Paretic Melancholia.—M. that may be the prodrome of paresis.

Passive Melancholia.—M. that develops slowly with a gradual failure of physical health, restless worry or jealousy being the first objective sign. It may be associated with anæmia (*anæmic m.*), or with diabetes (*diabetic m.*), or with tuberculosis (*phthisical m.*), or with gout (*podagrous m.*), or with rheumatism (*rheumatic m.*), or with syphilis (*syphilitic m.*), or with some uterine disease (*uterine m.*).

Periodic Melancholia. — See Recurrent Melancholia.

Puerperal Melancholia.—One of G. H. Savage's classes of m. that appears after and apparently depends upon childbirth.

Recurrent Melancholia.—M. in which the patient recovers from the disease but relapses at a longer or shorter interval, especially if placed in the environment in which the first attack occurred.

Religious Melancholia.—That form of m. with delusions in which there is intense despondency as to the religious condition; there are self-accusations of hypocrisy, impurity, neglect of religious duty, and commission of unpardonable sins.

Resistive Melancholia.—A term applied by Clouston to m. in which unreasoning active or passive resistance is the marked feature of the disorder.

Sexual Melancholia.—M. associated with ideas of impotence, venereal infection, or ungratified sexual desire. It is often a phase in ordinary m.

Sympathetic Melancholia. — M. that arises from some organic disturbance other than that of the brain.

MELANIDROSIS. — Black perspiration. See Sudoriparous Glands, Disorders of.

MELANISM.—A condition characterized by a dark or black color of the skin. It occurs as the result of an organic constitutional anomaly, or of Addison's disease, or of tuberculosis, or of the prolonged use of silver nitrate.

MELANOCHLOROSIS. — Chlorosis in which there is melanism.

MELANURIA.—Urine that rarely has a dark color when passed, but that blackens when some oxidizing agent is introduced, or when it is exposed to the air. The coloring material is not melanin, but a chromogen—melanogen. Bromine water added to urine containing melanin causes a yellow precipitate that gradually blackens. A concentrated solution of iron perchloride dropped into the urine will cause the latter to turn gray in this condition. M. may exist in any wasting disease.

MELITHÆMIA.—Sugar in the blood. The condition is normal, but sugar may be present in excess, as in diabetes.

MELROSE SPRINGS. — Four sulphureted and chalybeate s's near Maryville, Blount Co., Tenn. A resort.

MENDON MINERAL SPRINGS. — Carbonated s's in Worcester Co., Mass.

MENINGO - EPENDYMITIS. — Of Fagge, hydrocephalus in adults characterized by an accumulation of fluid in the ventricles with thickening of the ependyma.

MEPHITISM. — The diseased condition produced by poisonous exhalations.

MERANÆSTHESIA. — Partial anæsthesia.

MERYCISM.—Rumination, *q. v.*

MESSENA SULPHUR SPRINGS.—Three sulphureted s's east of Syracuse, Onondaga Co., N. Y. The waters contain calcium carbonate 14·8, calcium sulphate 68·4, magnesium sulphate 10·88, and calcium chloride 10·64 grains per gallon.

METALLOSCOPY.—A term applied by Dujardin-Beaumetz to the phenomena observed in hysterical patients in consequence of the application of metals to the skin. The phenomena consist of vasomotor or sensory disturbances, or even both.

METALLOTHERAPY.—The treatment of certain nervous diseases, especially those of hysterical origin, by the application of plates, bracelets, rings, or chains of different metals to the affected locality. As inert substances, such as wood, have produced similar results, these are not due to feeble electric currents generated by the metal. Axenfeld and Huchard refer to *balneal m.*, in which the action of mineral waters on the organism produced the phenomena of m.: to *hydro-m.*, in which cutaneous irritation with hot or cold water produced the phenomena; and to *internal m.*, in which the internal administration of metals produced like results.

METHÆMOGLOBINÆMIA. — The presence of free methæmoglobin in the blood. It is produced by large doses of potassium chlorate, by the inhalation of amyl nitrite, or by administering kairin, thallin, hydrochinon, iodine, bromine, turpentine, acetanilid, etc. The condition is detected by the spectrum showing the four absorption bands characteristic of methæmoglobin.

METHÆMOGLOBINURIA. — Methæmoglobin in the urine. Hoppe-Seyler holds that the blood pigment in the urine is always in the form of methæmoglobin.

MICHIGAN CONGRESS SPRING.—See Lansing Magnetic Well.

MICROBÆMIA.—A morbid state of the blood produced by microbic infection.

MICROCARDIA. — Abnormal smallness of the heart.

MICROCYTE.—A very minute red blood corpuscle. The term is also applied to degenerated blood corpuscles, and to degenerate endothelia of the vessels found in the blood.

MICROCYTHÆMIA. — A disease described by Van Lair and Masius in which microcytes appear in the blood. They consider it due to increased splenic and diminished hepatic activity. The condition occurs in many morbid states, especially in toxicoses, infectious diseases, etc.

MICROGLOSSIA. — Abnormal smallness of the tongue.

MICROPHAGES.—Small phagocytes or wandering cells in the lymphoid tissue of the alimentary tract. See Phagocytosis, p. 385.

MIDLAND MAGNETIC WELL.—A saline spring, containing 160·21 grains of salts per imperial gallon, in Midland Co., Mich. A resort. The principal salts are potassium sulphate 82·19 grains, sodium chloride 32·7 grains, sodium sulphate 22·07 grains, calcium chloride 6·22 grains, and calcium sulphate 4·46 grains.

MILBURN SPRINGS.—Three chalybeate s's near Winslow, Pike Co., Ind. A resort.

MILFORD SPRINGS.—Four chalybeate s's, flowing 440 gallons per hour, in Hillsborough Co., N. H. A resort.

MILHOUR SPRINGS.—Three sulphureted s's, flowing 75 gallons per hour, in Limestone Co., Ala. A resort.

MILK AND THE MILK CURE.—Milk is a white or yellow-white opaque liquid secreted by the breasts of female mammals that has a specific gravity varying from 1·018 to 1·045. It should have a neutral reaction, though it is often amphoteric, probably in consequence of the presence of both acid and alkaline sodium phosphates. It contains in solution milk sugar, three or four different proteids, various mineral salts, traces of lactic and acetic acids, of alcohol, creatin, cholesterin, lecithin, and urea, of carbon dioxide, nitrogen, and oxygen gases, and in suspension it contains fat globules and casein.

Its composition varies in different animals. Analyses by J. König show that the constituents in several hundred different samples of the milk of the cow, goat, sheep, ass, and mare were:

	Water.	Casein.	Albumin.	Fat.	Sugar.	Salts.
Cow's milk:						
Average .	87·17	3·02	0·53	3·69	4·88	0·71
Minimum .	80·32	1·79	0·25	1·67	2·11	0·35
Maximum .	90·69	4·23	1·44	6·47	6·03	1·21
Goat's milk .	86·91	2·87	1·19	4·09	4·45	0·96
Sheep's milk.	81·63	4·09	1·42	5·83	4·86	0·73
Mare's milk .	90·71	1·24	0·75	1·17	5·70	0·37
Ass's milk * .	89·01	3·57		1·85	5·05	0·52

* Vernois and Becquerel.

Milk contains all the alimentary substances required for the support and maintenance of animal life; and not only is it the exclusive food of all mammalian young, but it is also advantageously employed as the exclusive food for adults under various circumstances.

According to Germain Sée, if we allow for a ration for a normal adult 125 to 130 grammes of nitrogenous principles, 100 grammes of fat, and 250 grammes of carbonaceous principles, it would be necessary to give 4 litres of milk a day to afford sufficient nitrogenous material, 5 litres a day to yield the necessary carbonaceous food principles, and only 3 litres a day to furnish the necessary amount of fats. Milk is therefore a mixed food containing a preponderance of fat.

From the analyses given above, it is seen that sheep's milk is particularly rich in casein and fat, and, like goat's milk, a large part of its nitrogenous matter is in the form of albumin, but it is rarely used as human food.

Cow's milk contains nearly three times, and goat's milk four times, as much nitrogenous matters as human milk, while mare's and ass's milk nearly equal the latter in the proportion of these constituents; but cow's, goat's, and mare's milk contain less sugar than ass's or than human milk; and cow's, ass's, or mare's milk contain less fat than human or than goat's milk. Ass's milk is light, sweet, and easy of digestion, and it is a useful but rarely employed food for persons whose stomachs are too weak to digest cow's milk. Goat's milk, while rich in solids, nitrogenous and fatty constituents, contains a peculiar aromatic (hircic) acid, and, though highly nutritious, it is not easily digested.

Milk is frequently diluted by vendors, who increase its volume by adding water and obtain a normal specific gravity of the sophisticated fluid by adding cane or milk sugar or salt. Borax, boracic or salicylic acids have been added to preserve the milk; sodium carbonate or bicarbonate, or potassium nitrate or carbonate, have been employed to correct acidity; caramel, turmeric, and annotto to give it a rich color: and flour, arrowroot, dextrin, chalk, glycerin, and gelatin to make the fluid appear more creamy.

The quality of the milk is influenced by the breed, age, food, treatment, housing, the drainage and general condition of the dairy, the purity of the water supply, and the time of calving. Mr. L. F. Abbot proposed to obviate the latter factor by spaying the cows, as the operation increases the flow and improves the quality of the milk.

All milk used for food should be carefully examined. Most cities have more or less rigidly enforced ordinances regarding the sale of adulterated milk, and in some States this matter is a subject of State regulation: as in New Jersey, where the minimum amount of total solids is fixed at twelve per cent, and the maximum amount of water at eighty-eight per cent; or in Massachusetts, where, in all cases of prosecution if the milk shall be shown upon analysis to contain more than eighty-seven per cent of water or less than thirteen per cent of milk solids, it shall be deemed adulterated.

Dr. Babcock has devised a simple method of separating the fat from the casein by means of sulphuric acid and heat, and collecting the fat by centrifugal action and measuring it in a graduated tube. His apparatus consists of a centrifugal holding a number of test bottles of two ounces' capacity, with a narrow graduated neck, a pipette graduated at 17·6 cubic centimetres, and a cylindrical glass measure graduated at 17·5 cubic centimetres. The measure is filled with sulphuric acid of a specific gravity of 1·82, and the acid added to 17·6 cubic centimetres of milk in a test bottle. The latter is shaken and placed in the centrifugal, by which it is revolved for five minutes, when it is taken out and hot water added until the fluid rises nearly to the upper graduation in the bottle's neck; it is then subjected to centrifugal action for another minute, when it is taken out, and the proportion of fat may be read off from the graduations. As the proportion of casein to fat is an almost constant ratio, the percentage of casein may be easily calculated.

Pathogenic organisms may be present in milk in consequence of contamination from the cow either before or after the milk leaves the udder, or from dust or dirt blown into the milking pail, or from the persons handling the milk, or from contamination of the vessels in which the milk is contained. Mr. Ernest Hart reported fifty epidemics of typhoid fever, fourteen of scarlatina, and seven of diphtheria that were traceable to milk. The milk from tuberculous cattle often contains the *Bacillus tuberculosis*, and in a number of States the State Board of Health employs dairy inspectors, who examine herds and order the killing of tuberculous animals.

In order to destroy these micro-organisms in milk, sterilization has been secured by subjecting the milk to a steam temperature of 100° C.; but this destroys the starch-liquefying ferment and the sugar, and the casein is rendered less coagulable by rennet. Accordingly, Pasteurization, or subjecting milk to a temperature of 75° C. for about fifteen minutes, followed by rapid cooling, is generally practiced. Dr. Rowland Godfrey Freeman has introduced an efficacious apparatus consisting of a zinc receptacle containing boiling water, into which nursing bottles containing milk are introduced for the necessary time, and then cold water from the faucet is allowed to run over the bottles in the receptacle.

Dr. Freeman finds that Pasteurization affords a safeguard against the deleterious effects of any bacteria that milk may contain, without interfering with its nutritive qualities; that this process efficiently destroys the germs of cholera, typhoid fever, diphtheria, and tuberculosis, as well as the *Streptococcus pyogenes*, the *Staphylococcus pyogenes*, and the *Bacillus coli communi*. Pasteurization does not modify the size of the curds formed when milk is subjected to the action of gastric juice, and it may be used after peptonizing milk to stop the action of the ferment.

Milk has been employed as a remedy for disease since the time of the fathers of medicine. For phthisis, gout, sciatica, leucorrhœa, hectic fever, typhoid fever, intermittent fever, dropsy, Bright's disease, and obesity it has been commended as a curative or remedial agent. As early as the third century milk cures existed; and in Italy in the year 1,600 different plants were cultivated in fields, and these were used as pastures for cows whose milk, thus medicated, was employed in the treatment of certain diseases.

Since the time of Hippocrates the vapor from boiling milk has been used for inhalation in various inflammations of the respiratory passages. Skoda especially has commended the employment of milk, because, together with the aqueous vapor, there are other constituents of the milk that exercise an emollient influence in these inflammations.

Human, goat's, and cow's milk have been injected into the veins in lieu of transfusion of blood, and in the treatment of chronic Bright's disease, acute anæmia, and other diseases.

In 1865, Dr. Philip Karell published a paper in the *St. Petersburg medicinische Zeitschrift*, in which he directed attention to the scientific value of milk cure. He said that after fruitlessly trying all sorts of remedies in many chronic and obstinate diseases, he had at last succeeded in thoroughly bringing the alimentary canal under his control. In all dropsies, in asthma that is the result of emphysema or pulmonary catarrh, in neuralgia due to intestinal disorder, in simple hypertrophy and in fatty degeneration of the liver, in all diseases where there is faulty nutrition, milk is the best and surest of remedies. Milk seems to regulate nutrition. It should be taken in small draughts, from two to six ounces, and at stated intervals, every three or four hours, all other kinds of nourishment being forbidden. In winter the milk should be made tepid by placing it in a tumbler in a vessel containing hot water; in summer it should be taken at the temperature of the surrounding atmosphere. It should not be gulped down, but quaffed slowly. The quantity may be gradually increased, two quarts a day being administered during the second week. The milk should always be skimmed.

In 1877, Dr. S. Weir Mitchell stated that his treatment in neurasthenia, especially in fat and anæmic women, was to put the patient at absolute rest in bed, and place her on a diet of skimmed milk which is kept at such an amount as will thin the woman at a rate that will cost her about half a pound daily. A woman weighing one hundred pounds, lying in bed, needs about three pints of skimmed milk daily, given as Karell directs. He found that when using milk as a restricted diet it is sometimes necessary to substitute beef soup for a day or two, on account of the disgust that milk may occasion. Beginning with three ounces of milk every two hours, the quantity is increased in a few days up to two quarts, given in divided doses, every three hours. If there is obstinate constipation, he gives one quarter of a grain of extract of aloes with two grains of dried ox gall. The simple milk diet is a great aid to riddance of chloral, bromides, and morphine.

The disgust that milk may occasion is an unfortunate contingent in this treatment; and Germain Sée says that neither raw nor boiled, hot nor cold milk, nor milk to which Vichy or lime water or some liquor has been added, is tolerated by some persons.

Dr. James Tyson agrees with Donkin, that no measure is so efficient in removing the sugar in glycosuria as an exclusive milk diet. A certain number of cases are completely relieved, and the symptoms do not return after a cautious addition to the milk diet and gradual substitution thereof by nitrogenous, and, still later, even by starchy and saccharine foods. In other cases there is no sugar in the urine as long as the milk diet is continued, although glycosuria and the other symptoms recur immediately that other food is substituted for milk. In another class of cases sugar is much diminished but does not disappear, while in a small number of diabetics a milk diet is so badly tolerated that it must be discontinued. In diabetes, Dr. Tyson gives four ounces of skimmed milk every two hours from 7 A. M. till 9 P. M. As this is insufficient food for an adult, the quantity of milk is increased to six ounces every two hours on the second day, and in a few days to eight ounces. If the quantity is insufficient, milk may be taken at night, or the interval increased to three hours, and larger quantities taken at a time. Five to ten pints of milk a day generally suffice; but where larger quantities are taken a part may be given as curd. When the skimmed milk is not easily tolerated, a little lime water or Vichy may be added; and if it constipates, a saline aperient or an aperient mineral water may be used daily. Tyson does not believe that milk is directly curative in diabetes, but that by furnishing a food which is nonirritating and easily assimilable, even as to its saccharine constituent lactose, a rest is given to the starch and sugar assimilating apparatus, and the reparative tendency of Nature is allowed to assert itself, and the hepatic or intestinal condition which causes the glycosuria disappears.

There can be no doubt but that a certain number of cases of diabetes consist in a simple organic or functional derangement of organs which only require to be let alone in order to restore themselves to a normal state; while the irritation caused by foods which can only be assimilated through their offices must result in more or less permanent lesions.

The skim milk furnishes a food of a kind which gives the liver a thorough rest—and a more complete rest than any other diet as yet suggested. This, Tyson believes, is the only way in which it acts in the cure of diabetes. Hence it is that there are certain cases due to lesions remote from the liver which are themselves incurable, either spontaneously or through direct treatment, which milk can not reach; such are some forms of pancreatic disease. In these cases the lives of the patients are prolonged by any diet which furnishes the requisite reparative and force-producing elements in an available shape. In such case a starchy and saccharine food is wasted, simply because the resulting grape sugar passes directly through the system. Milk and the albuminous foods, not being converted to any extent into grape sugar, are still available as force producers, and thus defer the unfavorable termination, or, in a word, keep the diabetic from starving.

Tyson states that he has yet to see an instance of persistent uric-acid sediment in which the exclusive use of milk was not followed, sooner or later, by a total disappearance of the deposit; while he had known its persistent use to be followed by the easy discharge of uric-acid calculi of considerable size *per urethram*.

The *rationale* of these results has been made perfectly plain by the chemical study of the urine of persons on such a diet, by Dr. John Marshall, of the University of Pennsylvania. The most important result of these analyses is the fact that in the total twenty-four hours' urine of persons on the skim milk no appreciable amount of uric acid could be found.

While an exclusive milk diet is so efficient in cases of pure uric-acid gravel, it is not to be especially recommended in phosphatic calculus. Indeed, it is rather contraindicated; for the effect of a milk diet is to alkalize the urine, and therefore to tend to maintain a phosphatic sediment.

While nothing can be hoped for in respect to solvent action, or tendency to solvent action upon oxalate-of-lime sediments, by urine derived from a milk diet, yet, as it is commonly supposed that the same conditions of system which tend to produce uric acid are those which produce oxalate of lime, it may be expected that milk treatment will also be useful in the oxalate-of-lime tendency.

The third set of diseases in which Tyson found the milk treatment especially useful was certain forms of Bright's disease. In these, more discrimination has to be exercised than in any of the foregoing. In general, it may be said that it is in the contracted kidney of interstitial nephritis that milk is most useful; the headache, nausea, vertigo, and "fullness" in the head, and the palpitations which are so often very annoying symptoms, are frequently relieved by it. Here, too, Tyson found that the skimmed milk is especially indicated, because anything which increases the labor of digestion aggravates the symptoms above mentioned. It would seem, too, that those suffering with contracted kidney are better when the blood is not too good in quality or too rich in solids. On the other hand, it is not so necessary that the diet should be exclusively milk, and a sufficient quantity of bread and vegetables may be permitted to break up the monotony, while meat, eggs, and all foods rich in albumin should, as a rule, be prohibited. In this disease, especially, the constipation incident to a milk diet should be guarded against.

In parenchymatous nephritis and amyloid kidney Tyson found milk less useful, yet it was a very convenient and suitable diet, often producing diuresis and relieving dropsies. When a diuretic effect is desired buttermilk was to be preferred; it was as easily assimilated as skimmed milk, and was often more palatable.

That a milk diet should be useful in certain cases of gastro-intestinal disease is generally recognized. There are two classes of cases for which it is adapted. The first is that represented by the ordinary dyspeptic, whose symptoms are sometimes dispelled as by magic by a pure skim-milk diet systematically carried out and modified by the free addition of lime water. Where milk is illy borne, or produces flatulence, it may be peptonized.

Tyson states that it is more particularly in the treatment of organic diseases of the gastro-intestinal tract that the bland and unirritating qualities of milk diet are indicated. In gastric ulcer the use of no other food than peptonized milk should be permitted. In chronic enteric disease of both small and large intestines, and particularly of the latter, it is very doubtful whether it is in the power of therapeutic means to directly affect the diseased parts. Treatment must therefore consist in such measures as will favor Nature's inherent tendencies to restore lost tissue. This can only be secured by placing the patient on a diet which is non-irritating, leaves little waste, and at the same time makes the smallest demand upon the digestive function. To accomplish this, it is necessary to obtain his consent to the use of a diet of peptonized milk for an indefinite period; for no promises can be made as to the date at which other food dare be permitted. The uninterrupted presence of natural stools, and the continued absence of pain, are the only reliable criteria. To be able to carry out such a treatment satisfactorily, it is absolutely essential to secure the confidence of the patient. The process of obtaining this depends largely upon the personal qualities of the physician, and the ability to be able to speak authoritatively; but when the probability of almost certain recovery is held out, and it is shown that the good effect of weeks of treatment are undone by so simple a solid as a small piece of bread, the battle is half won. Particularly in those cases of irritation of the large bowel, attended by the discharge of mucus or mucous casts, may we expect from the milk treatment the most satisfactory results, while success by local treatment is very rarely attained. The use of milk is rational, and consistent with what we know of the essential conditions of growth and repair.

Like S. Weir Mitchell, Tyson has found skimmed milk most beneficial in treating excessive obesity. While he advises a pint of milk every four hours, he permits more if there is hunger, believing that it is not likely that too much can be taken to prevent the desired reduction in weight. Tyson warns against reducing the weight too rapidly; and when the weight is approximately that of a certain standard ratio to height, unskimmed milk and other articles of food may be added.

Recent experiments made by Drs. A. Gilbert and S. A. Domencini have demonstrated that the milk diet diminishes in a marked degree the number of bacteria in fæces.

An adult of normal size, weight, and condition, whose fæces with his usual diet contained 67,000 germs per milligramme, was put on an an exclusively milk diet for five days. At the end of two days the fæces contained 14,000, after three days 5,000, after four days 4,000, and at the end of five days only 2,250 bacteria. The weight of the fæcal evacuation, which while the subject followed his ordinary diet reached 175 grammes, was reduced to 73 grammes, and the number of microbes eliminated daily through the intestinal tract fell from nearly 12,000,000,000 to 164,000,000. In short, the milk diet resulted in a reduction of the proportion of microbes in the fæces to $\frac{1}{73}$ part of the physiological quantity.

These results were obtained by the use of nonsterilized milk; sterilized milk, indeed, did not show any greater efficacy in reducing the quantity of micro-organisms in the stools.

They also noticed that in dogs and rabbits a milk diet has exactly the same effects as in man; in dogs the number of microbes fell from 21,000 or 25,000 per milligramme to 500 or 1,000.

In addition, a milk diet exerts its action not only on the fæcal matters, but also on the whole range of the gastrointestinal tube.

They demonstrated that in the dog the stomach contains nearly 50,000 germs per milligramme at an advanced stage of gastric digestion; that the duodenum, of all the parts of the gastrointestinal tract the poorest in microbes, contains nearly 30,000; that in the small intestine the number increases progressively from the pylorus to the ileocæcal valve, and in the ileum exceeds 100,000; and, lastly, that in the large intestine it is rather more than 30,000.

In a dog subjected for two weeks to an exclusively milk diet, and killed two hours after the ingestion of 300 grammes of milk, the stomach contained only 100, the duodenum 50, the jejunum 100, the ileum 1,300, and the large intestine 1,275 germs, per milligramme. The milk diet had consequently brought about almost complete asepsis of the digestive tract.

In their opinion this antiseptic action is the result of various factors. The explanation is, no doubt, mainly to be sought in the digestibility of this substance, in its almost complete absorption, and in the small quantity and feeble nutritive properties of the residue it leaves; perhaps also, the presence of the milk facilitates the destructive action of the digestive juices, and especially of the gastric juice, on the microbes.

Be this as it may, there is certainly no direct action of the milk itself brought into play, for, as they ascertained, a culture of the intestinal bacteria is twice as active in this liquid as in the nutritive *bouillon* employed in laboratories.

These facts explain the beneficial results obtained by an exclusively milk diet in dyspepsia accompanied by intrastomachal growths of bacteria, in acute and chronic enteritis associated with diarrhœa, in dysentery and typhoid fever, etc. They explain also the usefulness of milk diet in diseases of the liver, when this organ is incapable of performing its antitoxic function, and when, in consequence, hypertoxicity of the urine results and the disturbances associated with hepatic inadequacy threaten to occur. Lastly, they explain the marvelous effects of a milk diet in nephritis and in the treatment of patients affected with uræmia, in whom, if the renal lesion can not be directly combated, it is at least possible to reach by this means one of its causes.

Curd and Whey.—The coagulum formed by adding an acid or rennet to milk is called *curd*, and the fluid from which it separates is termed *whey*.

According to Bauer, whey contains: water, 93·3; albuminates, 0·82; fat, 0·24; lactose, 4·65; lactic acid, 0·33; and salts, 0·65. It has been used in some febrile diseases, in obesity, in abdominal plethora, and in phthisis; but as it only contains the water, sugar, salts, and a trace of the albuminates of milk, it can not be considered a very useful form of milk cure.

Buttermilk is that form of milk that remains after the separation of the cream in the manufacture of butter. It is a thick, acid fluid, in which the casein exists in a finely coagulated state, the acidity being due to the conversion of the greater part of the lactose into lactic acid. It has considerable nutritive value, but must be used in the fresh state. Eulenberg speaks highly of its value in gastric catarrh with atrophy of the gastric glands. It has been used instead of milk in the various diseases in which the latter is given.

Koumiss is milk that has undergone acid and alcoholic fermentation by the conversion of its sugar into alcohol and carbonic acid. It is used as a food and also an intoxicating drink by the nomadic tribes in the Russian steppes, and is made with mare's milk. But a form of koumiss is prepared in the United States with cow's milk. There is great difference of opinion among Russian authorities regarding koumiss, though the weight of evidence seems to be toward the idea that the best koumiss and the best results of koumiss treatment are only obtained in the steppes, the food and environment of the mare undoubtedly influencing the quality of the milk. Russian writers state that the best koumiss is made from the milk of a breed of mares that is the product of artificial selection through many centuries. They state that the best koumiss is made in May, June, and July from the milk of mares that have not been put to work, and that have been pastured in the steppes not far from the mountain ranges, where they can find flowing water and salt beds.

From a chemical standpoint koumiss is a fluid the composition of which is constantly changing. Stahlberg's analyses give the following percentages:

	Koumiss 2 days old.	Koumiss 6 months old.
Alcohol	1·65	3·23
Fat	2·05	1·01
Milk sugar	2·20	....
Lactic acid	1·15	2·92
Casein	1·12	1·21
Salts	0·28	
Carbonic acid	0·70	1·86

According to Homenko, Daal, and Seeland, koumiss does not inconvenience the digestive organs, as much as ten litres a day being taken, though such a quantity is excessive; the urine is increased in cold weather, and diaphoresis is increased in warm weather; the bowels become regular; the blood is richer in hæmoglobin; and there is a general increase of tissue. Its intoxicating action is slight and transient. It is valuable in anæmia, chlorosis, marasmus, convalescence from typhoid fever, gastric disorders, and in tuberculosis. In the latter, cough and dyspnœa cease, expectoration lessens, and the patient gains in weight and in strength.

Koumiss prepared artificially with cow's milk by means of any of the koumiss ferments in the market will be found a useful adjunct in the treatment of the diseases of the classes herein referred to.

MILLBOROUGH SPRINGS.—Two sulphureted and chalybeate s's in Bath Co., Va. A resort.

MILL CREEK APOLLINARIS SPRING.—A carbonated s., containing 3·8125 grammes per liter of salts, principally sodium carbonate, sulphate, and chloride, in Gallatin Co., Mont. Unimproved.

MILLER'S HOT SPRINGS.—Hot s's, having a temperature of 170° F., near Franklin, Elk Co., Nev.

MILLER'S MINERAL WELL.—A saline s. near Barboursville, Knox Co., Ky.

MILL'S MINERAL SPRINGS.—Four saline, sulphureted s's, the water having a temperature of 170° F., near Anderson's Springs, Lake Co., Cal. A resort.

MINERAL HILL HOT WHITE SULPHUR SPRINGS.—Five sulphureted s's, flowing over 150 gallons of boiling water per hour, in Eureka Co., Nev. A resort.

MINERAL HILL SPRINGS.—Eight sulphureted s's, flowing 400 gallons per hour, near Bean's Station, Grainger Co., Tenn. A resort.

MINERAL SPRINGS, CONN.—Four sulphureted, chalybeate s's in North Woodstock, Windham Co., Conn. Once a resort.

MINERAL SPRINGS, GA.—Fourteen sulphureted s's near Newnan, Coweta Co., Ga. Once a resort, but now unimproved.

MINERAL WELL, MINN.—A saline s., containing 156·46 grains of salts, principally sodium sulphate, per gallon, at Tracy Station, Lyon Co., Minn.

MINERAL WELLS, TEX.—One hundred and forty springs, one containing 226·23 grains, another 33·24 grains of salts, principally sodium and magnesium sulphates, per gallon, in Palo Pinto Co., Tex. A resort.

MINNEHAHA SPRING.—One of the Saratoga springs.

MINNEQUA SPRINGS. — Three chalybeate, sulphureted s's, flowing 600 gallons per hour, near Minnequa, Bradford Co., Pa. A resort.

MIRROR WRITING.—Writing that resembles ordinary chirography when reflected from a mirror. See RETROGRAPHY.

MISENHEIMER'S SULPHUR SPRINGS.—Two sulphureted and chalybeate s's near Copal Grove, Stanly Co., N. C. A resort.

MISHEMAN'S SPRINGS.—Chalybeate s's near Bilesville, Stanly Co., N. C.

MISONEISM.—Of C. Lombroso, a morbid aversion to anything new or unusual.

MISOPÆDIA. — A morbid aversion to children.

MISSISSIPPI SPRINGS. — Four sulphureted s's near Raymond, Hinds Co., Miss. Used as a resort prior to 1868.

MITCHELL'S CHALYBEATE SPRINGS. — Alkaline, saline s's on Stone Quarry Creek, Hot Spring Co., Ark.

MITHRIDATISM.—Immunity from poisoning produced in an organism by the administration of gradually increased doses of poison.

MIXED SPRING.—A saline, chalybeate s., flowing 200 gallons per hour, near Dripping Springs, Lincoln Co., Ky. A resort.

MOGILALIA.—Dyslalia.

MOGOPHONIA.—Slight laryngeal spasms affecting elocutionists and flute players.

MONARTHRITIS. — Arthritis affecting only one joint.

MONATHETOSIS. — Athetosis affecting only one limb or one side of the body.

MONO BASIN WARM SPRINGS.—Saline, alkaline s's, containing 2·085 grammes of salts per litre; the water has a temperature of 85° to 90° F. They are located near Mono Lake, Mono Co., Cal.

MONOCHOREA. — Chorea involving a single part or locality.

MONODIPLOPIA. — Diplopia with one eye. It occurs in commencing cataract, in irregular cornea, and in rare instances in cerebral tumors.

MONO LAKE.—A lake in Mono Co., Cal., the waters of which contain 51·85 grammes of salt per litre. Of the salts, 19·49 grammes are sodium carbonate, 10·07 grammes sodium sulphate, 18·22 grammes sodium chloride, and 2·23 grammes potassium chloride.

MONOPHASIA.—Dyslalia in which only a single syllable, word, or sentence can be uttered when consecutive speech is attempted.

MONOPHOBIA.—A morbid dread of being alone.

MONOPLEGIA.—A paralysis of one limb, or of one side of the face, that is caused by a cerebral, spinal, or peripheral lesion. M. is to be distinguished from a localized paralysis in which a particular muscle is, or group of muscles are involved. In *brachial m.* the palsy is limited to the arm, and is caused by a lesion of the arm center in the Rolandic area. *Brachiocrural m.* is limited to the arm and leg, and results from a cortical lesion around the upper two thirds of the Rolandic fissure. In *brachiofacial m.* an arm and one side of the face is involved in consequence of lesion of the middle or lower third of the ascending frontal and parietal convolutions. *Crural m.* is limited to the lower extremity, and is caused by a circumscribed lesion in the ascending frontal and parietal convolutions. *Anæsthetic m.* is anæsthesia of a single extremity caused by a rheumatic neuritis or a pachymeningitis at the origin of the spinal nerves. *Peripheral m.* is that variety caused by neuritis. *Spinal m.* results from a lesion of the spinal cord. *Unilateral oculomotor m.* is the consequence of cortical disease; there are conjugate deviation of the eyes and rotation of the head and neck to the side opposite to that in which the lesion is situated.

MONOSPASM.—Spasm limited to one limb or to one side of the head. There may be *facial m.*, affecting the muscles of the face; or *masticatory m.*, affecting the muscles of the lower jaw; or *oculomotor m.*, involving the muscles of the eyeball and causing conjugate deviation.

MONROE HOT SPRINGS.—A hot s., flowing 4,200 gallons per hour, of water having a temperature of 150° to 160° F., near Prescott, Maricopa Co., Ariz. A bathing resort.

MONROE SPRINGS. — Sulphureted s's near Rochester, N. Y.

MONTEBELLO SPRINGS.—See NEWBURY S's.

MONTESANO SPRINGS.—Ten saline, sulphureted s's, flowing 150 gallons per hour, near Sulphur Springs landing, Jefferson Co., Mo. Analyses of the waters of two of the s's by Riggs and Potter show the following constituents:

Constituents.	Montesano Spring	[illegible] Spring
	Grains per gal.	Grains per gal.
Calcium carbonate	71·15	69·47
Magnesium carbonate	14·05	15·50
Calcium sulphate	52·37	51·93
Iron and alumina	0·87	0·75
Sodium hyposulphite	0·74	0·64
Sodium sulphide	0·33	0·43
Sodium chloride	[illegible]·11	368·21
Potassium chloride	16·77	16·99
Magnesium chloride	35·91	24·41
Magnesium bromide	Trace.	0·10
Magnesium iodide	0·85	
Silica	0·51	0·67
	538·56	541·60
Gases.	Cu. in.	Cu. in.
Carbonic acid	46·48	48·20
Sulphureted hydrogen	1·40	1·60

MONTGOMERY WHITE SULPHUR SPRINGS.—Sulphureted s's in Montgomery Co., Va. A resort.

MONTVALE SPRINGS. — Three chalybeate, sulphureted s's, flowing 200 gallons per hour, containing about 108·84 grains of salts, principally calcium sulphate and carbonate and magnesium and sodium sulphates, per gallon, in Blount Co., Tenn. A resort.

MOODYVILLE MINERAL SPRINGS.—Alkaline s's, near Blaine, Pottawatomie Co., Kan. A resort.

MOORESBURG SPRING.—A chalybeate s. near Mooresburg, Hawkins Co., Tenn. A resort.

MOORESVILLE MINERAL SPRINGS. — Calcic, saline s's, containing 41·52 grains of salts per gallon, in Livingston Co., Mo. A resort, and used commercially.

MOORE'S SPRINGS.—Sulphureted s's near Athens, Limestone Co., Ala.

MOORMAN WELL.—A saline, sulphureted spring, containing 2,707·62 grains of salts per imperial gallon, in Ypsilanti, Mich. Used commercially and as a resort. The salts include sodium chloride 1,888·35 grains, calcium sulphate 210·78 grains, magnesium chloride 153·72 grains, calcium chloride 172·04 grains, calcium carbonate 68·73 grains, potassium sulphate 42·4 grains, silicon dioxide 23·79 grains, and magnesium bromide 13·17 grains.

MORGAN SPRINGS.—Chalybeate s's in Rhea Co., Tenn.

MORPHINOMANIA.—This term is used to indicate either an uncontrollable desire for opium or its derivatives, or a mania produced by opium or by abstinence from it in a person addicted to its habitual use.

MORPHOMANIA.—A mania for external appearances, forms, and ceremonies.

MORRISON SPRINGS.—A sulphureted s. in Morrison, Jefferson Co., Col. A resort.

MORTALITY.—In the able introduction to the Report on the Mortality and Vital Statistics of the United States as returned by the tenth census, Surgeon John S. Billings said that the records compiled were little more than a convenient summary of the population and number of deaths recorded in each State. He referred to the fact that those records were hardly useful to make comparisons with the death rates of other countries, because the rates were too small, for the reason that all the deaths that occurred during the census year were not recorded, and because the calculations are based upon the number of persons surviving at the end of the year, which is greater than the number of living persons that actually furnished the number of deaths.

The death rate per thousand of living population was, in 1880, 15·09; in 1870 it was 12·77; and in 1860, 12·54. The calculations for the census of 1890 will not be available until 1895; but the increasing death rate indicates that more complete mortality returns have been secured at each census.

The census of 1880 showed that the male death rate was 15·35 and the female 14·81 per thousand of population, the excess of male deaths occurring during the earlier years of life. The mortality among whites was 14·74, among negroes 17·28 per thousand.

Cities.	Population U. S. census, 1890.	Annual rate per 1,000 of the population.			
		1893.	1892.	1891.	1890.
Altoona, Pa.	35,000	22·5	19·8	......	15·3
Atlanta, Ga.	65.514	27·1	24·1	25·3	24·6
Auburn, N. Y.	25,858	20·1	18·2	19·6	22·1
Baltimore, Md.	434,439	15·7	24·2	23·1	23·3
Binghamton, N. Y.	35,005	17·8	19·6	17·8	16·0
Boston, Mass	448,477	25·9	24·8	23·5	22·9
Brooklyn, N. Y.	806,343	25·9	25·6	26·4	24·3
Charleston, S. C.	65,165	27·91	29·2	29·06	27·94
Chicago, Ill.	1,099,850	24·7	23·7	24·3	19·6
Cincinnati, Ohio	296,908	19·8	20·2	22·3	22·3
Cleveland, Ohio	261,353	20·0	19·8	12·2	19·2
Detroit, Mich.	205,876	20·0	24·0	19·3	18·8
Erie, Pa.	40,634	17·4	20·4	......	......
Fall River, Mass.	74,398	23·4	25·3	24·3	22·1
Galveston, Tex.	29,084	20·8	24·5	23·9	20·4
Indianapolis, Ind.	105,436	19·9	18·8	18·4	16·2
Kansas City, Mo.	132,716	......	12·4	12·3	16·5
Louisville, Ky.	161,129	......	19·4	19·1	21·9
Memphis, Tenn.	50,313	21·31	25·0	27·96	26·71
Milwaukee, Wis.	204,468	21·2	21·7	22·9	17·9
Minneapolis, Minn.	164,738	13·5	15·5	13·7	14·7
Mobile, Ala.	31,076	26·5	28·4	25·3	27·2
Nashville, Tenn.	76,306	20·2	20·7	23·6	18·8
Newark, N. J.	181,830	26·8	28·1	28·3	25·1
New Orleans, La.	242,039	28·9	30·9	28·3	29·2
New York, N. Y.	1,515,301	29·4	29·1	28·8	26·6
Pensacola, Fla.	11,750	20·6	24·5	21·8	20·1
Philadelphia, Pa.	1,046,964	22·6	23·1	22·0	20·7
Pittsburg, Pa.	238,617	22·36	22·7	24·4	21·3
Portland, Me.	36,426	19·8	21·8	17·2	19·9
Providence, R. I.	132,146	24·6	22·3	19·9	19·2
Richmond, Va	81,388	25·4	25·2	26·6	28·3
Rochester, N. Y.	133,896	19·3	20·3	18·7	15·8
St. Louis, Mo.	451,770	20·4	20·71	21·0	18·4
St. Paul, Minn.	133,156	....	......	15·9	15·5
San Diego, Cal.	16,159	9·7	10·7	11·7	10·6
San Francisco, Cal.	298,997	19·9	21·7	23·3	22·8
Toledo, Ohio	81,434	18·0	19·9	18·1	16·4
Washington, D. C.	230,392	26·6	27·6	26·0	23·7

The mortality in certain of the larger cities of the United States for the years 1890, 1891, 1892, and 1893 is given in the accompanying table, that is compiled from the Weekly Abstracts of Health issued by the United States Marine-Hospital Service, and from the reports of local boards of health. As a rule, the estimate of mortality is based upon the returns of population obtained by the national census of 1890, and not on an estimate of mean population for each year. There is often variance between the figures in this table and those given in the annual reports of the boards of health of different cities. The reason for this is, that the board often calculates its mortality rate upon the basis of an estimated population. Take, for example, the city of Memphis, Tenn. The United States census of 1890 gave the population of that portion of the city comprised within the jurisdiction of the Board of Health as 50,313; but the board considered this erroneous, and during 1890, 1891, and 1892 made their calculations on an estimated population of 60,000, making the death rate about four per thousand less than it actually was. In 1893, allowing for an increase of population during the three years since the census, the board made an estimate based on a local census, and calculated the death rate on a population of 57,951, or more than 2,000 less than had been used to determine the per-thousand mortality of the three previous years. This instance is but one of many, and it is not improbable that all of these statistics are less rather than equal to the actual mortality rate. When it is recalled that the most frequent causes of death are those from communicable diseases, in this country tuberculosis being first, then pneumonia, diphtheria, cholera infantum (before which in order of frequency is heart disease, and after which is stillborn), enteric fever, malarial fever, croup, and scarlatina, it may be seen that the longevity of the inhabitants of any city is dependent upon the efficiency of the local board of health in supervising dairies and slaughter houses, so as to insure the innocuous character of the milk and meat supplies, upon the care that is exercised in preventing contamination of the source of water supply and the sanitary condition of the water and ice, on the isolation of communicable diseases, and on the sanitary control of the city in general.

Color.—A factor that greatly increases the per-thousand mortality in our Southern cities is the large negro population. This may be judged from the following data:

		1893.	1892.	1891.	1890.
Charleston	white	18·53	20·29	19·15	17·70
	colored	38·13	36·28	37·77	36·98
Memphis	white	16·58	19·64	20·02	19·33
	colored	27·29	25·85	28·88	26·14
Atlanta	white	14·78	13·80	15·25	15·71
	colored	33·54	30·66	34·48	36·28
Mobile	white	21·11	23·98	21·57	17·89
	colored	34·51	34·22	30·11	24·89

Dr. H. B. Horlbeck, the health officer of Charleston, S. C., called attention to the importance of this subject in 1891. He investigated the mortality rates per thousand of the white and negro population in several Southern cities, and found they were as follows:

	White, per thousand.	Negro, per thousand.
Charleston, 1880 to 1890	21·39	43·66
Memphis, 1876 to 1890	23·32	29·03
Mobile, 1876 to 1890	22·68	28·73
Nashville, 1875 to 1890	17·91	32·30
New Orleans, 1881 to 1890	23·78	37·87
St. Louis, 1880 to 1890	19·02	34·16
Washington, 1876 to 1890	18·40	33·60

This increased mortality among negroes is due to their lessened resistance to disease in part, and to their mode of life, that is indifferent to all, or almost all, hygienic precautions.

MORTALITY OF DISEASES.—The same factors that are mentioned in the article on this subject in the body of this work as influencing the prevalence and mortality of disease exist in the United States as in European countries.

Tuberculosis.—The census of 1880 showed that in cities this disease caused 285·5, and in the country 162·9 deaths, in 100,000 population. In the city of New York, during the decade 1882–1891, the average percentage of the mortality from tuberculosis to the total mortality was 13·79, while the average death rate was 3·29 per thousand living. The greatest mortality occurred during the first five and the last months of the year.

In Minnesota, during the quinquennium 1887–1891, tubercular diseases caused a mortality of 9·67 per cent of the total mortality, and 1·07 deaths in each thousand of population. The greatest mortality is in the spring and winter months.

In St. Louis, Mo., during the decennium 1881–1890, tubercular diseases averaged 10·39 per cent of the total mortality; while in Pittsburg, from 1883–1893, the average was 8·89 per cent of the total mortality.

Pneumonia.—In New York city, during the decade 1882–1891, the mortality from pneumonia was 10·51 per cent of the total mortality, and 2·51 per thousand of population. The greatest mortality occurred during the first five months of the year.

In 1880 the deaths from pneumonia in rural districts were 122·5, and in cities 143, per 100,000 population.

In the State of Minnesota, during the quinquennium 1887–1891, the average mortality from pneumonia was 5·87 of the total, or 0·65 per thousand of population.

In St. Louis, Mo., the pneumonia mortality was 6·79 per cent of the total deaths.

Diphtheria.—In 1880 this disease caused in rural districts 75·3, and in cities 80 deaths, in 100,000 of population. The prevalence of this disease is greatly influenced by season.

	Massachusetts, average 4 years.	Minnesota, average 5 years.
Spring	24·4	20·20
Summer	20·1	17·96
Autumn	26·4	80·97
Winter	28·9	30·85

Enteric or typhoid fever caused in the rural districts, in 1880, 47·5, and in the cities 34·6 deaths, in 100,000 of population. In Minnesota, during the quinquennium 1887–1891, it caused 4·14 per cent of the total mortality, and 44·6 deaths per 100,000 of population.

Croup caused, in 1880, in the rural districts 35·1 and in the cities 40·8 deaths in 100,000 population.

Scarlet fever caused in the rural districts 28·4 and in the cities 55·4 deaths in 100,000 population.

Measles caused in the rural districts 16·2 and in cities 15·4 deaths in 100,000 population.

As yet the warfare waged against communicable diseases is too unsystematic to be productive of lessened mortality. But with the advances in education and in knowledge it is hoped that another decade may witness a marked lowering in their mortality percentages.

MOULTONBOROUGH MINERAL SPRING.—A chalybeate s., flowing 200 gallons per hour, in Carroll Co., N. H. Used commercially prior to 1882.

MOUND SODA SPRING.—Three carbonated, alkaline s's in Park Co., Col. Unimproved.

MOUND SPRINGS.—Four hot s's, flowing 1,000 gallons per hour, near Plymouth, Elder Co., Utah. A local resort.

MOUNTAIN GLEN HOT SPRINGS.—Sulphureted s's, having temperatures from 60 to 100 F., near Santa Barbara, Cal. A local resort.

MOUNTAIN VALLEY SPRINGS.—Three calcic s's, containing 21·82 grains of salts, principally calcium, magnesium, and iron bicarbonates, per gallon, near Hot Springs, Garland Co., Ark. Used commercially and as a resort.

MOUNT AIRY SPRINGS.—Chalybeate s's in Habersham Co., Ga.

MOUNT CLEMENS MINERAL SPRINGS.—Two saline s's in Mount Clemens, Macomb Co., Mich. Used commercially.

MOUNT NEBO SPRINGS.—Five chalybeate s's, flowing 190 gallons per hour, near Dardanelle, Yell Co., Ark. A resort.

MOUNT ZIRCON SPRING.—A saline s. in Melton Plantation, Oxford Co., Me.

MUCINURIA.—Mucin in the urine. It is not necessarily a pathological symptom, as it may be derived from the urethra or the vagina. The urine is turbid, deposits a bulky cloud that forms a viscid, gelatinous sediment at the bottom of the vessel. Mucin may be precipitated by lead acetate.

MUDDY SPRINGS.—Twenty hot s's near West Point, Lincoln Co., Nev.

MUNGEL'S SPRINGS.—Four sulphureted and chalybeate s's, flowing 70 gallons per hour, near Abingdon, Washington Co., Va. A resort.

MURPHY'S SEVEN SPRINGS.—Seven alkaline, calcic s's, containing 22·81 grains of salts, principally calcium, magnesium, and sodium bicarbonates, per gallon, near Junction City, Davis Co., Kan.

MURRAY'S SPRINGS.—Saline, chalybeate s's, containing 0·37 grains of salts, principally calcium carbonate and magnesium, sodium and potassium sulphates, in 1,000, near Lewis, Daviess Co., Ky.

MUSICOMANIA.—Monomania produced by excessive devotion to music.

MUSICOTHERAPY. — The therapeutic use of music. It is of great benefit in certain mental diseases.

MUSTARD'S MINERAL SPRINGS. —Sulphureted s's near Witten's Mills, Tazewell Co., Va. Used medicinally.

MYASTHENIA.—Muscular debility; it may be due to defective nutrition, or to degeneration, or to fatigue.

MYELÆMIA. — Leucocythæmia caused by disease of the bone marrow.

MYELALGIA.—Pain in the spinal cord.

MYELAPOPLEXIA.—Spinal apoplexy.

MYELASTHENIA.— Neurasthenia due to disease or disturbance of the spinal cord.

MYELATROPHIA.—1. Atrophy of the spinal cord. 2. Atrophy from spinal paralysis.

MYELOMALACIA.—Ischæmic softening of the spinal cord.

MYELOPARALYSIS.—Spinal paralysis, *q. v.*

MYELOPHTHISIS. — Posterior spinal sclerosis.

MYOCLONIA.—A disease in which myoclonus is a prominent symptom, such as paramyoclonus multiplex, electric chorea, Gilles de la Tourette's disease, etc. Vanlair describes an *astasic m.*, in which the myoclonus produces a displacement of the affected member; a *rhythmic m.*, in which the contractions are rhythmical; and a *stasic m.*, in which there is a muscular tumefaction appreciable to sight, touch, and auscultation. Seligmüller calls paramyoclonus multiplex *m. congenita.*

MYOCLONUS.—A clonic spasm or convulsive movement of a muscle or group of muscles.

MYODYNIA.—See MYALGIA.

MYO - ENDOCARDITIS. — Myocarditis and endocarditis occurring together.

MYO-ŒDEMA.—1. Muscular œdema. 2. Idio-muscular contraction—a phenomenon produced in a muscle when a sudden local stimulus is applied to it near its tendinous insertion, causing a nodule to form that soon disappears. Its presence indicates rapid muscular wasting from exhausting disease.

MYOPACHYNSIS.—A muscular thickening. Uhde has applied the term *m. lipomatosa* to the muscular hypertrophy with fatty degeneration that occurs in pseudo-hypertrophic muscular paralysis.

MYOPATHY.—A disease or morbid condition of the muscles.

MYOTONIA.—Muscular spasm. *Congenital m.* is a hereditary disease characterized by the development of tonic cramps when the patient attempts voluntary movements. It has been called Thomsen's disease because he was the first physician to describe it, it having existed in his family for five generations. It develops during childhood, the patient noticing that on attempting to use his muscles there is a painless but temporary spasm or contraction. The muscles of the arms and legs are more frequently implicated than those of the eye, face, or throat. The spasms are increased by cold or emotion. The reflexes and the sensation are normal. The electrical excitability of the nerves is normal; that of the muscles is usually increased; and Erb has described the myotonic reaction, in which the contractions caused by either current slowly attain their maximum and slowly relax, wavelike contractions passing from the cathode to the anode.

Dana believes the disease to be a primary muscular dystrophy, though he concedes that there may be a defect of innervation resulting from some congenital anomaly of the motor tract.

The disease is incurable. Thomsen states that active muscular exercise benefits the patient.

MYXÆMIA.—A mucoid dyscrasia attended with accumulation of mucin in the blood, tissues, and secretions.

NAPA SODA SPRINGS.—Twenty-seven carbonated, saline s's, containing 68·76 grains of salts per gallon, in Napa Co., Cal. Used commercially and as a resort.

NARCOHYPNIA. — Waking numbness, a subjective condition in which there is numbness and temporary paralysis of an extremity on awakening, but no anæsthesia. A. H. Smith, who described it, believed it to be connected with lowering of the circulation, as it disappears by rubbing or spontaneously. The symptoms resemble those caused by the temporary compression of an arm or leg. It is very obstinate. Electricity, strychnine, and mineral acids are used in the treatment.

NARCOLEPSY.—Of Gélineau, a rare neurosis characterized by an overpowering desire to sleep; slumber is generally of short duration, and the paroxysms recur at intervals. It is believed that the trouble is due to paroxysmal vascular or chemical changes in the nervous centers. Females are more often affected than males; the age of attack varies from fifteen to forty. It may be brought on by fright or mental or physical strain, or may occur in dementia. Change of occupation and environment may benefit the patient. Gowers recommends the administration of caffein and nitroglycerin.

The disease may be distinguished from trance by the brevity of the attacks of sleep, by their recurrence, and by the ability to arouse the patient. It is to be distinguished from *petit mal* by its perfect resemblance to ordinary sleep, and the fact that the unconsciousness in the former lasts only a few moments.

NASHVILLE SULPHUR SPRING. —A saline, sulphureted artesian well in Nashville, Tenn. Used locally.

NAUPATHIA.—Seasickness, *q. v.*

NECROMANIA.—Mania in which there is a desire for death or a desire to violate a corpse.

NECROMIMESIS.—Of Mickle, a morbid mental state in which the patient believes himself to be dead.

NECROPHOBIA. — A morbid fear of death or of dead bodies.

NECROPNEUMONIA. — Gangrene of the lung, *q. v.*

NELSON SPRINGS.—Hot s's near Golconda, Humboldt Co., Nev.

NEOPHRENIA.—Of Kahlbaum, primary psychical debility appearing in early youth.

NESTOTHERAPY. — The treatment of disease by fasting.

NEURODERMATROPHIA.—A white, linear, atrophic and anæsthetic streak or spot in the skin caused by disturbed nerve influence.

NEUROLYSIS.—Exhaustion of a nerve by prolonged overstimulation.

NEUROMIMESIS.—A neurosis characterized by simulation of organic disease.

NEUROTABES.—The assemblage of sensory and motor troubles, resembling those caused by posterior spinal sclerosis, that is due to peripheral neuritis. A *peripheric n.* is described that is a peripheral neuritis associated with tabes and causing the localized areas of anæsthesia and hyperæsthesia.

NEUROTROPHASTHENIA. — A condition in which there is defective nutrition of the nervous system.

NEVADA MINERAL SPRINGS.—Three sulphureted s's, flowing 826 gallons per hour, in Vernon Co., Mo.

NEVIEN'S SULPHUR SPRINGS.—Saline, sulphureted s's forming sources of Salt River, Lincoln Co., Ky.

NEW BADEN SPRINGS.—Five alkaline, calcic s's, flowing 500 gallons per hour, containing 61·65 grains of salts, principally calcium bicarbonate and sulphate, per gallon, near Kirksville, Adair Co., Mo.

NEWBURY SPRINGS. — Two sulphureted, calcic, and chalybeate s's, containing 28·96 grains of solids, principally calcium carbonate and insoluble silica, per gallon, in Orange Co., Vt. A resort.

NEW HOLLANDS SPRING.—Three calcic s's, flowing 1,200 gallons per hour, near Gainesville, Hall Co., Ga. A resort.

NEW POINT COMFORT SPRINGS.—See HOSEA SALINE SULPHUR S'S.

NEWPORT SULPHUR SPRINGS.—Four chalybeate and sulphureted s's near St. Mark's, Wakulla Co., Fla. A resort.

NEW RIVER WHITE SULPHUR SPRINGS.—Three sulphureted s's, flowing 150 gallons per hour, having a temperature of 85° F., near Staytide, Giles Co., Va. A resort.

NEW SARATOGA SPRINGS.—Three chalybeate, carbonated s's, flowing 300 gallons per hour, containing 9·87 grains of salts, principally calcium and magnesium bicarbonates, per gallon, in Star Prairie, St. Croix Co., Wis.

NEWSOM'S ARROYO GRAND WARM SPRINGS.—Three sulphureted s's, said to flow 10,000 gallons per hour of water, having temperature from 40° to 100° F., in San Luis Obispo Co., Cal. A resort.

NEW SOUR LAKE.—See SARATOGA S'S, TEX.

NEW SPRING.—A sulphureted, chalybeate s. near Spartanburg, S. C. It has a local reputation.

NEWTON SPRINGS.—Chalybeate s's in Pulaski Co., Ark. A resort.

NIPHABLEPSIA. — Snow blindness; it is due to retinal paralysis resulting from prolonged reflection of light from the snow.

NORTH WATERFORD SPRINGS.—Sulpho-chalybeate s's, containing 7·25 grains of salts, principally iron and aluminum sulphates, in 8,000, in Oxford Co., Me.

NORWALK MINERAL WELL.—A chalybeate s. in Monroe Co., Wis.

NORWOOD SPRINGS.—Chalybeate s's near Pikeville, Bledsoe Co., Tenn.

NOSOMANIA.—An insane fear of disease; it includes syphilophobia, cholerophobia, etc.

NOSOTOXICOSIS.—An abnormal condition referable to the presence of basic products that are formed in the system in disease.

NOTIFICATION OF COMMUNICABLE DISEASES.—In most of the municipalities of the United States the local board of health, by virtue of the authority conferred by the legislation that created the board, or by virtue of special legislation, require all practitioners of medicine to send notice when a case of a communicable disease comes under their care. This service the physician must render without compensation, and subject to the penalty of a fine for neglect or failure to make the report. The diseases that are included as communicable vary in different cities and States.

In some States, the State Board of Health requires local boards to report to it such cases of diseases dangerous to the public health as are reported to them. Recently, Massachusetts has passed a law providing that when the board of health of any city or town has had notice of the occurrence of a case of smallpox or any other disease dangerous to the public health in such city or town, that board of health shall, within twenty-four hours after the receipt of the notice, report the same to the State Board of Health. If the local board refuses or neglects to send such a notice under the circumstances as specified, the town or city shall forfeit its claim upon the Commonwealth for the payment of any expenses that may be incurred in preventing the spread of the disease.

In the city of New York, on the receipt of such notification, a sanitary inspector visits the infected premises. If isolation of the disease can not be secured, he directs the patient's removal to the hospital for infectious diseases, where the patient is cared for as long as necessary, without charge.

In England, in 1889, the law regarding notification of infectious disease was passed, that required notification in London, and authorized sanitary authorities throughout the kingdom to adopt the act if they saw fit. The diseases specified were smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlet fever, typhus fever, typhoid or enteric fever, relapsing fever, continued fever, and puerperal fever; and provision was made for the temporary or permanent addition by any sanitary authority, with the consent of the local government board, of infectious diseases other than those enumerated. The act further provided that the medical practitioner should be paid two shillings and sixpence for each notification of a case in his private practice, or one shilling if the case occurred in his practice as a medical officer to any public body. The law has been adopted by the majority of sanitary authorities, some having added measles, some whooping cough, a few rötheln, and in solitary instances chicken pox and hydrophobia were added to the list of diseases.

On December 1, 1893, a compulsory notification act went into force in France. It was made part of the law regulating the practice of medicine, and provided that every physician, licentiate, or midwife should, as soon as the diagnosis was established, notify the public authorities of every case of epidemic disease coming under their observation. The Paris Academy of Medicine was requested by the law to formulate the list of diseases, and after a very thorough discussion of the subject the following list was adopted: Cholera and choleriform diseases, yellow fever, plague, variola and varioloid, scarlatina, miliary fever, diphtheria (including croup), typhoid fever, typhus fever, dysentery, puerperal infections, and ophthalmia neonatorum.

This latter list is fairly comprehensive, though to-day the feeling is more general that to such a list should be added leprosy, tuberculosis, whooping cough, measles, and rötheln.

The notification of the existence of communicable diseases enables a board of health to follow the spread of such diseases, and to adopt such measures as may be necessary to restrict the prevalence of those diseases to the persons first affected. It makes it possible to investigate the origin of these diseases, and to enforce measures that will tend to prevent their recurrence under similar circumstances. As the greater part of the mortality in all civilized countries is due to communicable diseases, everything that tends to restrict those diseases also tends to increase the expectation of life, and thus to benefit the community. In view of the fact that our American system of imposing fines for failure to report such diseases has failed to attain the desired end, and in view of the fact that such reporting is an important service rendered the State or municipality, it is advised that the present system of attempting to get something for nothing be abandoned, and that physicians be compensated for each report of such diseases that is sent to the Board of Health.

NOT-TAHN-DE-LET SPRING. — An alkaline, saline s. near Keam's Cañon, Apache Co., Arizona.

NUCHALGIA.—Of S. G. Burnett, pain in the back of the head and neck radiating over a region corresponding to the attachment of the ligamentum nuchæ. It is regarded as a symptom of incipient melancholia.

NUCLEIN AND NUCLEIN THERAPY.—Nuclein is the name applied by Miescher to a body he separated from the nuclei of pus corpuscles, and that he subsequently obtained from the segmentation spheres of the yolk of egg and from salmon melt. Plosz has obtained it from the nuclei of the red corpuscles of birds, Hoppe-Seyler from yeast, and Lubavin from casein. Wherever nuclei are found, nuclein has been surmised to exist.

For the following data the writer is indebted to the recent papers of Professor Victor C. Vaughan and Dr. John Aulde.

"Chemically, the nucleins are complex, proteid bodies, characterized especially by the large amount of phosphorus which they contain. The phosphorus exists in the form of nucleinic acid, which is combined with a highly complex basic substance. So far as we know at present, the nucleinic acid of all nucleins is the same, yet the basic part differs in the various nucleins. This basic substance yields, as decomposition products, one or more of the so-called xanthin bodies: adenin, guanin, sarkin, and xanthin. Some nucleins yield only adenin, and these may be designated as adenyl nucleinic acids. Those which furnish xanthin most abundantly may be called xanthyl nucleinic acids. Generally speaking, the nucleins are insoluble in dilute acids and soluble in dilute alkalies. They resist peptic digestion, and in this way may be separated from most other proteid bodies.

"Certain substances which are histologically and functionally nucleins do not yield any xanthin base as a decomposition product. These are now called paranucleins. Some of these are the antecedents of true nucleins. Thus the yolk of the egg contains a paranuclein, which may be isolated by removing the accompanying proteids by peptic digestion. This substance does not yield any xanthin base, but during the process of incubation it develops into a true nuclein.

"Some nucleins are combined with albumins, forming compounds known as nucleo-albumins. When one of these bodies is submitted to peptic digestion, the albumin is converted into a peptone and the nuclein forms an insoluble precipitate. The casein of milk is a nucleo-albumin, the albumin of which is peptonized by gastric digestion.

"Physiologically, nucleins may be said to form the chief chemical constituents of the living parts of cells. Speaking broadly, nuclein is that constituent of the cell by virtue of which this histologic unit grows, develops, and reproduces itself. It is the function of the nuclein of the cell to utilize the pabulum within its reach. It must be evident that those tissues most abounding in cellular elements contain relatively the largest amounts of nuclein. It must also be seen that it is by virtue of their nuclein that the cells of various organs and organisms possess and manifest their individual peculiarities. We should therefore expect to find that the nuclein of the yeast cell is not identical with that of the *Bacillus tuberculosis*, and that the nuclein of the spleen differs from that of the thyroid gland. The number of kinds of nuclein is limited only by the varieties of cells. Nuclein is the chemical basis of that part of the cell designated by the histologist as the nucleus, sometimes called chromatin on account of the readiness with which it absorbs and holds coloring agents. It is the nuclein of the bacterium which takes up and retains the stains, and it is on account of this fact that the nuclein of the *Bacillus tuberculosis* differs from that of other bacilli, that we are able to distinguish the former from the latter by its tinctorial properties. Differences in reaction with staining reagents, so plainly seen under the microscope, are only outward manifestations of less apparent and more important differences in chemical composition."

Vaughan, Novy, McClintock and Kossel, of Berlin, have experimented with nucleins obtained from yeast, eggs, the spleen, thyroid gland, and testes, and have found them to be distinctly bactericidal. Vaughan and McClintock's experiments seem to demonstrate that a nuclein is the germicidal constituent of blood serum, and that it is furnished by the polynuclear white corpuscles.

Nuclein therapy is a therapy based upon the assumption that a powerful antiseptic substance is secreted by the nucleus of the white blood corpuscle. Theoretically, phagocytosis as elaborated by Metschnikoff must depend on something more than the mere influence of the modified white blood corpuscle, and Vaughan's investigations indicate that the something is nuclein. Attempts have been and are being made to adapt nucleins to clinical purposes, on the idea that they will stimulate the activity of the nuclear body of the blood cells, and thus maintain a hæmic antisepsis that will be inimical to the growth and multiplication of micro-organisms.

Vaughan and Huber have found that the subcutaneous injection of from twenty to one hundred and twenty minims of nuclein increases the number of white blood corpuscles; that this increase occurs in both healthy and tuberculous persons; that, with like quantities of nuclein injected, the increase varies with the person—it may be slight, and it may be threefold; that this increase occurs principally in the polynuclear cells, and is evident as a rule as soon as the third hour after treatment, and generally disappears after the forty-eighth hour. They used yeast nuclein and spleen nuclein.

Aulde has given nuclein internally in doses of $\frac{48}{150}$ grain three or four times a day. He states that it causes no unpleasant symptoms; the patients feel exhilarated, and improve.

The administration of nuclein is indicated in malaria, diphtheria, typhoid fever, tonsillitis, dermatoses, and tuberculosis in its initial stages; but further experiment is necessary to determine the therapeutic value of nuclein, or whether it has a therapeutic value.

NUNDA MINERAL SPRINGS.—Three saline s's, flowing 30 gallons per hour, in Livingston Co., N. Y. The water contains 104·10 grains of calcium carbonate, 1·05 grains of iron carbonate, 184·41 grains of calcium sulphate, 203·58 grains of magnesium sulphate, 6·82 grains of sodium chloride, and traces of alumina and silica, in each gallon. It is a resort, and the water is sold.

NUPTIOMANIA.—Of Morselli, a variety of delusional insanity in which the predominant idea is the expectation of marriage with a person of higher social station.

NURSE'S CONTRACTURE.—A term applied by Trousseau to tetany, because he first observed the disease in nursing women.

NYCTOPHOBIA.—A morbid dread or fear of night.

OAK ORCHARD ACID SPRINGS.—Eight acid and chalybeate s's in Alabama, Genesee Co., N. Y. Analyses of the waters by J. R. Chilton, E. Emmons, and Porter give the following constituents:

	Spring No. 1.	Spring No. 2.	Oak Orchard acid water.
	Grains per gal.	Grains per gal.	Grains per gal.
Sodium sulphate		...	3·16
Calcium sulphate	39·60	12·41	13·72
Potassium sulphate	.	...	2·48
Aluminum sulphate	9·68	...	6·41
Magnesium sulphate	6·28	4·98	8·49
Iron sulphate	...	39·28	....
Iron protosulphate	14·32	...	82·22
Sodium chloride	.	....	1·43
Silica	1·04	1·84	3·33
Organic matter	3·28	10·88	6·65
Sulphuric acid	82·96	129·06	133·31

The amount of free sulphuric acid in these waters is very high. The water is taken in doses of from half a wineglass to a wineglassful three times a day, being first diluted with an equal quantity of pure water.

OBSESSION.—In psychiatry, the delusion of being possessed by demons.

OCEAN SPRINGS.—Saline, sulphureted s's, containing 61·33 grains of salts per gallon, on the Gulf coast, in Jackson Co., Miss. A resort.

OCHEE SPRINGS. — Twelve alkaline, calcic s's, flowing 500 gallons per hour, near Providence, R. I. The water is sold.

OCONEE CHALYBEATE SPRINGS.—Chalybeate s's near Eatontown, Putnam Co., Ga. They have a local reputation.

OCONEE WHITE SULPHUR SPRING.— A sulphureted s. near Gainesville, Hall Co., Ga. A resort.

ŒSOPHAGALGIA.—Pain in the œsophagus.

ŒSOPHAGEURYSMA.—Morbid dilatation of the œsophagus.

ŒSOPHAGOCELE.—A general or partial dilatation of the œsophagus, forming a diverticulum. See Œsophagus, Diseases of, p. 254.

ŒSOPHAGOSTENOSIS. — Stricture of the œsophagus.

OGEMAW MINERAL SPRINGS.—Eight chalybeate s's in Ogemaw Co., Mich. They have a local reputation.

OHIO MAGNETIC SPRING.—An alkaline, calcic s., flowing 750 gallons per hour, in Union Co., Ohio. A resort.

OIKOPHOBIA.—A monomania in which a patient has an unconquerable aversion to his home, and becomes worse if taken there.

OJO AZUFRE. — Sulphureted s's near Fort Wingate, Bernalillo Co., New Mexico.

OJO CALIENTE (JOSEPH'S), N. M.—Four alkaline, saline, and thermal s's, flowing 6,000 gallons per hour, having temperatures from 108° to 112° F., one containing 260·21 parts, a second 254·30 parts of salts, principally sodium carbonate, in 100,000, near Barranca, Taos Co., New Mexico. A resort.

OLD RED SPRING.—See Saratoga S's.

OLESON'S SULPHUR SPRINGS.—Sulphureted s's in Walworth Co., Wis.

OLIGIDRIA.—A diminution in the normal amount of perspiration. See Sudoriparous Glands, Diseases of, p. 942.

OLIGOCHROMÆMIA. — A diminution in the normal quantity of hæmoglobin. The degree of o. may be determined by the hæmometer.

OLIGOCHROSIS.—Diminution of hæmoglobin in the individual blood corpuscles.

OLIGOCYTHÆMIA.—Deficiency of red blood corpuscles. The degree of o. may be determined by the hæmacytometer or the hæmotocrit.

OLIGOMANIA. — A form of insanity which, although potentially affecting all the mental faculties and operations, apparently involves only a part, such as the emotions, the intellect, or the will, or certain manifestations only of a mental faculty.

OLIGOZOÖSPERMIA.—That variety of male sterility in which the spermatozoöids are diminished in number and activity.

OLIGURIA.—A diminution in the quantity of urine excreted. It occurs in febrile conditions and in circulatory disturbances.

OLIVER SPRINGS. — Six sulphureted and chalybeate s's, flowing 150 gallons per hour, in Anderson Co., Ky. A resort.

OLYMPIAN SPRINGS. — Ten saline sulphureted s's in Bath Co., Ky. They are named Salt Sulphur S., Black Sulphur S., White Sulphur S., Main Chalybeate S., Chalybeate S., Salt Lick, Epsom Well, Tea S., and Kitchen Well. The waters contain from 0·293 to 6·28 parts of solid constituents in 1,000.

ONIOMANIA. — A mania for spending money for all kinds of articles, useful and useless.

ONOMATOMANIA.—That condition of an insane person in which the impression produced by the mention of a particular word, like that produced by some special chance occurrence, habitually awakens memories that lead to an exacerbation of the morbid mental symptoms.

The term is also applied to a functional derangement of the speech centers occurring in certain nervous and mental diseases, as a result of which the patient is possessed by an agonized effort to recall some particular word, by an irresistible impulse to repeat a given word continually, or by a dread of some commonplace word on account of some meaning attached to it or on account of its associations.

OÖPHORITIS.—Inflammation of the capsule or of the tissues composing the stroma of the ovary. See Ovary, Diseases of.

OÖPHOROMANIA. — A psychosis described by Skae in which there is insanity due to disease or disturbance of the female genitalia, and that is commonly accompanied by delusions regarding sexual intercourse.

OÖPHOROPATHY.—Any ovarian disease.

OPAL SPRING. — See Gibbon Geyser Basin.

OPHTHALMOPLEGIA. — Paralysis of one or more muscles of the eyeball. It may be *nuclear*, in consequence of a lesion of the centers for the third, fourth, or sixth nerves; or it may be *external*, and affect one or more of the extrinsic muscles of the eyeball; or *internal*, and involve the muscles of the iris or the ciliary muscles, or both; or *partial*, affecting one or two of the muscles; or *total;* or it may be *progressive*, many or all of the muscles of both eyes gradually becoming paralyzed, and finally producing symmetrical immobility of the eyeballs with more or less ptosis.

OPIOKAPNISM. — Addiction to opium smoking. The systemic disturbances it produces are described under Morphinism, *q. v.*

OPIOPHAGISM. — Addiction to opium eating. See Morphinism.

OPISTHOPORIA. — Walking backward when forward locomotion is attempted. It is a very rare symptom, and has been reported in a case of alcoholism.

OPSOMANIA.—An uncontrollable desire for dainty or sweet food.

ORANGE SPRING.—A saline, sulphureted s., flowing 5,055,000 gallons per hour, in Marion Co., Fla. A resort.

ORCHIALGIA. — Neuralgia of the testicle.

ORCHICHOREIA. — Choreiform movements of the testicle in consequence of spasmodic contractions of the cremasteric muscle, the condition being usually associated with orchialgia. O. may be *simple*, affecting only one testicle; or *complete*, affecting both glands; or *alternating*, affecting first one testicle and then the other.

ORGANOPATHY.—An organic disease. W. Sharp applied the term to the theory of the action of particular drugs on particular organs.

ORKNEY SPRINGS.—Twenty-three alkaline, calcic s's, flowing 572 gallons per hour, one containing 20·89 grains of salts, another 20·10 grains of salts, per imperial gallon, in Shenandoah Co., Va. A resort.

ORRICK'S SULPHUR SPRING.—A sulphureted s. near Berkeley Springs, Morgan Co., W. Va.

OSMOMETER.—An instrument for measuring the acuteness of the sense of smell. A simple o. may be made by using several vials containing solutions of oil of cloves in different strengths. See Olfactory Nerve, Disorders of.

OSTEALGIA.—Pain in a bone.

OSTEO-ARTHRITIS. — Rheumatic arthritis.

OSTEOCAMPSIA. — The curvature of bones caused by osteomalacia.

OSTEOCARCINOMA. — Carcinoma arising from bone. Also a carcinoma in which there is calcareous degeneration.

OSTEOCHONDROMA. — A neoplasm composed of osseous and cartilaginous tissues.

OSTEOLYSIS. — Softening and destruction of bone, as in caries.

OSTEOPATHY.—Any disease of bone.

OTOMYCOSIS. — Parasitic inflammation of the external auditory meatus.

OTOPATHY.—Any disease of the ear.

OTT'S WELL.—A saline spring, containing 5,328·75 grains of salts, 401·09 of which are calcium and 107·04 magnesium bicarbonates, per imperial gallon, in Mifflin, Crawford Co., Ind.

OTTUMWA MEDICAL SPRINGS.—An alkaline, saline s., flowing 40 gallons per hour, containing 356·45 grains of salts, 200·88 of which are sodium sulphate, per gallon, in Wapello Co., Iowa. A resort, and the water is sold.

OURAY MINERAL SPRINGS.—Nine alkaline, carbonated, sulphureted hot s's, having temperatures from 120° to 140° F., in Ouray Co., Col.

OVARIOCELE.—A hernia of the ovary. See Ovary, Hernia of.

OWATONNA MINERAL SPRINGS.—Nine alkaline, calcic s's, one containing 85·02 grains, a second 22·82 grains of salts per gallon, in Steele Co., Minn.

OWEN'S LAKE.—See Castalian Mineral Water.

OWEN'S MINERAL WELL.—A saline, sulphureted spring, containing 3,004·14 grains of salts per imperial gallon, in Ypsilanti, Mich. The water is sold.

OWOSSO CHALYBEATE SPRING.—A chalybeate s., containing 63·40 grains of salts per gallon, in Shiawassee Co., Mich. A resort.

OXFORD SPRING.—A chalybeate s., containing 6·22 grains of salts per gallon, in New Haven, Conn. The water is sold.

PACIFIC CONGRESS SPRINGS.—Saline, chalybeate s's, containing 335·85 grains of salts, principally sodium carbonate and chloride, per gallon, near San José, Cal. A resort, and the water is sold.

PAGOSA SPRINGS.—Four hot soda s's, having a temperature of 148° F., in Conejos Co., Col. A resort. The waters contain about 325 grains of salts per gallon, about 220 of which are sodium sulphate.

PAHGUN SPRING.—A hot s., having a temperature of 100° F., in Mohave Co., Arizona.

PAINT LICK MINERAL WELL.—A saline spring in Garrard Co., Ky.

PALO PINTO MINERAL WELL.—About one hundred and forty springs in Palo Pinto Co., Tex. The constituents vary in quantity, the water of one spring containing 226·23 and of another 33·24 grains per gallon. The principal salts are sodium and magnesium sulphates and sodium chloride.

PANACEA SPRINGS.—Thirteen saline, carbonated, and chalybeate s's, flowing 3,700 gallons per hour, one containing 9·79 grains of salts per gallon, in Halifax Co., N. C. A resort.

PANNEURITIS.—A general inflammation of the peripheral nerves. See Neuritis.

PANOPHOBIA.—A symptom in certain psychoses, especially melancholia, characterized by a great anxiety about everything, especially the immediate interests of life, and a general fear regarding the ultimate results of all actions.

PARACUSIS. — Any morbid condition that affects the hearing. There may be *p. acris*, in which the hearing is painfully acute and intolerant of moderate sound; or *p. duplicata*, in which all or certain sounds are heard double; or *p. imaginaria*, in which there is *tinnitus aurium*; or *p. loci*, in which there is inability to distinguish the direction from which a sound comes; or *p. Willisii*, in which the hearing of deaf people is improved during the continuance of loud noises, such as those made by railroad or street cars. See Hearing.

PARAGAMMACISMUS. — Inability to pronounce *g*, *k*, or the guttural *ch* and the substitution of other consonants therefor.

PARAGEUSIA.—Inability to distinguish differences in taste. See Taste, Disorders of.

PARAISO SPRING.—A saline s., having a temperature of 118° F., containing 58·80 grains of salts per gallon, near Soledad, Monterey Co., Cal. A resort.

PARAKINESIS. — A supposed qualitative change in motor activity analogous to paresthesia.

PARALALIA.—A partial impairment of the power of speech.

PARALAMBDACISMUS.—Inability to pronounce *l*, other letters being substituted therefor.

PARALEXIA.—Inability to read words as they are written.

PARAMNESIA.—A morbid state described by Lordat in which there is an erroneous use of known and remembered sounds.

PARAMUSIA.—A variety of aphasia in which there is a disturbance of musical expression, false tones and intervals being employed.

PARANOIA.—While this term has been applied loosely to various mental conditions, American alienists apply it to a functional insanity that starts from a degenerative condition that is characterized by a special deviation of the highest mental functions, but that does not imply either serious weakness or general disorder of the mind. English alienists use the term "delusional insanity" to describe the condition, as chronic and systematized delusion is the essential sign. It may be due to insane inheritance, or develope slowly as in ordinary mania and melancholia. The course of the disease is chronic.

PARAPHASIA.—Aphasia characterized by the substitution of words that are insufficient to express the idea that the person intends to convey. It may be *choreiform* in expression and due to chorea, or *commissural* and due to injury of the commissural nerve fibers of the brain, or *paretic* and due to paralysis, or *spastic* in consequence of muscular spasm.

PARAPHRASIA. — Incoherent speech depending on defective concepts. It may be *precocious*, when the ideas are formed and expressed too hurriedly; or *tardy*, when they are formed and expressed too slowly; or there may be *p. thematica*, in which there is great confusion of ideas and the thread of the discourse is lost sight of; or *p. verbalis*, in which an inappropriate word or idea is unconsciously employed.

PARAPLEGIA, ALCOHOLIC. — P. caused by alcohol. S. Wilks considered it of spinal origin, but the pain in all the limbs, the myatrophy, and the acinesia indicate that it is often a multiple neuritis due to alcoholism.

PARAPLEGIA, APOPLECTIC. — A double paralysis resulting from an old and a recent hæmorrhage into the motor centers, or from circumscribed lesions in the median portion of the pons, or from aneurysm at the base of the brain. It may be distinguished from *spinal p.* by the absence in the latter of motor paralyses of the cranial nerves.

PARAPLEGIA, CATALEPTIFORM.—A p. described by Benedikt that is characterized by motor disturbances that are shown by the persistent resistance by muscular conduction of voluntary impulse. The disorder affects all the muscles of the body, including those of the eyes. It is probably of hysterical origin.

PARAPLEGIA, DYSENTERIC. — A rare complication in dysentery in which paresis of the inferior extremities, hyperæsthesia, and pain occur, and are followed by anæsthesia and complete paraplegia. It is undoubtedly due to auto-intoxication, and is probably the consequence of multiple neuritis.

PARAPLEGIA, ENTERIC.—See PARAPLEGIA, DYSENTERIC.

PARAPLEGIA, HYPERTROPHIC, OF INFANCY.—Pseudo-hypertrophic muscular paralysis.

PARAPLEGIA, HYSTERO-TRAUMATIC. — Charcot applied this term to a hysterical paraplegia supervening upon slight traumatism.

PARAPLEGIA, PAINFUL.—A form of p. described by Cruveilhier and by Charcot in which the paralysis comes on gradually and is associated with dosodynia. The latter is due to compression of the posterior columns of the cord by neoplastic tissue.

PARAPLEGIA, PHIMOSAL.—A term applied by C. E. Beardsley to the reflex p. caused by phimosis.

PARAPLEGIA, SPASTIC.—P. caused by primary lateral sclerosis of the spinal cord. See SPINAL CORD, DISEASES OF.

PARAPLEGIA, TOXIC.—P. caused by ptomainic, leucomainic, mineral, vegetable, or gaseous poisoning; it is usually the result of a primary peripheral neuritis.

PARAPLEGIA, URINARY.—A paretic or paralytic affection, described by Charcot, of the lower extremities, supervening in the course of certain diseases of the urinary passages, and appearing to be connected with the latter as a consecutive disorder.

PARASIGMATISMUS. — Inability to pronounce *s* or *sh*, other sounds being substituted therefor.

PARIS CHALYBEATE SPRINGS.—Three s's, flowing 250 gallons per hour, in Lawrence Co., Mo. A resort.

PARKERSBURG MINERAL WELLS.—Ten saline, carbonated springs, flowing 40 gallons per hour, containing 84 grains of salts per gallon, near Parkersburg, W. Va.

PARK'S ALKALINE MINERAL SPRING.—A calcic s., flowing 50 gallons per hour, containing 14·93 grains of salts per gallon, near Pelham, Caswell Co., N. C.

PARNASSUS SPRINGS.—Five carbonated, saline, and sulphureted s's, one containing 333·75 parts of salts, another 333·92 parts, and a third 217·21 parts in 100,000, near Beulah, Pueblo Co., Col. They have a local reputation. The principal constituents are sodium and magnesium carbonates and sodium chloride.

PAROQUET SPRINGS. — Saline, sulphureted s's, containing 442·40 grains of salts, 309·60 of which are sodium chloride and 67·71 calcium chloride, per gallon, near Shepherdsville, Bullitt Co., Ky. A resort.

PARURIA.—Any morbid excretion of urine.

PATE SOUR WELL.—An acid, calcic, chalybeate spring, containing 188·98 grains of salts, principally calcium, ferric, and magnesium sulphates, per gallon, in Sulphur Springs, Hopkins Co., Tex.

PATHOPHOBIA.—A morbid dread of disease.

PAVILION SPRING. — See SARATOGA SPRINGS.

PAYTON MINERAL SPRING.—An alkaline s., flowing 225 gallons per hour, in Douglas Co., Ore. A resort.

PEABODY SPRINGS. — See SELTZER MINERAL S'S.

PEACOCK SPRING.—A sulphureted s., flowing from 600 to 1,800 gallons per hour, in Rensselaer, Jasper Co., Ind.

PEARL GEYSER, YELLOWSTONE PARK, WYO.—See GIBBON GEYSER BASIN.

PEARSON'S SPRINGS.—Five alkaline, sulphureted s's in Lake Co., Cal. A resort.

PECAN SPRING.—A s., flowing 21,600 gallons per hour, near Cherry Spring, Gillespie Co., Tex.

PEDICULOPHOBIA.—Monomania characterized by a morbid dread of lice.

PENNYWITS SULPHUR SPRINGS.—Sulphureted s's in Crawford Co., Ark. A resort.

PERIARTERIITIS. — Inflammation of the outer coat of an artery. See ARTERY, DISEASES OF.

PERIARTHRITIS. — Inflammation of the tissues about a joint. See JOINTS, DISEASES OF.

PERIBRONCHITIS.—Inflammation of the tissue surrounding the bronchi. See BRONCHI, DISEASES OF.

PERICHOLECYSTITIS.—Inflammation of the tissues about the gall bladder.

PERICOLPITIS. — Inflammation of the connective tissue surrounding the vagina.

PERICYSTITIS.—Inflammation of the connective tissue surrounding the bladder.

PERIGASTRITIS.—Inflammation of the peritoneal coat of the stomach.

PERILYMPHANGEIITIS. — Inflammation of the adventitia of a lymphatic vessel.

PERIMENINGITIS.—Cerebral or spinal pachymeningitis.

PERIMETRITIS.—Inflammation of the peritoneal coat of the uterus. See PELVIC PERITONITIS.

PERIMYELITIS.—Spinal meningitis.

PERIŒSOPHAGITIS. — Inflammation of the connective tissue surrounding the œsophagus.

PERI-OÖPHORITIS. — Inflammation of the ovarian peritonæum.

PERIPHLEBITIS. — Inflammation of the external coat of a vein.

PERISALPINGITIS. — Inflammation of the tissues about the Fallopian tube.

PERISPLENITIS.—Inflammation of the tissues about the spleen. In *capsular p.* the peritoneal covering of the spleen is affected.

PERRY COUNTY WARM SPRING.—An alkaline, calcic s., flowing 5,400 gallons per hour, near Harrisburg, Pa. Once a resort.

PERRY SPRINGS.—Three saline, sulphureted, and chalybeate s's, one containing 40·17 grains, a second 38·24 grains of salts per gallon, in Pike Co., Ill. A resort.

PERRYVILLE SALT WELL.—A saline spring in Perry Co., Ark.

PETROLEUM SPRING.—A hot s., having temperature of 96° F., on the island of Paoha, in Mono Lake, Mono Co., Cal.

PFISTER'S MINERAL SPRING.—A s. near Junction City, Davis Co., Kan. The water contains 324·24 grains of salts per gallon, including sodium chloride 119·28, sodium sulphate 92·40, magnesium sulphate 58·24, and calcium sulphate 44·80 grains.

PHÆOMYELITIS.—A term applied by Martineau to acute generalized inflammation of the gray substance of the spinal cord.

PHALANGITIS. — Inflammation of a phalanx.

PHALLALGIA.—Pain in the penis. See PENIS, DISEASES OF.

PHALLITIS.—Inflammation of the penis.

PHIFER'S CHALYBEATE SPRINGS.—Chalybeate s's in Fayette Co., Ill.

PHLEBEPATITIS. — Inflammation of the hepatic or portal veins.

PHLEBOSTENOSIS.—Stenosis or occlusion of a vein.

PHONOPHOBIA. — A morbid fear of sounds.

PHOSPHORIDROSIS.— Phosphorescent perspiration.

PHTHISIOPHOBIA.—A morbid dread of phthisis.

PHTHISIURIA. — A state resembling that due to pulmonary tuberculosis, but caused by disease of the kidneys.

PICKWICK WHITE AND RED SULPHUR SPRINGS.—Sulphur s's near Walnut Grove, Hardin Co., Tenn. A resort.

PIEDMONT SPRINGS.—Two chalybeate s's near Danbury, Stokes Co., N. C. A resort.

PIMELOSIS.—A more correct name for adiposis.

PIMELURIA.—The excretion of urine containing fatty matter. Chyluria.

PINE GROVE MINERAL SPRING.—A calcic, chalybeate s., flowing 60 gallons per hour, containing 15·52 grains of salts per imperial gallon, in Amherst, Hillsborough Co., N. H. A resort.

PINKERTON SPRINGS.—Alkaline s's, having temperature of 95° F., near Trimble, La Plata Co., Col.

PINKHAM MINERAL SPRING OR WELL.—A calcic s. near Seattle, Wash.

PITCHER SPRINGS.—Sulphureted s's in Chenango Co., N. Y.

PITTSFORD SULPHUR SPRINGS.—Sulphureted s's in Monroe Co., N. Y.

PLAINFIELD SPRING.—A sulphureted s. in Washington Co., Vt. Once a resort.

PLANARTHRAGRA.—Wandering articular gout. See GOUT.

PLANOMANIA. — A monomania for wandering.

PLEURALGIA.—Neuralgia of the intercostal nerve.

PLUMBISM. — The systemic condition produced by lead poisoning. See LEAD, POISONING BY.

PLUTOMANIA.—A variety of megalomania in which the person affected believes he is very wealthy.

PNEUMAPYOTHORAX. — Thoracic empyema with the formation of gas.

PNEUMARTHROSIS.—The formation of gas in a joint.

PNEUMATOCARDIA. — Accumulation of gas in the cavities of the heart.

PNEUMATOSIS. — A morbid condition characterized by the presence of gas where in health it does not occur, or by an excess of gas in a natural situation.

PNEUMATOTHERAPY. — The treatment of disease by the use of compressed or rarefied air.

PNEUMATURIA.—The presence of free gas in the urine. It may occur in cystitis.

PNEUMONOCONIOSIS.—Infiltration of the lung and of the bronchial glands with particles of inhaled foreign matter.

Those who pursue their occupations in a dusty or gritty atmosphere, who are constantly inhaling fine particles of coal, cotton, felt, flax, flint, iron, jute, lime, mother-of-pearl, straw, or wood, as is the case with miners, weavers and spinners, potters, grinders and metal workers, stone masons, chaff cutters, and others, are subject to irritation in the larger bronchi due to the presence of these particles. The bronchi become thickened, there is excessive secretion, a tendency to bronchial spasm, and the lung tissue becomes indurated and consolidated.

Post-mortem examination shows the lungs to be deeply pigmented, consolidated, and to contain large quantities of the inhaled particles. The latter may even be found in the bronchial glands. The lungs are invaded by fibroid tissue, and the pleura thickened and often adherent. Tubercle bacilli have been found in caseous masses, but not in the fibrosis. Persons so employed have an habitual dry cough with recurring bronchitis and subsequent emphysema, and sometimes there are asthmatic paroxysms. As the disease progresses the cough becomes moist, the percussion note is dull, the expectoration contains some of the inhaled particles, and the patient loses strength and weight. Eventually signs of cavities appear. The course of the disease is chronic.

The treatment of the condition is hygienic, by better ventilation of workshops and mines, especially the employment of forced draughts and the use of respirators to filter the inspired air, and the temporary abandonment of the occupation by the affected person. See PHTHISIS.

PNEUMONŒDEMA.—Pulmonary œdema. See LUNGS, ŒDEMA OF.

PNEUMONOLITH.—A pulmonary calculus. It may be formed by an aggregation of particles of inhaled mineral matter as in chalicosis, or it may be the result of calcareous degeneration of a tubercle.

PNEUMONOMYCOSIS. — A disease of the lungs caused by the presence of *fungi*, as the *Aspergilli*, *Sarcinæ*, etc.

PNEUMONOSTENOSIS. — Contraction of a lung.

PNEUMOPERITONITIS. — Peritonitis with the formation of gas in the peritoneal cavity. See PERITONÆUM, DISEASES OF.

PNEUMOPYOTHORAX.—The presence of pus and gas in the pleura.

PNEUMOSEROTHORAX. — Pneumothorax with a serous effusion.

POLAND SILICA SPRINGS.—Three alkaline s's, flowing 480 gallons per hour, one containing 14·29, another 3·95 grains of salts per gallon, in South Poland, Me. A resort, and water is sold.

POLAND SPRING. — An alkaline s., flowing 490 gallons per hour, containing 3·75 grains of salts per gallon, in South Poland, Me. A resort.

POLIENCEPHALITIS. — A term applied by Strümpell to inflammation of the gray matter of the cerebral cortex. See BRAIN, DISEASES OF.

POLIOMYELITIS.—Inflammation of the gray matter of the cord. See SPINAL CORD, DISEASES OF.

POLLARD'S MINERAL WELL.—A sulphureted spring, containing 1·22 grains of salts in 1,000, near Crab Orchard, Lincoln Co., Ky.

POLYÆSTHESIA. — A sensory abnormity in which a single point touching the skin is felt as more than one.

POLYCYTHÆMIA. — A condition in which there is an excess of red corpuscles in the blood.

POLYMYOSITIS.—Simultaneous inflammation of a number of muscles. An acute progressive p. has been described in which all the muscles are affected, they swell and suppurate, and the disease terminates fatally. This disease is probably of microbic origin.

POLYPHRASIA.—A term applied to the morbid garrulity present in some psychoses.

PONCE DE LEON SPRING.—A chalybeate s., flowing 100 gallons per hour, in Atlanta, Ga.

PONCHO HOT SPRINGS.—One hundred s's, flowing 1,000,000 gallons per hour of water having a temperature of from 90° to 168° F., in Chaffee Co., Col. A resort.

PORENCEPHALUS. — A condition in which, owing to congenital nutritional defects, cavities or depressions exist in the cerebral hemispheres. These hollows are mostly on the surface and extend to various depths in the cerebral hemispheres; they are filled with serous fluid, and they represent areas of partial cerebral atrophy. The condition may be due to prenatal hæmorrhage, thrombosis, or embolism, or to injuries at birth.

PORTER SPRINGS.—One hundred chalybeate s's, flowing 800 gallons per hour, in Lumpkin Co., Ga. A resort.

PORTER'S SPRINGS, COL.—Sulpho-chalybeate s's in Denver, Col.

PORTER'S SPRINGS, TEX.—Chalybeate and sulphureted s's in Houston Co., Tex.

POWDER SPRINGS.—Four sulphureted, chalybeate s's, flowing 150 gallons per hour, one having 21·36 grains of salts per gallon, in Cobb Co., Ga. A local resort.

POWHATAN LITHIA AND ALUM SPRINGS.—Four chalybeate s's near Ballsville, Powhatan Co., Va.

PRESBYCUSIS.—Diminution in the power of hearing. See HEARING, DISORDERS OF.

PRESBYOPHRENIA. — Senile dementia.

PRICE'S CHALYBEATE SPRING.—A chalybeate s., near Eric, Loudon Co., Tenn. A local resort.

PRIMM'S SPRINGS.—Five calcic, sulphureted s's, flowing 515 gallons per hour, one containing 81·53 grains of salts, principally calcium, magnesium, and sodium sulphates, per gallon, in Hickman Co., Tenn. A resort.

PROCTALGIA.—Neuralgia of the rectum. See RECTUM, DISEASES OF.

PROCTOPARALYSIS—PROCTOPLEGIA.—Paralysis of the sphincters ani.

PROPEPTONURIA. — The presence of propeptone in the urine. See ALBUMOSURIA.

PSEUDOCHROMÆSTHESIA. — An anomaly in the perception of visual sensations in which the vowels in words appear colored; often each has a separate tint.

PSEUDOLIPOMA.—A localized œdematous infiltration occurring especially above the clavicle or about the knee that is observed in rheumatism.

PSEUDONOMANIA.—A form of moral insanity in which there is marked propensity for lying.

PSEUDOSCLEROSIS.—A general neurosis described by Westphal that simulates multiple sclerosis of the brain and spinal cord.

PSYCHOMETRY.—The measurement of the sense relations of mental phenomena.

PSYCHOPARESIS. — Mental enfeeblement.

PSYCHOSIS.—Any disease of the mind.

PSYCHROPHOBIA.—A morbid dread of cold.

PTOMAINÆMIA. — Infection of the blood by a ptomaine.

PULASKI ALUM SPRINGS. — Three chalybeate s's, flowing 178 gallons per hour, containing 137·96 grains of salts, principally iron and aluminum sulphates, per gallon, in Dublin, Pulaski Co., Va. A resort, and water is sold.

PULLER'S SPRINGS. — Two hot s's, having temperatures of 102° to 110° F., in Madison Co., Mont. A resort.

PUROHEPATITIS.—Suppurative hepatitis. See LIVER, DISEASES OF.

PUTNAM SPRINGS. — See SARATOGA SPRINGS.

PYLANT'S SPRINGS. — See CASCADE SPRINGS.

PYLETHROMBOSIS. — Thrombosis of the portal vein.

PYOPERICARDITIS. — Suppurative pericarditis.

PYOPERITONITIS. — Suppurative peritonitis.

PYROPHOBIA.—Morbid dread of the danger of fire.

QUARANTINE IN THE UNITED STATES.—Quarantine "may be defined as a period of varying length during which persons coming from localities where epidemic disease exists are detained for the purpose of observation at the locality where they arrive. It may be seen that this applies to an inland as well as to a seaport town; the period of observation may be as brief as in a sanitary-inspection service or include a detention of several days; and inferentially the term includes a properly equipped establishment for the residence, if necessary, of well persons who are detained for observation; a hospital for caring for any that may be taken ill; appliances and apparatus for disinfecting clothing and baggage; and a suitable corps of physicians, trained nurses, and other employees necessary for the effective administration of the establishment.

The sixth section of chapter 534 of the Statutes of the State of New York provides that the diseases against which maritime sanitary regulations apply are yellow fever, typhus or ship fever, relapsing fever, cholera, smallpox, scarlatina, measles, diphtheria, or any disease of a contagious, infectious, or pestilential character which shall be considered by the health officer dangerous to the public health. The quarantine laws or regulations of most of the States include these diseases, and the regulations of the United States add leprosy to the list. Some of these diseases are so familiar to us that in our daily life we give them but little heed, while others arouse in the mind when mentioned a dread that is the consequence of a knowledge, vague though it may be, of the ravages they have committed by their epidemic manifestation. Those of the contagious or infectious diseases that are endemic in America may, in a series of years, cause as many or more deaths in a locality than are the consequence of an epidemic of one of the exotic contagious or infectious diseases. For among the many blessings conferred upon our country is that of not being the *fons et origo* of any epidemic disease: and the epidemics of yellow fever, typhus fever, smallpox, and cholera that have ravaged this country have always been imported.

"One of the fundamental duties of the State is that of protecting the lives, and consequently the health, of its citizens; and we may infer that both State and national Legislatures regard quarantine as one of the means of protecting the people from infectious diseases, as all of our maritime States have enacted quarantine laws, and as early as 1799 Congress enacted its first law on the subject." It provided that the quarantines and other restraints established by the health laws of any State should be duly observed by the local officers of the Treasury and War Departments; and it further required that these officers should faithfully aid in the execution of such quarantine and health laws, according to their respective powers and within their respective precincts, as they shall be directed, from time to time, by the Secretary of the Treasury. This statute further provided for the discharge of the cargo of a vessel in quarantine, and for the deposit of the goods in warehouses that shall be purchased or erected under orders from the President.

Based upon the provisions of this law, that clearly recognized the right of the States to enact quarantine laws, is the law of April 29, 1878, that confers upon the Surgeon General of the Marine Hospital Service authority to frame all needful rules and regulations for the purpose of enforcing quarantine, in the event of any contagious or infectious disease appearing in any foreign port or country. This law also explicitly states that these rules and regulations shall not conflict with or impair any State or municipal quarantine laws. This statute further provides, in section five, that local quarantine officers shall, upon the application of "the respective State or municipal authorities, be authorized to act as officers or agents of the national quarantine system and shall be clothed with all the powers of United States officers for quarantine purposes, though receiving no pay or emolument from the United States. It is provided that vessels coming from a foreign port or country where cholera or yellow fever exists, or smallpox is known to have existed in an epidemic form within thirty days preceding their arrival, and vessels or vehicles conveying any person or persons, merchandise, or animals affected with any contagious disease or having had the latter on board within thirty days preceding their arrival, shall not enter any port of the United States until disinfected, and certified to be so by a medical officer of the Marine Hospital Service, or other agent of the Treasury Department.

"This latter section would seem to necessitate a sanitary inspection of all vessels entering a port by one of the officials above specified. And the present Attorney-General has decided that this act in general empowers the national Executive to supplement the State statutes and regulations wherever and whenever necessary.

"In August, 1888, Congress enacted a law that provided a penalty for trespass upon quarantine territory under the jurisdiction of the United States, as well as a penalty for violation of any of the quarantine regulations; and also made appropriations for the establishment of certain quarantine stations; and in March, 1890, a law was enacted to prevent the introduction of contagious diseases from one State to another, and for the punishment of certain offenses of violation of the quarantine laws and of the rules and regulations that had been framed by the Surgeon General of the Marine Hospital Service for the administration of quarantine. This has been referred to as the Interstate Quarantine law."

A law was enacted February 15, 1893, entitled "An Act granting additional quarantine powers and imposing additional duties upon the Marine Hospital Service." It provides, first, that no vessel shall enter a port of the United States from a foreign port without a bill of health, signed by the United States consul or a medical officer of the United States Government; and provides a penalty of five thousand dollars to be imposed on any vessel coming into American waters without such bill of health. Furthermore, the vessel shall not be admitted to entry except in accordance with other provisions of the act, and with such regulations of State and municipal authorities as may be made consistently therewith; and before being permitted to enter or discharge its cargo or land its passengers a certificate must be obtained from the health officer at the quarantine station, certifying that the rules and regulations have in all respects been complied with, both on his part and on the part of said vessel and its master. This bill of health and the quarantine certificate are to be delivered to the collector of customs.

The Secretary of the Treasury is directed to make rules and regulations to be observed by vessels at ports of departure and on the voyage, and the President may detail a medical officer of the Government to serve in the office of the consul at any foreign port for the purpose of making the necessary inspection of vessels, to see that the regulations are complied with, to sign the bills of health, and to furnish information.

Consular officers are required to be notified by the Secretary of the Treasury of the regulations made with regard to vessels, cargoes, passengers, and crew at ports of departure and on the voyage; and of the regulations also to be observed in the inspection and treatment of vessels on arrival at ports of destination in the United States. The Supervising Surgeon General of the Marine Hospital Service is required to examine the quarantine regulations of all State and municipal boards of health, and at ports or places which are found to have no quarantine regulations under State or municipal authority, where such regulations are, in the opinion of the Secretary of the Treasury, necessary, and at ports or places where State or municipal regulations exist which, in the opinion of the Secretary, are not efficient, the Secretary is empowered to make additional rules, which, after being promulgated, are to be enforced by the sanitary authorities of the States and municipalities if they will undertake to execute and enforce them, but if said authorities refuse or fail, the President shall adopt such measures as are necessary to their enforcement.

The law further specifies that it shall be the duty of the Supervising Surgeon General of the Marine Hospital Service, under the direction of the Secretary of the Treasury, to perform all the duties in respect to quarantine and quarantine regulations which are provided for by this act.

It further provides that information shall be obtained of the sanitary condition of foreign ports and places through the consular officers of the United States; that weekly reports shall be obtained of the sanitary conditions of ports and places within the United States, and for the collection of such other information affecting climatic and other conditions of the public health as may be pertinent. Weekly extracts of the consular and other sanitary reports are to be prepared and published, and transmitted to the collectors of customs, State and municipal health officers, and other sanitarians. The law further permits the Secretary of the Treasury to remand an infected vessel from any port which is not provided with proper facilities to the nearest national or other quarantine station, and after treatment at a national quarantine station, with a certificate furnished by the United States quarantine officer, a vessel shall be admitted to entry at any port of the United States named in the certificate. But at ports where sufficient quarantine provision has been made by State or local authorities, the Secretary of the Treasury may direct vessels bound to said ports to undergo quarantine at said State or local station.

The President has the right to prohibit in whole or in part the introduction of persons and property from such countries or places as he shall designate, and for such period of time as he may deem necessary, whenever by reason of existence of cholera or other infectious or contagious disease in a foreign country there is serious danger of the introduction of the same into the United States, despite the quarantine defenses.

The law provides that if a State wishes to surrender the use of its quarantine buildings and disinfecting apparatus to the United States, the Secretary of the Treasury is authorized to receive them and pay a reasonable compensation to the State for their use.

In conformity with the law the Secretary of the Treasury has issued regulations that prescribe the form of the bill of health; the definition of an infected port; what vessels shall be inspected before the bill of health is granted; the time and method of making the inspection, with all necessary details for the enforcement of cleanliness and perfect sanitation, including disinfection, and relating both to the vessel itself and the cargo, crew, and the passengers, both steerage and cabin. In ports infected with cholera, passengers of the cabin class must produce evidence as to abode during the four days immediately preceding embarkation, and if necessary they and their baggage may be detained and the baggage subjected to such disinfection as is necessary. Steerage passengers in a cholera-infected port or from a cholera-infected place must be detained five days under medical observation, and their personal effects and baggage must be disinfected by steam. The regulations further forbid the shipment of certain articles of bedding and clothing from an infected port, also certain articles of merchandise, such as old rags, old jute, and old gunny, during the prevalence of an epidemic and for thirty days after it has been officially declared at an end. All rags at all times are to be disinfected before shipment to the United States.

The law provides that these regulations are to be enforced at foreign ports, either by United States consuls or by medical officers of the Government who are detailed abroad for the purpose.

These laws herein referred to comprise the national legislation relating to quarantine. From the beginning this duty has been assigned to the Treasury Department, for to that department belongs the administration of the laws relating to commerce, of those relating to the survey, lighting, and policing of our coast line, of those relating to immigration, and of those relating to the hygiene and sickness of our mercantile marine. To perform this latter duty the Marine Hospital Service was organized in 1798, and to-day its officers are on duty at every principal seaport in the country. Besides this, the immigrant inspection service and the quarantine service have been added to its duties, because it was the regularly organized medical bureau of the Treasury Department. The efficiency of this service has been demonstrated in the sanitary history of the United States during the past five years; and indeed it would be superfluous to make any argument regarding the desirability of having an efficiently organized corps, trained to perform quarantine duty, whose experience in the discharge of their duty, first in one, then in another section of the country, would familiarize them with the prevailing diseases of these sections, and whose freedom from political influences makes them independent of outside pressure in the discharge of their duties.

An exclusive national quarantine can not be maintained until Congress passes a law assuming national authority in the matter. The Supreme Court of the United States has virtually decided that Congress has such authority, for in the case of the Morgan Steamship Company *vs.* the Louisiana Board of Health (*United States Reports*, vol. cxviii, p. 455) Associate-Justice Miller said, in delivering the opinion of the Court (May 10, 1886): "It may be conceded that whenever Congress shall undertake to provide for the commercial cities of the United States a general system of quarantine, or shall confide the execution of the details of such a system to a national board of health, or to local boards, as may be found expedient, all State laws on the subject will be abrogated, at least so far as the two are inconsistent. But until this is done the laws of the State on the subject are valid." He further states that "quarantine laws belong to that class of State legislation which, whether passed with intent to regulate commerce or not, must be admitted to have that effect, and which are valid until displaced or contravened by some legislation of Congress."

QUITMAN RED SULPHUR SPRINGS.—Two sulpho-chalybeate s's, flowing 500 gallons per hour, in Clarke Co., Miss. A local resort.

RAHR'S ARTESIAN WELL.—An alkaline, calcic artesian well, flowing 130 gallons per hour, in Manitowoc, Wis. Unimproved.

RALEIGH MINERAL SPRINGS.—Saline, chalybeate s's near Memphis, Shelby Co., Tenn.

RANDOLPH MEDICAL SPRINGS.—Two saline, chalybeate s's, flowing 2,200 gallons per hour, in Randolph Co., Mo. A resort.

RAPE.—In the United States in general rape is the carnal knowledge by a man of any woman above the age of ten years against her will or consent, or of a female child under the age of ten years with or against her will. Sexual intercourse with a female over the age of ten years is rape if through idiocy, imbecility, or any mental unsoundness, either temporary or permanent, she is incapable of giving consent; if at the time the act is committed she is unconscious of the nature of the act, and this fact is known to the defendant; if her resistance is forcibly overcome, or is prevented by fear of immediate and great bodily harm, which she has reason to believe will be inflicted upon her; or is prevented by stupor or by mental weakness produced by an intoxicating, narcotic, or anæsthetic agent, administered by or with the privity of the person accused of the crime. It is immaterial that the woman is not a virgin, or that she be a common prostitute, even having offered to permit intercourse for ten cents.

The age of consent in female children is sometimes older than ten years; in Louisiana it is twelve, in New York sixteen years.

Indecent assault may include various factors of an attempt to commit rape, in the case of a child comprising putting the hands on her external genitals, or even feeling her legs.

Legally rape may only be committed when there is a physical capacity in the direct perpetrator. In some countries and in some of the States it is held that a boy under fourteen can not commit the crime of rape, and no evidence is admissible to the contrary if he be under that age, even though the fact could be shown that he had the requisite capacity. In the United States, as a rule, however, the presumption of capacity is not conclusive, but rebuttable, as has been decided by the courts in Ohio, Massachusetts, New York, and Tennessee By statute, a boy under fourteen can not be convicted of rape in California, while North Carolina and Florida courts have decided in conformity with the English law. The Supreme Court of Louisiana has rejected the English law *in toto*, and holds that there is no foundation for any presumption of incapacity whatever. This latter decision is in conformity with medical knowledge; for not only is sexual precocity in male children under fourteen more frequent than is generally supposed, but it is within the knowledge of all physicians of experience that boys from four years old upward may and do have sexual relations with their nurses or other females, and that a sexual appetite thus generated may induce such a boy to attempt assaults on young female children. For family reasons assaults of this character are concealed, and are not made a matter of criminal prosecution.

In the United States, as in England, it is not essential to prove emission in order to establish the fact of forcible carnal knowledge; evidence of the least penetration suffices, and the proof of penetration may be indirect.

The ravished female is a competent witness even to the extent of testifying against her husband if he is indicted as accessory to the crime; and material facts and circumstances may be admitted as corroborative evidence, other witnesses not being necessary to prove the fact of rape.

In the case of an infant under years of discretion, her unsupported evidence—not even an examination of her person or medical testimony being required—justifies a conviction of rape if the jury is satisfied that the evidence leaves no reasonable doubt of guilt.

Dr. Jerome Walker, of Brooklyn, in his experience as physician to a Society for the Prevention of Cruelty to Children, reported instances of alleged rape by twenty-one individuals on twenty-six female children: 1 three years old, 1 four years old, 3 six years old, 2 seven years old, 3 eight years old, 4 nine years old, 2 ten years old, 1 eleven years old, 3 twelve years old, 2 thirteen years old, 1 fourteen years old, and in 3 instances the age was not specified. He advises that the physician should satisfy himself whether the child's story is probable or possible, and whether there is any motive for her falsifying; whether there is any motive for one or both parents, or for any relation or friend, to abet the child in her statements. The examiner must also determine what the motive was that induced the alleged assailant to attempt connection, and whether his story is probable; what the physical evidence is that the child has been injured or penetrated; whether the injury found resulted from attempted connection or in some other way; and whether the discharge is gonorrhœal or leucorrhœal. In the cases he examined the hymen was plainly perceptible in thirteen children; in three instances it was very pliable; in one, its free border was quite thick; and in all, the septum was strong. In six children the presence or absence of the hymen was not clearly ascertained. In eight children it was absent.

Dr. F. M. Hamlin has given the following excellent rules for the microscopic examination of supposed seminal stains, as the old method of soaking and washing the fabric and examining the washings often gives poor and unreliable results:

"If the stain to be examined is upon any thin cotton, linen, silk, or woolen fabric, cut out a piece about one eighth inch square, lay it upon a slide previously moistened with a drop of water, and let it soak for half an hour or so, renewing the water from time to time as it evaporates; then with a pair of needles unravel or fray out the threads at the corners, put on the glass cover, press it down firmly, and submit to the microscope.

"If the fabric is of such thickness or nature that it can not be examined as above, fold it through the center of the stain, and with a sharp knife shave off the projecting edge thus made, catching upon a slide moistened with water the particles removed. After soaking a few minutes—say five to ten—the powdery mass will sink down through the water and rest upon the slide. The cover glass may now be put on and the preparation examined."

Dr. Hamlin states that the latter plan serves well for hairs, and that a circle of liquid marine glue run around the cover glass will temporarily preserve the specimen, carbolic acid or chloral hydrate being added to the water as a preservative. He has not found any dye or solvent necessary, and a power of three hundred diameters suffices for the examination.

Rape by Females.—The French and German law regarding rape is so phrased that it punishes females who violate the chastity of a young male child. Tardieu has collected ten cases of rape committed by women on boys. In most of the cases the latter were violated by servants in whose care they had been placed. According to Tardieu, these children present the symptoms of excessive general fatigue due to their premature excesses: the countenance is pale, the eyes surrounded by dark circles, the skin hot and dry, the pulse accelerated, the stomach painful and tender, the groin swollen and sensitive, the thighs and the legs tremulous, the sexual parts very much developed, the penis being long and demiturgescent, the glans easily uncovered, the meatus red and inflamed, the testicles flaccid, and the cord very painful. In the examination of the accused woman the expert should endeavor to establish her identity with the statement made by the victim. As a rule, the only means by which such rape can be established is where gonorrhœa or syphilis has been thus communicated, though where there is deformity in the woman that prevents sexual relations with an adult male the fact may be strong presumptive evidence against her. Casper and Liman report the case of a six-year-old boy who contracted gonorrhœa from his governess with whom he slept; of a thirty-one-year-old deaconess who had polluted a five-and-a-half-year-old boy; of a mother who had committed incest with her nine-year-old son; of a servant girl who taught an eight-year-old boy how to have sexual relations with her; of a twenty-year-old servant girl who took an eight-and-a-half-year-old boy into her bed night and morning. In two cases in France females of eighteen obliged boys under fifteen to comply with their wishes; and in another case a girl of that age communicated syphilis to two boys aged thirteen and eleven years. Dr. E. L. Keyes cites Roubaud's case of nervous impotence that affected a man aged thirty-nine, who, when fourteen years old, was initiated into the mysteries of Venus by a young friend of the family aged twenty-one. Dr. C. A. Bryce, of Richmond, Va., has published the history of the rape of a boy aged seven years by a girl aged fourteen, who infected the child with syphilis.

The professional experience of the writer and of medical friends convinces him that this crime is far more frequent than is imagined, and many cases of sexual perversion and of impotence are the consequence of premature abuse of a young boy's sexual instincts by young females, often of good social standing, with whom he may be associated.

In several of the Southern States rape is punishable by death; and referring to the propensity of the negro to rape white women, Dr. Hunter McGuire says: "Death—certain, swift, and merciless—is the penalty. This is the unwritten law of every community in the South; from it there is no appeal." Several eminent and reputable physicians have proposed that this crime be punished by asexualization—the sexual sterilization attained by castration sufficing to punish the criminals and to protect society by preventing their propagation.

RAVENDEN SPRINGS.—An alkaline s., containing 21·79 grains of salts per gallon, in Randolph Co., Ark. A resort.

RAWLEY SPRINGS.—Three chalybeate s's, flowing 178 gallons per hour, containing 5·78 grains of salts per imperial gallon, in Rockingham Co., Va. A resort.

RED BLUFF SPRINGS.—Alkaline, saline s's near St. Thomas, Lincoln Co., Nev.

RED BOILING SPRINGS.—Three sulphureted and chalybeate s's, containing 45 grains of salts, principally calcium carbonate and sulphate and magnesium sulphate, per gallon, in Macon Co., Tenn.

RED CREEK SPRINGS.—See PARNASSUS SPRINGS.

RED SULPHUR SPRINGS.—Two sulphureted s's, flowing 210 gallons per hour, containing 23·96 grains of salts per gallon, in Monroe Co., W. Va. A resort.

RED SWEET SPRINGS.—See SWEET CHALYBEATE S's.

REED AND LYON WHITE SULPHUR SPRING.—A sulpho-chalybeate s. near Bedford Springs, Pa. A resort.

REID'S MINERAL SPRINGS.—A carbonated, saline s., in South Argyle, Washington Co., N. Y. A local resort.

REIGER SPRING.—A saline s., flowing 40 gallons per hour, near Lineville, Mercer Co., Mo. A resort.

RETROGRAPHY. — Writing backward, or writing that resembles the mirrored image of ordinary writing.

The condition usually occurs in left-handed persons, and the writing is from right to left. Erlenmeyer has explained this by the fact that it is usually easier to employ the arms in a centrifugal direction, the left hand beginning its motions from the right, and the right hand beginning at the left, so that the motions may not be hindered by the trunk of the body.

The explanation of the phenomenon is that an image is formed in each visual center of the brain, and when, through disease or injury, that in the left brain is destroyed, the person affected writes from a reversed image in the right side of the brain. Consequently the image B on the left side would become ᗺ on the right side of the brain, and would be so written with the left hand. Ireland believes that there are grounds for suspecting that in some cases the mental image, as well as the copy reproduced on paper, was really reversed.

R. occurs more frequently in women than in men, and it is more easily acquired by highly nervous people. It may be temporary, recurrent, or permanent.

RETROPULSION.—The act of forcing a part back. The term is most familiar in its application to the backward movement sometimes seen in paralysis agitans, taking the place of ordinary progression.

RHACHIALGIA.—Pain in or about the spine. See SPINE, DISEASES OF.

RHACHIOMYELITIS. — Inflammation of the spinal cord.

RHACHIOMYELOPHTHISIS.—Tabes dorsalis, *q. v.*

RHACHIOPARALYSIS—RHACHIOPLEGIA.—Spinal paralysis.

RHACHITIS.—Rickets, *q. v.*

RHAGADES.—Fissures in the skin; they often occur in the corner of the mouth, about the anus, and on the hands or feet.

RHEA SPRINGS.—Two alkaline, saline, chalybeate s's, flowing 480 gallons per hour, containing 20·77 parts of salts in 1,000,000, in Rhea Co., Tenn. A resort.

RHEUMARTHRITIS. — Acute rheumatic arthritis.

RHINALGIA.—Pain in the nose.

RHINANTRALGIA.—Pain in the nasal cavities.

RHINOSCLEROMA.—An induration of the nasal tissues. See NOSE, DISEASES OF, p. 228.

RHOTACISM.—The faulty pronunciation or use of the letter *r*.

RHYPOPHOBIA — RUPOPHOBIA.—A morbid dread of dirt. Cf. MYSOPHOBIA.

RICE'S SPRINGS.—See WARM S'S, ARK.

RICHFIELD SPRINGS.—Sulphureted, chalybeate, and saline s's situated near the head of Canaderaga or Schuyler's Lake, Otsego Co., N. Y. An analysis of the waters by C. F. Chandler showed that they contained 154·28 grains of salts and 14·2 cubic inches of sulphureted hydrogen per gallon. The principal salts are calcium sulphate 112·34 grains, magnesium bicarbonate 31·74 grains, magnesium sulphate 5·15 grains, and small quantities of sodium, potassium, and strontium sulphates and of sodium and lithium chlorides.

RIGA MINERAL SPRINGS. — Carbonated, chalybeate s's in Monroe Co., N. Y.

RINNAH WELLS SPRINGS.—Three carbonated s's near Andalusia, Rock Island Co., Ill. Used locally.

RIVERSIDE MAGNETIC MINERAL SPRINGS.—Two calcic, saline s's, one containing 232·89 grains, the second 638·66 grains of salts, principally calcium and magnesium sulphates and sodium and magnesium chlorides, per gallon, near Detroit, Mich. A bathing resort.

RIVER SPRINGS.—Nine chalybeate s's, flowing 100 gallons per hour, in St. Mary's Co., Md. A resort.

ROANOKE RED SULPHUR SPRINGS.—Four sulphureted and chalybeate s's, flowing 1,278 gallons per hour, containing 21·71 grains of salts per gallon, near Salem, Roanoke Co., Va. A resort.

ROBB'S CHALYBEATE SPRING.—A chalybeate s. in McCracken Co., Ky.

ROBINSON'S SPRING.—A chalybeate s., flowing 120 gallons per hour, in Van Buren Co., Tenn. A resort.

ROCHEPORT SULPHUR SPRINGS.—Four sulpho-saline s's in Boone Co., Mo. A local resort.

ROCHESTER SPRINGS. — Saline s's near Harrodsburg, Ky.

ROCKBRIDGE ALUM SPRINGS.—Chalybeate s's in Rockbridge Co., Va. Analyses of the waters show that they contain from 17·94 to 116·27 grains of salts per gallon. The principal constituents are aluminium and magnesium sulphates. The water is astringent, diuretic, and laxative. It is a popular resort.

ROCKBRIDGE BATHS.—Alkaline s's in Rockbridge Co., Va. A resort.

ROCKCASTLE SPRING.—A chalybeate s., flowing 25 gallons per hour, containing 0·1481 parts of salts in 1,000, in Pulaski Co., Ky.

ROCK ENON SPRINGS.—Eight alkaline, saline, chalybeate, and sulphureted s's, containing 40·43 grains of salts, principally iron oxide and magnesium sulphate, per gallon, in Frederick Co., Va. A resort.

ROCKINGHAM VIRGINIA SPRINGS.—Ten saline, chalybeate s's, flowing 730 gallons per hour, in Rockingham Co., Va. A resort.

ROCK SPRING.—A sulphureted s. near Apopka, Orange Co., Fla.

ROCKY MOUNTAIN SPRINGS, COL.—Carbonated saline and ferruginous s's near Jamestown, Boulder Co., Col. They are at an elevation of 6,500 feet above the sea. The waters contain 165·24 grains of salts per gallon, of which 10·46 grains are sodium sulphate, 15·31 grains are calcium carbonate, 4·96 grains sodium chloride, 4 grains sodium silicate, and 2·89 grains iron carbonate.

ROPER MINERAL WELLS.—Two sulphureted chalybeate springs, flowing about five gallons per hour, in Greenville, Butler Co., Ala.

ROSICRUCIAN SPRINGS.—Three alkaline, saline s's, flowing 800 gallons per hour, one containing 35·43, a second 3·05 grains of salts per gallon, in Lincoln Co., Me. A resort.

ROSS MINERAL SPRINGS.—Saline, sulphureted s's in Prospect Hill, Saline Co., Ill.

ROWLAND SPRINGS.—Sulphureted, chalybeate s's in Cartersville, Bartow Co., Ga.

ROYSTON'S CHALYBEATE SPRINGS.—Saline, chalybeate s's in Pike Co., Ark.

RUSSELL SULPHUR SPRINGS.—Two sulphur s's in Russell Co., Ky.

RYAN'S HOT SPRINGS.—Hot s's, having temperature of 120° F., flowing 1,400 gallons per hour, near Dillon, Beaver Head Co., Mon.

RYDER'S BLOOD SPRING.—See Blood S.

SACCHAROMYCES.—A genus of nonchlorophyllaceous cryptogams forming a group commonly known as the yeast fungi, including most of the fungi capable of exciting alcoholic fermentation in saccharine liquids. They consist of rounded or ellipsoidal apparently nonnucleated cells that are able to live without free oxygen, and that, under suitable conditions, reproduce themselves by repeated processes of budding.

The *S. capillati* is a species that has spherical conidia, usually from 2·5 to 5·5 μ in diameter, and forms glomerules that bud. It is found on the human scalp, and Pekelharing considers it the cause of pityriasis capitis.

The *S. guttulatus* occurs in the digestive tract of animals, birds, and reptiles; the cells are from 15 to 24 μ long, elliptical in shape, and opaque brown in color.

The *S. psoriasis* occurs in the human scalp; it is from 28 to 30 μ long, invested with a double membrane, and arranged in chains. It is found around the hairs but not in their follicles.

SACCHAREPHIDROSIS.—The excretion of saccharine perspiration. See Diabetes Mellitus.

SADISM.—A form of sexual perversion in which there is the association of active cruelty and violence with lust. The lustful emotion awakens the impulse to cruelty, and acts done in obedience to the impulse cause sexual gratification. It is named after the novelist De Sade.

ST. CLAIR MINERAL SPRING.—A saline s. in St. Clair Co., Mich. The water contains 12,571·73 grains of salts per gallon, including sodium chloride 9,565·01 grains, calcium chloride 2,437·49 grains, magnesium chloride 398·38 grains, calcium sulphate 140·19 grains, and small quantities of other salts.

ST. CROIX MINERAL SPRING.—A s. flowing 700 gallons per hour, near East Farmington, Polk Co., Wis. The water contains 20·56 grains of salts, principally calcium, magnesium, and sodium bicarbonates, per gallon. A resort.

ST. LOUIS ARTESIAN WELL.—A saline, calcic artesian well, 3,843 feet deep, at Insane Asylum, St. Louis, Mo.

ST. LOUIS MAGNETIC SPRING.—An alkaline, carbonated s., containing 272·6 grains of salts, principally sodium, calcium, and magnesium bicarbonates and calcium sulphate and silicate, per imperial gallon, in Gratiot Co., Mich.

ST. REGIS SPRINGS.—See Massena S.

ST. RONAN'S WELL.—A saline spring, flowing 30 gallons per hour, in Warrick Co., Ind. The water contains magnesium and calcium oxide and sulphuric acid.

SALPINGIAN.—Pertaining to a tube, especially the Eustachian or Fallopian tube.

SALPINGITIS.—Inflammation of the oviduct or of the Eustachian tube.

SALPINGO-NASAL.—Pertaining to the Eustachian tube and the nose.

SALTATORY.—Progressing by leaps: applied to describe certain spasms.

SALT CREEK SPRING.—A saline s., flowing 7,000 gallons per hour, in Pueblo Co., Col.

SALTILLO MINERAL SPRINGS.—See McCarthy's Mineral S's.

SALT LAKE.—An alkaline lake in Lac-qui Parle Co., Minn.

SALT LAKE CITY WARM SPRING.—A saline, sulphureted s., flowing 32,903 gallons per hour of water having a temperature of 103° F., containing 33·88 grains of salts per gallon, in Salt Lake City, Utah. Used chiefly for bathing.

SALT SPRINGS.—Six saline s's, flowing 148,000 gallons per hour, in Marion Co., Fla. Used locally.

SALT SULPHUR SPRINGS.—Four sulphureted s's, flowing 400 gallons per hour, one containing 150·28 grains, a second 172·48 grains of salts, principally calcium, magnesium, and sodium sulphates, per gallon, in Monroe Co., W. Va.

SALT SULPHUR WELL.—A saline, sulphureted spring in Nicholasville, Jessamine Co., Ky.

SALT WELL.—A saline spring near Stone's Ferry, Lincoln Co., Nev.

SALUBRIAN SPRINGS.—Two sulphureted s's, flowing 60 gallons per hour, near Hopkinsville, Christian Co., Ky. A local resort.

SAMOSET MINERAL SPRINGS.—Alkaline s's, containing 24·85 grains of salts per gallon, in Nobleborough, Lincoln Co., Me.

SAN BERNARDINO HOT SPRINGS.—Calcic s's, one containing 128 parts, a second 127 parts of salts, principally sodium sulphate and chloride, in 100,000, the water having temperature from 108° to 172° F., in San Bernardino, Cal.

SAND CAVE SPRING.—A sulphureted s. near Fort Defiance, Apache Co., Ariz.

SAND CREEK MINERAL SPRING.—A chalybeate s., flowing 500 gallons per hour, near Azalia, Bartholomew Co., Ind.

SANDWICH SPRINGS.—A place in Ontario, Canada, where there are gaseous, alkaline, saline, and sulphurous s's.

SAN JUAN CAPISTRANO HOT SPRINGS.—Hot s's having temperature from 120° to 123° F., containing 29·29 parts of salts in 100,000, in Los Angeles Co., Cal.

SANS SOUCI SPRING.—One of the Ballston Spa Springs, *q. v.*

SANTA BARBARA HOT SULPHUR SPRINGS.—Seven sulphureted s's, having temperature from 112° to 117° F., one containing 47·5, another 38·4 parts of salts, principally sodium chloride and carbonate, per 100,000, near Santa Barbara, Cal.

SAN YSIDRO SPRING.—A carbonated s., containing 0·5632 parts of salts, principally sodium chloride and sulphate, in 100, near Jemes, Bernalillo Co., New Mexico.

SAPPHISM.—Labia-lingual friction and suction of the clitoris. It may be a manifestation of depravity or of sexual perversion. Clitoridectomy may be performed on those abandoned to this vice.

SAPRÆMIA.—Infection of the blood by putrefactive products.

SARATOGA A SPRING.—See Saratoga S's.

SARATOGA SELTZER SPRING.—See Saratoga S's.

SARATOGA SPRING, CAL.—A thermal s. south of Death Valley, Inyo Co., Cal.

SARATOGA SPRINGS, N. Y.—One of the best, if not the best known spa in the United States, located in Saratoga Co., N. Y. The principal constituents of the waters as shown by the appended analyses of the various springs, are sodium chloride, the alkaline carbonates, and carbonic-acid gas. These will suggest the range of applicability of the waters. See table on page 1289.

SARATOGA SPRINGS, TEX.—Nine acid and saline s's, flowing 30 gallons per hour, in Hardin Co., Tex.

SARATOGA SPRINGS, WYO.—Six saline, chalybeate s's, flowing 600 gallons per hour of water having a temperature of 120° F., in Carbon Co., Wyo. A resort.

SAUQUOIT SULPHUR SPRING.—A saline s. in Oneida Co., N. Y.

SCABIOPHOBIA.—A morbid dread of scabies.

SCAPULALGIA.—Pain in the scapula. Tillaux applies the term to neuralgia affecting the circumflex nerve.

SCARBOROUGH MINERAL SPRING.—An alkaline, chalybeate s., flowing 300 gallons per hour, containing 9·09 grains of salts per gallon, in Cumberland Co., Me.

SCHELLBURNE HOT SPRINGS.—Two hot s's in White Pine Co., Nev. Used for irrigation.

SCHIZOMYCETES.—A genus of microscopic saprophytic or parasitic achlorophyllic split or fission fungi. Cohn divides them into four principal groups: *Micrococcus, Bacterium, Bacillus*, and *Spirillum*. Flügge also makes four divisions: *Micrococcus*, including *Streptococcus, Diplococcus, Staphyloccus, Ascococcus*, and *Sarcina; Bacillus*, including *Bacterium* and *Proteus; Spirillum*, including *Spirochœte* and *Vibrio;* and a division of variable forms including *Cladothrix, Beggiatoa*, and *Crenothrix*. Ward divides them into the *Asporeæ*, including *Micrococcus, Streptococcus, Sarcina, Merismopedia*, and *Ascococcus*, that have no spores that are distinct from the vegetative cells; the *Arthrosporeæ*, including the *Arthrobacteria;* the *Leptotricheæ*, and the *Cladotrichiæ*, that have spores produced by segmentation and different in character from the vegetative cells; and the *Endosporeæ*, including the *Bacillus*, some *Spirilli*, and other forms that do not have spore formation.

SCHIZOMYCOSIS.—Any disease due to the presence of schizomycetes in the animal organism.

SCHOOLEY'S MOUNTAIN SPRING.—A calcic, chalybeate s., flowing 20 gallons per hour, containing 7·17 grains of salts per gallon, in Morris Co., N. J.

SCHUYLER COUNTY SPRING.—A saline, chalybeate s., containing 156·03 grains of salts, principally calcium sulphate and iron protosulphate, per gallon, in Schuyler Co., Ill.

SCLERENCEPHALIA. — Sclerosis of the brain.

SCLERODACTYLIA.—Scleroderma confined to the hands and feet.

SCLEROTHRIX.—Morbid hardness and dryness of the hair.

SCOPOPHOBIA.—A morbid aversion to being seen.

SCOTOMA.—A blind patch in the field of vision. The condition may be *absolute*, in which case all perception of light is absent; or *central*, and limited to the region of the macula lutea; or *flittering* or *scintillating*, when the patch has serrated borders and spreads from the center so as to produce a large defect in the field. In *negative s.* the retinal center is entirely destroyed, and the defect is as imperceptible to the patient as is Mariotte's spot; while in *positive s.* the defect is visible as a dark spot before the eye.

SCURVY IN INFANTS.—The first reported instance of scurvy in infants is that in *Virchow's Archiv* in 1873, in an infant fifteen months old. In 1878 there was a report in the

Saratoga Springs.

Analysts: α, C. F. Chandler; β, J. H. Steele; γ, Allen; δ, Sharples; ε, J. R. Chilton; θ, Appleton; κ, J. G. Pohle.

	Champion Spouting Spring.	Columbian Springs.	Crystal Springs	Congress Springs	Empire Spring.	Eureka Spring.	Excelsior Spring.	Flat Rock Spring	Geyser Spouting Spring.	Hamilton Spring.	Hathorn Spring.	High Rock Spring.	Kissingen or Tritten Spring.	Pavilion Springs.	Putnam Spring.	New Putnam Spring.	Red Spring.	Saratoga A or Alum Spring.	Seltzer Spring.	Walton, or Iodine, or Star Spring.	Union Spring.	United States Spring	Vichy Springs.	Washington or White Springs
	α.	β.	α.	α.	α.	γ.	γ.	α.	α.	γ.	α.	α.	δ.	α.	ε.	α.	θ.	κ.	α.	α.	α	α.	α.	ε.
SOLIDS.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal.	Grains per gal	Grains per gal	Grains per gal.	Grains per gal.	Grains per gal	Grains per gal.	Grains per gal	Grains per gal	Grains per gal.	Grains per gal	Grains per gal	Grains per gal.
Sodium carbonate	.....	.....	.....	.....	.....	.....	.....	.....	.....	34·25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sodium bicarbonate	17·62	15·40	10·06	10·77	9·02	8·75	15·00	9·10	71·28	.....	4·29	34·89	67·62	3·76	14·32	8·08	15·33	6·75	29·43	12·66	17·01	4·67	82·87	8·48
Calcium carbonate	.....	68·00	.....	.....	.....	.....	.....	.....	.....	97·99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Calcium bicarbonate	227·07	.....	101·88	148·40	109·66	41·32	77·00	98·63	168·39	.....	170·65	131·74	140·26	120·17	68·80	157·56	101·26	56·85	89·87	124·46	96·70	93·12	95·52	84·10
Magnesium carbon	.....	.....	.....	.....	.....	.....	.....	.....	.....	39·06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Magnesium bicarb.	193·91	46·71	75·16	121·76	42·96	29·34	32·33	29·47	149·34	.....	176·46	54·92	70·47	76·27	51·60	173·61	42·41	20·48	40·31	61·91	109·69	72·88	41·50	65·97
Strontium bicarb	0·08	.....	Trace	Trace	Trace	.....	.....	0·01	0·43	.....	Trace	Trace.	Trace	Trace.	.....	0·11	Trace	.....	Trace	Trace	Trace	0·02	Trace.	.....
Lithium bicarbonate	6·27	.....	4·83	4·76	2·08	.....	.....	3·23	9·00	.....	11·45	Trace	5·13	9·49	.....	9·83	0·94	1·72	0·90	7·59	2·61	4·85	1·76	.....
Iron carbonate	.....	5·58	.....	.....	.....	.....	.....	.....	.....	4·62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Iron bicarbonate	0·65	.....	2·04	0·34	0·79	3·00	3·22	0·09	0·98	.....	1·13	1·48	1·56	2·57	7·00	0·45	.....	1·72	1·70	1·21	0·27	0·71	0·05	8·80
Barium bicarbonate	2·08	.....	0·73	0·93	0·07	.....	.....	0·10	2·01	.....	1·71	Trace.	0·99	0·88	.....	0·38	.....	.....	Trace.	0·10	1·70	0·91	0·59	.....
Potassium sulphate	0·25	.....	2·16	0·89	2·77	.....	.....	0·48	0·32	.....	.....	1·61	Trace.	2·03	.....	2·26	.....	0·37	0·56	5·40	1·82	.....	Trace	.....
Sodium sulphate	.....	.....	.....	.....	.....	.....	1·32	.....	.....	.....	.....	.....	.....	.....	1·68	.....	.....	2·50	.....	.....	.....	.....	.....	.....
Magnesium sulphate	.....	.....	.....	.....	.....	2·15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0·29	.....	.....	.....	.....	.....	[illegible]
Sodium phosphate	0·01	.....	Trace.	0·02	0·02	.....	.....	0·04	Trace.	.....	Trace	.....	.....	Trace.	0·21	Trace.	.....	.....	Trace	Trace	0·03	0·02	Trace	.....
Sodium biborate	Trace	.....	Trace.	Trace.	Trace	.....	.....	Trace.	Trace	.....	Trace	.....	.....	Trace	.....	Trace	.....	.....	Trace	Trace	Trace	Trace	Trace	.....
Sodium chloride	702·24	267·00	328·47	400·44	506·63	166·81	870·64	108·85	562·08	298·66	509·97	390·13	338·50	459·90	214·00	268·04	88·53	565·30	134·29	398·86	453·30	141·87	128·69	182·73
Potassium chloride	40·45	.....	8·33	8·05	4·29	.....	.....	7·99	24·64	.....	9·60	8·50	16·98	7·66	.....	14·87	6·86	0·36	1·34	9·70	8·73	8·62	14·11	.....
Magnesium chloride	.....	.....	.....	.....	.....	.....	.....	10·83	.....	.....	.....	.....	.....	.....	.....	.....	.....	Trace.	.....	.....	.....	.....	.....	0·48
Potassium bromide	.....	Trace	.....	.....	.....	1·57	Trace.	.....	.....	.....	.....	.....	.....	.....	Trace.	.....	.....	.....	.....	.....	.....	.....	.....	0·47
Sodium bromide	3·58	.....	0·41	8·56	0·27	.....	.....	0·32	2·21	.....	1·58	0·73	1·80	0·99	.....	1·62	.....	.....	0·63	0·57	1·30	0·84	0·99	.....
Calcium fluoride	Trace.	.....	Trace	Trace	Trace	.....	.....	.....	Trace.	.....	Trace	Trace	Trace.	Trace.	.....	Trace.	.....	.....	Trace.	Trace.	Trace	Trace	Trace	.....
Sodium iodide	0·23	2·56	0·06	0·11	Trace.	4·67	4·24	0·01	0·25	3·59	0·19	0·08	0·04	0·07	2·00	Trace.	.....	.....	0·03	0·18	0·04	0·05	Trace	2·24
Alumina	0·46	.....	0·31	Trace.	0·42	0·28	.....	0·04	Trace	.....	0·13	1·22	Trace	0·33	0·56	0·22	*2·10	0·38	0·37	Trace.	0·32	0·09	0·48	Trace
Silica	0·70	2·05	3·21	0·84	1·46	0·58	.....	1·34	0·66	1·00	1·26	2·26	1·28	3·16	0·84	8·00	3·25	1·46	2·56	1·28	2·65	3·19	0·76	[illegible]
Sodium silicate	.....	.....	.....	.....	.....	.....	4·00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Potassium silicate	.....	.....	.....	.....	.....	.....	7·00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Organic matter	Trace	.....	Trace.	.....	Trace.	.....	.....	Trace.	Trace.	.....	Trace	Trace.	.....	Trace.	.....	Trace.	.....	Trace.	Trace	Trace	Trace	Trace	Trace	.....
Total	1,195·58	407·30	537·15	700·90	680·41	258·37	514·75	270·53	991·54	479·17	888·40	627·56	644·63	687·28	361·01	640·03	255·68	†658·18	302·02	617·37	696·17	331·84	367·32	[illegible]
GASES	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.	Cu. in.
Carbonic acid	465·46	272·06	317·45	392·30	344·67	239·00	250·00	.....	454·08	320·00	375·75	409·46	361·50	332·46	326·40	.....	.....	212·00	324·08	407·65	384·97	245·73	388·07	[illegible]
Atmospheric air	.....	4·50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6·40	.....	.....	.....	.....	.....	.....	.....	.....	.....

* With iron oxide.

† Contains traces of calcium chloride and sulphate.

London *Lancet* of three cases of infantile scurvy. At the International Medical Congress in Copenhagen seven cases of this disease in children were reported.

Dr. W. P. Northrup and Floyd Crandall have collected the records of thirty-six cases of infantile scurvy, in which they were able to get detailed histories. Among these thirty-six cases there were representatives of every social grade, but the authors believe the disease to be more frequent in rich than in poor, especially very poor, families. This is due to the fact that the main cause of scurvy in infants is exclusive feeding on some proprietary food or sterilized milk or cream. The exact diet was known in thirty-three cases; of these, twelve were fed on proprietary food exclusively, six on condensed milk or evaporated cream, and three on a combination of these. It thus appears that sixty-three per cent were fed upon proprietary food and condensed milk. Sterilized milk was the diet in two cases. Dr. L. Emmet Holt has stated that in three large institutions in New York, in which children are fed "almost exclusively" on sterilized milk, not a single case of scurvy has developed in five years; which seems to show that where the process is carried to a reasonable degree no danger is to be apprehended. The objection has never been made to Pasteurized milk. Moreover, overdilution of milk may be a cause of scurvy, as is shown by the fact that it was the diet in three out of the thirty-three cases in which the diet was stated. Children suffering from scurvy present commonly the following symptoms: (1) Anæmia; (2) pain (often intense) on motion; (3) swelling and tenderness of the lower limbs, one or both, affecting the lower part of the thigh most commonly, and, next to that, the leg; (4) spongy and bleeding gums, if the teeth have been cut. If the eruption of the teeth has not occurred the gums may be little or not at all affected. The swelling of the limb is, as a rule, tense and shining, and often, but not always, purplish or livid. It does not pit on pressure. The characteristic lesion is subperiosteal hæmorrhage, which may be complicated by detachment of the epiphyses. Hæmorrhages into the muscles, skin ("purpura," "petechiæ," "ecchymoses"), and mucous membranes are of frequent occurrence. Many of the cases were rhachitic, but there appeared to be no causal relation between the two diseases. Most, if not all, cases of "acute rickets" are, in the opinion of Northrup and Crandall, examples of rickets with intercurrent scurvy. The commonest age for scurvy in infants and children is between nine and fourteen months. The condition is liable to be diagnosed erroneously as rheumatism, stomatitis, rickets, sarcoma, osteitis, and, owing to the pseudoparalysis produced by immobility of a lower limb due to the pain attending movement, as infantile paralysis. When untreated it is very fatal, but is cured rapidly by a diet of fresh milk, beef juice, and orange juice. Milk may, if necessary, be diluted with barley water, and in warm weather Pasteurized or sterilized for a short time.

SEASICKNESS.—In an elaborate study of seasickness by Dr. W. W. Skinner, published in the *New York Medical Journal* for December 30, 1893, the writer stated that the principal symptoms of seasickness resulted from the lowering of the patient's arterial blood pressure, and that the latter was a condition *sine qua non* of their development. As the result of a number of years' experience he concluded that seasickness in a person otherwise healthy and not too aged was promptly curable in the vast majority of cases. And even in aged persons, or in persons having certain affections of the circulatory apparatus, there is often amelioration of the general condition by the employment of the method of treatment advocated by Dr. Skinner.

This treatment consists in the hypodermic injection of from half a milligramme to a milligramme of atropine sulphate, associated with a milligramme of strychnine sulphate (or nitrate) dissolved in a cubic centimetre of distilled mint water. If within the space of two hours after the first injection the patient is not cured, a second injection of one cubic centimetre may be administered, and even a third two hours later. Children and adolescents are very susceptible to this medication, and it causes an almost immediate cessation of vomiting after the first injection, and there is soon no more nausea, cephalalgia, or distress.

Dr. Skinner states that the administration of these eminently toxic substances demands a great degree of attention, prudence, and supervision on the part of the physician, who alone should be the judge of the opportunity of their administration, and of their dose in each individual case; but given at proper times and in suitable doses no harm will follow their administration.

As the sympathetic nervous system plays a preponderating *rôle* in the causation of seasickness, the latter may be regarded as a neurosis of the sympathetic. Of course it may recur during the course of a long voyage, but each attack is almost always amenable to the same treatment.

SEARCY SPRINGS.—Sulphureted, chalybeate s's in White Co., Ark. A resort.

SEBREE SPRINGS.—Several saline, sulphureted, and chalybeate s's, one containing 0·835 grains of salts in 1,000, another 35·33 grains of salts per gallon, in Webster Co., Ky. A resort.

SECO SPRINGS.—Three sulphureted and chalybeate s's near McAlister, Indian Territory.

SEIGLER SPRINGS. — Chalybeate s's near Adams Spring, Lake Co., Cal. A resort.

SELTZER MINERAL SPRINGS.—Three s's, flowing 1,000 gallons per hour, containing 293·72 parts of salts, principally sodium sulphate and calcium carbonate, in 100,000, in Springdale, Boulder Co., Col.

SENECA MINERAL SPRINGS.—Two chalybeate s's in Oconee Co., S. C.

SENECA SPA SPRINGS.—Sulphureted s's near Buffalo, N. Y.

SERUM THERAPEUTICS.—While recent investigations have shown that fresh serum *per se* has a bactericidal property, the researches of Behring and others have shown that this property is most marked in serum obtained from animals possessing a natural or acquired immunity to diseases.

Various explanations have been offered regarding the particular germicidal substance in the serum. Buchner has demonstrated that this bactericidal action is not due to serum albumin, for if the latter is converted into peptones the germicidal action of the serum is not destroyed. Vaughan and McClintock consider that the substance is a proteid because a temperature of 55° C. destroys its activity, and the only proteid that would not be destroyed by pepsin is nuclein. Serum has been employed in the treatment of the following diseases:

Cholera.—Dr. A. Chernel published, in the latter part of 1893, an account of experiments made by Pawlowski and Buchstof to determine the value of the blood serum of immune animals in the treatment of cholera.

They believe the complex symptoms of cholera to be caused by the absorption into the system of peptotoxine, which is produced by the comma bacilli; hence the efforts of therapeutists must be directed to find a substance which will neutralize this poison which is circulating in the blood. They think they have found this remedy in the blood serum of animals rendered immune against cholera.

In making these experiments they first endeavored to render the animals to be experimented upon immune; then they studied the properties of their blood serum; and, finally, they tried to render another series of animals immune with this, or to treat them if already infected.

To render animals immune, they injected first weak cultures, and then stronger ones into the selected animals—twenty guinea pigs and as many rabbits. The inoculation was in part through intraperitoneal or subcutaneous injection, and partly through the stomach by means of a stomach tube. The results were always favorable: the animals proved perfectly immune against cholera virus.

Doubtless the same course could be followed in rendering human beings immune; but, on account of the danger of infection during the treatment, a less dangerous way has been sought. They think this has been found in the use of the serum of immune animals.

To obtain such blood serum in sufficiently large quantities, dogs are rendered immune. In these animals the first injection, causes diarrhœa, loss of appetite, and general loss of flesh; but the following injections, even when very active cultures are used, are harmless.

Pawlowski and Buchstof mixed this serum in a test tube with cholera cultures, but the bacilli found the medium unfavorable for growth, and in twenty-four hours Bujwid's reaction could not be obtained. It appeared from the experiments that 0·55 cubic centimetre of the remedial serum would be sufficient to render a human being immune to the disease. Of sixteen dogs experimented upon, seventy-five per cent survived. Two dogs having shown marked cholera symptoms, one was treated with the serum and survived, while the other died.

See TOXINES OF CHOLERA.

Diphtheria.—Klemensiewicz and Escherich published, in 1892, the results of experiments made with guinea pigs that showed that these animals could be rendered immune to an injection of a virulent pure culture of the diphtheria bacillus for periods from fourteen to twenty days, by preliminary inoculation with the blood serum of patients just convalescent from that disease. Injections of blood serum from healthy adults who had not had diphtheria conferred no immunity whatsoever. These experiments corroborated those of Héricourt, Richet, and Behring, and demonstrated that in the blood of animals artificially protected against a certain specific disease there existed substances that, introduced into the systems of other animals, rendered such inoculated animals immune to the disease.

Behring accordingly injected in diphtheria patients twenty cubic centimetres of what he termed normal diphtherial therapeutic serum, and at subsequent injections ten cubic centimetres. The largest number of injections was five. The serum was injected under the skin of the chest, and gentle massage of the site of injection was practiced.

The method first employed for the purpose of making a quantitative estimation of the diphtheria antitoxine solution consisted in adding such a quantity thereof to a virulent culture of the diphtheria bacillus as would render the latter inert when injected (neutralization). Behring found that the smaller the amount of the antitoxine, containing serum required, the greater the amount of antitoxine present. Subsequently he abandoned this method, and during May, 1894, he defined normal diphtheria serum as such that, when an amount was injected corresponding to the proportion of 1 in 5,000 body weight, it would save a guinea pig after it had been injected with ten times the minimum fatal dose of a two-days'-old living diphtheria culture. Behring has successfully treated diphtheria in man by injecting hypodermically from 500 to 1,500 antitoxine normal units.

Ehrlich, Kossel, and Wassermann, in continuing these experiments of Behring, used the serum from goats rendered artificially immune, the immunity being produced by injections of increasing doses of dead diphtheria cultures. These experimenters ascertained the amount of antitoxines present by means of neutralization, making use of a virus equivalent to three in one thousand grammes of body weight. They found the immunity-producing unit was such that one tenth of a cubic centimetre sufficed to neutralize eight tenths of a cubic centimetre of virus. Of 220 children they treated with this serum, 67 were subjected to tracheotomy, with a mortality of 44·9 per cent; the mortality in the remaining 153 was 23·6 per cent. Six children treated on the first day recovered; 97 per cent of 66 treated on the second day recovered; but of 23 treated on the fifth day, only 56·5 per cent recovered. This steady decrease in the number of recoveries, according to the time when the patient was first treated, is not observed under other methods of treatment, although it conforms to experimental evidence.

Aronson and Wernicke have prepared a serum that they administer in doses of from half to one and a half cubic centimetres of serum injected at one time. Further experiment is necessary to determine the exact value of this method.

Pneumonia.—The brothers Klemperer have proved that the serum of rabbits that have been rendered immune against pneumonia, as well as that of men that have survived the crisis of a pneumonic attack, is endowed with antitoxic properties. They found that the normal individual can tolerate with impunity, and without local or general reaction, injections of serum of animals rendered refractory to the pneumonia diplococcus. They and other investigators have administered from five to seven cubic centimetres of this serum subcutaneously in the back in pneumonia patients, and find that there is a considerable fall of temperature, a slowing of the pulse and respiration, and a hastening of the crisis. It has been suggested that the diplococci give rise at first to a pneumotoxine, and later to another substance—antipneumotoxine—that has the property of neutralizing the pneumotoxine. As the blood of the immunized animal contains the antipneumotoxine, it is through it that the cure of pneumococcus infection results. Normal blood serum injected in pneumonia patients is without effect on pulse, temperature, or respiration.

Rabies.—Tizzoni and Centanni have recently experimented with the serum of animals rendered immune to rabies, and they claim that the serum of such animals has a protective power when injected into other animals that far exceeds immunity hitherto obtained by any other method. They state that such serum is efficacious at whatever period of incubation it may be administered, occasionally even when early symptoms have appeared. It is absolutely nonvirulent, and can not produce infection or any other evil consequence. The treatment may be rapidly carried out by means of one or more injections of the serum.

Smallpox.—Dr. B. Auché reported, in 1893, two cases of smallpox treated with hypodermic injections of serum obtained from the blood of variolous patients. The serum employed in the first case was obtained from a man, fifty-one years of age, of previous good health, free from syphilis, and who was admitted to the hospital a month and a half after he had suffered from a discrete form of smallpox. Once entirely recovered, he submitted to being bled. After proper disinfection of the skin, about fifty grammes of blood were drawn, and on the following day from fifteen to sixteen cubic centimetres of serum were obtained from this blood. Six cubic centimetres of this serum were injected into the patient. The serum used in the second patient was obtained from a young man, twenty-five years of age, who had recovered from a slight discrete form of variola. From about one hundred grammes of blood drawn, from thirty-five to forty cubic centimetres of serum were obtained, of which eighteen cubic centimetres were injected into the patient. In the first case the injections were made on the tenth day of the eruptive period; on the second patient, at the beginning of the period of suppuration. The results were negative in both cases. The treatment produced no effect, favorable or unfavorable, on the evolution of the disease.

Tetanus.—The experiments of Kitasato and Behring have showed that animals may be rendered immune to tetanus by the injection of attenuated and then of strong cultures of the bacillus, and that the serum of such animals injected into the tissues of other animals prevented the development of tetanus in the latter, and even cured the disease after preliminary symptoms had appeared. Their experiments have been corroborated by other investigators, and it has been found that this antitoxic serum, even when administered in very small doses, prevented tetanus with absolute certainty if injected before the tetanus poison; but if injected at the same time as the latter, there was a local tetanus; and the dose of serum necessary to prevent death was much greater when it was injected long after infection. A certain time after infection prevention of tetanus is impossible, no matter what quantity of serum is injected.

Behring ascertained that for the purpose of securing immunity a large quantity of tetanus serum was required, the quantity bearing a certain ratio to the animal's weight; and that the curative power of the serum of an immunized animal increased in direct proportion to the time the animal had been rendered proof against tetanus. By cultivation in the living animal he obtained a serum that had an immunizing power in the proportion of one to one million, and serum of this strength has been daily injected hypodermically, in doses of from forty-five to sixty-six grammes, with no harmful effect and apparently curative, the patient recovering. In patients treated with this serum the duration of the disorder is decidedly diminished by the treatment, the temperature is reduced, sleep is restored, the attacks of spasm grow weaker and rarer, the frequency of the pulse is diminished, and there is general improvement in the condition.

SEVEN SPRINGS, N. C.—Seven chalybeate s's, flowing 433 gallons per hour, in Wayne Co., N. C. A resort.

SEVEN SPRINGS, VA.—Seven chalybeate s's, containing 99·76 parts of salts in 100, near Abingdon, Washington Co., Va.*

SHADY GROVE SPRINGS.—Chalybeate and sulphureted s's near Dandridge, Jefferson Co., Tenn. A resort.

SHAFER'S HOT SPRINGS.—Springs having temperature of 210° F., containing 1·02 grain of salts, principally sodium sulphate and chloride, per litre, near Henry Lake, Lassen Co., Cal.

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* These figures are given by the *Bulletin of the United States Geological Survey*, but are certainly incorrect.—Ed.

SHANNONDALE SPRINGS. — Three saline, chalybeate s's near Charlestown, Jefferson Co., W. Va. The waters contain calcium and magnesium sulphates and calcium carbonate. A resort.

SHANTO SPRINGS. — Tepid s's near Fort Defiance, Arizona.

SHARON SPRINGS, N. Y.—Alkaline, saline, sulphureted s's, flowing more than 7,500 gallons per hour, in Schoharie Co., N. Y. Analyses of the waters by Chilton, Reid, Maische, and Pohle give:

Solids.	Chalybeate Spring. Grains per gal.	Gardner Magnesia Spring. Grains per gal.	Red Sulphur Spring. Grains per gal.	White Sulphur Spring. Grains per gal.
Sodium carbonate . .	....	0·34	0·24	....
Calcium carbonate .	....	6·73	8·97	....
Magnesium carbonate	8·96	0·80	0·41	....
Sodium sulphate . .	3·74	....	....	....
Calcium sulphate . .	63·80	93·50	96·64	55·84
Potassium sulphate .	Trace.	....	....	....
Magnesium sulphate .	8·15	19·68	18·96	21·20
Iron protosulphate .	1·40	....	....	....
Sodium chloride . .	....	1·23	0·23	1·12
Calcium chloride . .	....	0·16	0·06	....
Magnesium chloride .	....	0·43	0·73	1·20
Sodium sulphide . .	....	....	....	1·12
Calcium sulphide . .	....	6·25	0·89	
Magnesium sulphide	....			....
Silica	....	0·40	0·45	....
Organic matter . . .	28·48	....	....	....
Total	114·53	129·52	127·78	80·48
Gases	Cu. in.	Cu. in.	Cu. in.	Cu. in.
Sulphureted hydrogen	....	6·00	10·48	8·00
Carbonic acid . . .	....	2·21	4·56	....
Atmospheric air . .	....	3·00	4·00	....
Total	....	11·21	19·04	8·00

SHARON SPRINGS, VA.—Three chalybeate s's in Bland Co., Va. A resort.

SHAWNEE MINERAL SPRINGS.—Alkaline, calcic s's in Monroe, Michigan. A sanitary resort.

SHAW'S HOT SPRINGS.—Saline s's, flowing 4,000 gallons per hour, temperature 120° F., near Carson City, Nev. A resort.

SHEALTIEL'S MINERAL SPRINGS.—Two alkaline s's, flowing 200 gallons per hour, containing 14·65 grains of salts per gallon, near Waupaca, Wis. A resort.

SHEBOYGAN MINERAL SPRING.—A saline, calcic, artesian well in Sheboygan Co., Wis., that flows 8,400 gallons per hour. An analysis by C. F. Chandler shows that the water contains calcium bicarbonate 13·66 grains, iron bicarbonate 0·5 grain, manganese bicarbonate 0·17 grain, calcium sulphate 169·83 grains, calcium phosphate 0·04 grain, sodium chloride 306·94 grains, potassium chloride 14·48 grains, calcium chloride 27·83 grains, magnesium chloride 54·91 grains, lithium chloride 0·1 grain, sodium bromide 0·19 grain, aluminum oxide 0·13 grain, silica 0·47 grain, and traces of barium sulphate, sodium biborate, sodium iodide, and organic matter in each gallon.

SHEE'S SPA.—A sulphureted s. in Chenango Co., N. Y.

SHELBYVILLE THERMAL WELL.—A warm spring, temperature 76° F., in Shelby Co., Ind.

SHELDON SPRINGS.—Alkaline, saline s's, flowing 500 gallons per hour, containing 15·75 grains of salts per gallon, in Franklin Co., Vt. A resort.

SHENANDOAH ALUM SPRINGS.—Ten chalybeate acid s's, flowing 157 gallons per hour, in Shenandoah Co., Va. The water contains 5·22 grains of iron protoxide, 12·39 grains of alumina, and 59·54 grains of sulphuric acid in each gallon.

SHERIDAN SPRINGS. — Two saline, calcic s's, flowing 3,000 gallons per hour, containing 25·99 grains of salts per gallon, in Lake Geneva, Walworth Co., Wis. A local resort.

SHOCCO SPRINGS. — Chalybeate and sulphureted s's near Talladega, Ala.

SHOVER'S SPRING.—A chalybeate s., flowing 120 gallons per hour, in Hempstead Co., Ark. A resort.

SIDERODROMOPHOBIA. — A morbid dread of railway traveling.

SIDEROSIS. — The chronic interstitial pneumonia occurring among iron workers and due to the inhalation of fine particles of iron oxide.

SIGMATISM. — Defective pronunciation of *s* or *z*.

SILCOTT'S SPRINGS.—Chalybeate s's in Loudon Co., Va. Unimproved.

SILOAM SPRINGS, IOWA.—Two alkaline, calcic s's, flowing 420 gallons per hour, containing 32·36 grains of salts per gallon, in Iowa Falls, Hardin Co., Iowa. A sanitarium.

SILOAM SPRINGS, MO.—Fifteen alkaline, saline s's in Howell Co., Mo. A resort.

SILOAM SPRINGS, WIS.—Three saline s's, flowing over 1,000 gallons per hour, in Waukesha, Waukesha Co., Wis. The water contains sodium bicarbonate 0·02 grain, calcium bicarbonate 0·22 grain, magnesium bicarbonate 0·13 grain, sodium sulphate 0·05 grain, sodium chloride 0·02 grain, and silica 0·01 grain in each thousand grains of water.

SIMMON'S HOT SULPHUR SPRINGS.—Sulphureted s's, having temperature of 170° F., near Wilbur Springs, Colusa Co., Cal. They have a local reputation.

SINAPISCOPY. — The determination of sensory disturbances by applying mustard.

SITIOPHOBIA — SITOPHOBIA. — A morbid dread or repugnance to take food.

SITOMANIA. — Chipley employed this term in the sense of sitiophobia; Adams uses it in a better sense, to describe periodical mania in which there is bulimia.

SKAGG'S HOT SPRINGS.—Three carbonated s's, flowing 900 gallons per hour, having temperatures from 128° to 140° F., containing 214·81 grains of salts, principally sodium bicarbonate and biborate, per gallon, near Geyserville, Sonoma Co., Cal. A resort.

SMITH'S SPRINGS, TENN. — See Fernvale S's.

SMOKY VALLEY GEYSERS.—Boiling s's, flowing 4,200 gallons per hour, in Nye Co., Nev.

SNAKE RIVER SPRING.—A chalybeate s. near Covington, Alleghany Co., Va. A resort.

SNOWDEN MINERAL SPRING.—See Payton Mineral Spring.

SOCIAL HILL MINERAL SPRING.—A sulphureted s. in Muhlenberg Co., Ky.

SODA LAKES.—Alkaline, saline water, containing 125·13 grains of salts per litre, near Ragtown, Churchill Co., Nev.

SODAVILLE SPRING.—A carbonated s., flowing 15 gallons per hour, in Linn Co., Ore. A resort.

SOPHOMANIA.—A variety of megalomania in which the patient vaunts his superior wisdom.

SOUR LAKE MINERAL SPRINGS.—Thirteen acid s's, one containing 82·02, a second 46·76 grains of salts per gallon, in Hardin Co., Tex. A resort. The principal constituents of the water are aluminium, ferrous and magnesium sulphate, and sulphuric acid.

SOUR SPRINGS.—Thirty acid s's, flowing 1,200 gallons per hour, containing 448·98 grains of salts per gallon, near Luling, Caldwell Co., Tex. The principal constituents are magnesium and sodium chlorides, potash, alum, and calcium and magnesium sulphates.

SOWDER'S SPRING.—A calcic, saline s., containing 7·15 grains of salts in 1,000, near Crab Orchard, Lincoln Co., Ky.

SPAMENORRHŒA.—Scanty menstruation.

SPARKLING CATAWBA SPRINGS.—Five saline, carbonated s's, flowing 60 gallons per hour, near Hickory, Catawba Co., N. C. A resort.

SPARTA MINERAL WELLS. — Twelve saline, chalybeate s's, one containing 23·22 grains of salts, principally iron carbonate and sodium sulphate, per imperial gallon, in Monroe Co., Wis. The water is sold.

SPASMODISM.—A generic term suggested by Fleury for those nervous states that originate in medullary excitation.

SPASMOPHILIA.—A term used by Seeligmüller to describe nervous overexcitability with a tendency to convulsions.

SPA SPRING, MD.—A saline, chalybeate s., flowing 180 gallons per hour, in Bladensburg, Prince George's Co., Md. A resort.

SPA SPRING, N. J.—A chalybeate s. in Woodbridge, Middlesex Co., N. J.

SPA SPRING, W. VA.—A chalybeate s. near Berkeley Springs, Morgan Co., W. Va.

SPAULDING SPRINGS.—Four saline, chalybeate s's, flowing 2,400 gallons per hour, in Ralls Co., Mo. A resort.

SPLENÆMIA.—Leucocythæmia.

SPLENALGIA.—Pain in the spleen.

SPLENEPATITIS. — Inflammation of the liver and spleen.

SPLENOHÆMIA. — Congestion of the spleen.

SPLENOMALACIA.—Softening of the spleen.

SPLENOMEGALY.—Hypertrophy of the spleen. Debove has used this term to describe a splenic hypertrophy and progressive anæmia without leucocytosis or alteration in the lymphatic glands.

SPRING LAKE MAGNETIC WELL.—A saline s., containing 628·37 grains of salts, principally sodium, calcium, and magnesium chlorides, per gallon, in Ottawa Co., Mich. A resort.

SPRINGS OF DOS PALMOS. — Saline s's, containing 294·4 parts of salts, in 100,000 in San Diego Co., Cal.

SPRING VALLEY SPRINGS.—Twenty saline, sulphureted s's, flowing 2,000 gallons per hour, one containing 129·24 grains, a second 75·47 grains of salts per gallon, near Ottawa, Ill.

STAFFORD SPRINGS.—Two chalybeate s's, flowing 55 gallons per hour, in Tolland Co., Conn. A resort.

STAPHYLOCOCCÆMIA. — The presence of staphylococci in the blood.

STARK MINERAL SPRING.—A calcic, alkaline s., flowing 200 gallons per hour, in Bozrah, New London Co., Conn. A resort.

STAR SPRING.—See Saratoga Springs.

STEAMBOAT SPRINGS, COL.—Thirty saline, sulphureted s's, in Routt Co., Col. A resort.

STEAMBOAT SPRINGS, NEV.—Hot s's, having temperature of 204° F., in Washoe Co., Nev. A resort.

STEARODERMIA.—A skin disease affecting the sebaceous glands.

STERCORÆMIA.—A variety of blood poisoning due to the absorption of excretory alkaloids from the intestinal tract.

STEREOGNOSIS. — The recognition of the form of bodies; tactile s. is accomplished partly by cutaneous, partly by deep sensibility. Hoffmann and other observers have found that the recognition of small bodies was principally made by the skin and the senses of space and pressure, assisted by the power of motion in the joints and that of determining location in space.

STEWART'S SPRINGS.—Four saline s's, near Florence, Lauderdale Co., Ala. They have a local reputation.

STIBIALISM. — Systemic poisoning by antimony. See Tartar Emetic, Poisoning by.

STIGMA.—A punctiform cutaneous spot or mark; a red spot on the skin with elevated central efflorescence. The term is also employed to designate the mark of stigmatization, and any distinguishing mark or feature.

Thus the *hysterical stigmata* are psychical or somatic characteristics or marks that occur in and are indicative of hysteria; these have also been denominated *neurasthenic stigmata.* Some neurologists, as Gilles de la Tourette, divide hysterical stigmata into two classes: *Psychical stigmata,* those mental peculiarities characterized by extreme susceptibility to suggestions of a particular kind; and *somatic stigmata,* or the objective signs of hysteria, neurasthenia, and other neuroses.

The *physical stigmata of degeneration* are certain variations from the normal type in the configuration of the skull, extremities, or other portions of the body, that indicate a low or vicious type of mental development.

STIGMATIZATION. — The impression of marks like those of Christ's wounds on the bodies of certain individuals, usually women. The marks may be associated with bloody perspiration. The condition is a local vasomotor neurosis, probably due to auto-suggestion, though it is supposed to be miraculous.

STINKING SPRING. — Sulphureted spring near Coolidge, Valencia Co., New Mexico.

STOMATOMYCOSIS.—Any mycotic affection of the mouth. See Mouth, Diseases of.

STORM LAKE MINERAL SPRINGS.—See Chamberlain Mineral S's.

STOVALL'S SPRING.—A chalybeate s. near Columbia, Marion Co., Miss. Used to a limited extent for medicinal purposes.

STRADER'S MINERAL SPRING.—A chalybeate s. near Pelham, Caswell Co., N. C. Unimproved.

STREPTOCOCCÆMIA. — The presence of streptococci in the blood.

STRONG'S MILL SPRING.—A chalybeate and sulphureted s. in Colchester, New London Co., Conn. It has a local reputation.

STRONTIA MINERAL SPRING.—A saline, chalybeate s., flowing 350 gallons per hour, in Brooklandville, Baltimore Co., Md. The water is sold.

STRUMIPRIVUS.—Deprived of the thyroid gland. Applied to describe the cachexia due to loss of the thyroid gland.

STRYKER MINERAL WELL.—A saline spring, containing 621·51 grains of salts, principally sodium and magnesium chlorides and potassium sulphate, per gallon, in Williams Co., Ohio. A resort.

SUBINFLAMMATION. — A slight inflammation of slow progress.

SUBINVOLUTION. — Defective involution, especially employed with reference to the uterus.

SUDLEY SPRINGS. — Two chalybeate s's, flowing 52 gallons per hour, in Prince William Co., Va. Once a resort.

SUE HOT SPRINGS.—Springs having temperature of 160° to 185° F., in Salt Valley, Humboldt Co., Nev.

SUGGESTION.—The act of suggesting or the thing suggested. In psychology it is the act by which an idea is introduced into and accepted by the sensorium. In *direct s.* the idea is transmitted directly by speech to the brain; in *indirect s.* the idea is created in the brain in consequence of an impression received. *Hypnotic s.* is the process by which a hypnotized person is made to accept a hint or statement, although it may be unfounded, and to act accordingly. *Auto-s.* is the acceptance of an idea that is the consequence of impressions acquired or evolved by the individual himself. *Post-hypnotic s.* is one that is realized a longer or shorter time after waking. See Braidism.

SULLIVAN'S MINERAL SPRINGS.—Ten chalybeate s's near Bigbee, Washington Co., Ala. A local resort.

SULPHUR AND CHALYBEATE SPRINGS.—Five s's near Hopeville, Calhoun Co., Ark. Used commercially before the war.

SULPHUR MINERAL WELL.—A saline, sulphureted s. near Frankfort, Ky.

SULPHUR SPRINGS, IOWA.—Two sulphur s's in Buena Vista Co., Iowa.

SULPHUR SPRINGS, KAN.—Six calcic s's, flowing 360 gallons per hour, containing 46·05 grains of salts per gallon, in Cloud Co., Kan. Unimproved.

SULPHUR SPRINGS, LA.—Four chalybeate s's near White Sulphur Springs, La.

SULPHUR SPRINGS, MO. — Saline, sulphureted s's near Fayette, Howard Co., Mo. Unimproved.

SULPHUR SPRINGS, NEV.—Hot s's near Stillwater, Churchill Co., Nev.

SULPHUR SPRINGS, N. C—Sulphureted and chalybeate s's near Settle, Iredell Co., N. C. A local resort.

SULPHUR SPRINGS, TEX.—Eight s's in Millican, Brazos Co., Tex. A resort.

SUMMIT MINERAL SPRING.—An alkaline s., flowing 2,280 gallons per hour, containing 4·02 grains of salts per gallon, in Harrison, Cumberland Co., Me. A resort.

SUMMIT SODA SPRINGS.—Alkaline, carbonated s's, containing 88·68 grains of salts per gallon, near Soda Springs Station, Alpine Co., Cal.

SUSPENSION.—A method of treating painful inflammations of the extremities by raising the affected parts by means of an apparatus and retaining them in an elevated position. Or it is the perpendicular elevation of the body by means of straps about the axilla and under the chin, so that the weight of the lower extremities shall drag the spinal column downward. It is used to secure extension of the vertebral column in spinal curvature, and has been employed, with questionable advantage, to secure nutritional changes in the spinal cord in tabes dorsalis. See Spine, Curvatures of, and Tabes Dorsalis.

SWEET CHALYBEATE SPRINGS.—Four calcic, chalybeate s's, flowing 800 gallons per hour, containing 50 grains of salts per gallon, in Alleghany Co., Va.

SWEET SPRINGS, MO.—Five saline s's, flowing over 224,000 gallons per hour, near Brownsville, Saline Co., Mo. A resort.

SWEET SPRINGS, W. VA.—Calcic s's, flowing 48,000 gallons per hour, containing 60·68 grains of salts per gallon, in Monroe Co., W. Va. A resort.

SWIFT'S HOT SPRINGS.—See Shaw's Hot S's.

SWINNEY'S CHALYBEATE SPRING.—A chalybeate s. near Chameleon Springs, Edmondson Co., Ky.

SYLLABLE STUMBLING.—Dysphasia in which there is elision of one or more syllables of a word.

SYNKINESIS.—A term used by Ross to describe the involuntary movement of a paralyzed part that sometimes occurs in conjunction with voluntary movements of other parts.

SYPHILOMANIA.—A tendency to attribute diseases to syphilis; a morbid belief that one is affected with syphilis.

SYPHILOPHOBIA.—A morbid dread or fear of having syphilis.

TABACOSIS.—A condition observed in tobacco workers in which there is infiltration of a part or region, especially the lungs, with tobacco dust.

TACHYPHRASIA.—Great rapidity of speech, sometimes associated with stammering, observed in some forms of mental disease.

TACHYPNŒA. — Abnormally rapid respiration.

TÆNIOPHOBIA. — A morbid dread of being the host of a tapeworm.

TAHOE SPRINGS. — Hot s's, having temperature of 131° F., on Lake Tahoe, Placer Co., Cal. A resort.

[*] **TALIAFERRO SPRINGS.**—Chalybeate s's in Hopkins Co., Ky.

TALLADEGA SULPHUR SPRING.—A sulphureted, saline s., containing 50·15 grains of salts, principally sodium, potassium, and calcium carbonates, per gallon, near Fayetteville, Ala.

TAPHEPHOBIA.—A morbid fear of being buried alive.

TARASSIS.—A term proposed by Lanoaille de Lachèse for the congeries of symptoms commonly known as hysteria in the male.

TARPON SPRINGS.—Three sulphureted s's in Hillsborough Co., Fla. A resort.

TAR SPRINGS, IND.—Saline s's, containing 50 grains of salts, principally calcium, bicarbonate, and magnesium sulphate, per imperial gallon, in Crawford Co., Ind. Unimproved.

TAR SPRINGS, KY.—Saline s's near Cloverport, Breckinridge Co., Ky.

TATE'S EPSOM SPRING.—A saline, chalybeate s., flowing 120 gallons per hour, containing 271·88 grains of salts per gallon, in Grainger Co., Tenn. A resort. Each gallon contains 160·66 grains of calcium sulphate, 40·27 grains of sodium chloride, 31·91 grains of magnesium sulphate, 21·56 grains of calcium carbonate, and small quantities of sodium sulphate, iron chloride, and other salts.

TAWAWA SPRINGS.—Two chalybeate s's in Wilberforce, Greene Co., Ohio. A resort.

TAYLOR'S SPRINGS, ALA.—Four alkaline s's, flowing 80 gallons per hour, one containing 4·3 grains, a second 4·43 grains of salts per gallon, near Florence, Ala.

TAYLOR'S SPRINGS, VA.—See Massanetta Mineral S's.

TAZEWELL SULPHUR SPRINGS.—Four sulphureted s's, near Jeffersonville, Tazewell Co., Va. A resort previous to the war.

TELEOTHERAPEUTICS. — The treatment of disease by bringing near the affected person stoppered bottles containing the remedies usually employed. It is a form of suggestive therapeutics that attained a certain vogue with some French neurologists. It is necessary for the subject to be cognizant of the medicament employed in order to exhibit symptoms of its action.

TELLULAH MINERAL SPRINGS.—A saline s., flowing 400 gallons per hour, containing 0·24 part of salts in 1,000, in Appleton, Outagamie Co., Wis.

TENALGIA.—Pain in the tendons. It is usually a symptom of tenosynovitis.

TENDOPHONY.—The occurrence of auscultatory sounds ascribed to the chordæ tendinæ.

TENOSITIS.—Inflammation of a tendon.

TENOSYNOVITIS.—Inflammation of a sheath of a tendon and of the contiguous surface of the tendon. The affection usually occurs in the forearm, and is characterized by a peculiar creaking of the tendons when they move in their sheaths, pain, and inflammatory hyperplasia. Permanent fixation of the affected region is the best treatment.

TERATOPHOBIA. — A morbid fear of monstrosities, both actual and mythological, of deformed or physically peculiar people, or of caricatures.

TERRE HAUTE ARTESIAN WELL.—A saline, sulphureted artesian well, containing 365·07 grains of salts, principally sodium chloride and calcium bicarbonate, per gallon, in Terre Haute, Ind.

THALASSOPHOBIA.—A morbid dread or fear of the sea.

THALASSOTHERAPY.—Treatment of disease by means of residence near the sea, by sea bathing, or by sea voyage.

THANATOMANIA.—Suicidal mania.

THANATOPHOBIA.—A morbid dread or fear of death.

THEOMANIA. — Religious monomania. It is often accompanied by hallucinations of sight, hearing, and touch, and the patient believes himself to be under direct and immediate divine influence or inspiration, or even to be God himself.

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[*] This is pronounced Tolliver.

THERMAL ACID SPRINGS.—Warm s's near Little Owen's Lake, Inyo Co., Cal. One hundred thousand parts of the water contain sodium sulphate 15·1 parts, potassium sulphate 2·5 parts, calcium sulphate 15·3 parts, magnesium sulphate 1·2 part, aluminium persulphate 127 parts, iron persulphate 33·2 parts, sulphuric acid 78·4 parts, and traces of lithia, ammonia, phosphoric and nitric acids, and chlorine.

THERMONEUROSIS.—A fever due to primary disturbance of the nervous centers.

THERMOPALPATION.—The determination of the bodily temperature by palpation.

THOMAS'S MINERAL WELLS.—Saline springs, containing 84·81 parts of salts, principally sodium and calcium chlorides, in 1,000, in Fountain Co., Ind.

THORP'S SPRINGS.—Two alkaline s's, flowing 600 gallons per hour, in Hood Co., Tex. A resort.

THREE SPRINGS.—Three sulphureted s's in Huntingdon Co., Pa. A resort.

THROMBOARTERITIS. — Arteritis with thrombosis.

THROMBOLYMPHANGEITIS. — Lymphangeitis with thrombosis.

THROMBOPHLEBITIS. — Phlebitis with thrombosis.

THYMOPATHY.—Any mental affection or derangement.

TILFORD'S MINERAL WELL.—An alkaline s., containing 36·16 grains of salts, principally sodium carbonate, sulphate, and chloride, per gallon, in Wartrace, Bedford Co., Tenn.

TOLENAS SPRINGS.—Nineteen alkaline, carbonated s's, flowing 600 gallons per hour, containing 360 grains of salts per gallon, in Solano Co., Cal. Each gallon contains sodium carbonate 53·36 grains, magnesium carbonate 10·88 grains, calcium carbonate 48·32 grains, iron carbonate 0·64 grain, sodium biborate 20·56 grains, sodium chloride 215·92 grains, potassium chloride 5·68 grains, potassium iodide 2·08 grains, alumina 0·96 grain, and silica 1·6 grain.

TOMICHI HOT SPRINGS.—Seventy-five saline, sulphureted s's, temperature from 140° to 160° F., near Elgin, Gunnison Co., Col. A local resort.

TOPONARCOSIS.—Local anæsthesia.

TOPONEUROSIS.—A topical neurosis.

TOPOPHOBIA.—A morbid fear of particular places.

TOXALBUMIN.—Any one of the toxic substances resulting from the action of the various bacilli on the albumins of the tissues, and resembling either serum albumin or globulin.

TOXICOSIS.—A poisoning of the system. Von Jaksch makes the following divisions: Morbid symptoms depending upon the retention of certain physiological bases are known as *retention t.*, as uræmia. Morbid symptoms due to the presence of basic products formed in the system in disease are known as *naso t.* Morbid symptoms due to the formation of toxic basic substances from morbid matter, as pus, etc., are known as *auto-t.* Morbid symptoms due to the action of toxic bases taken into the system with the food, as the poison of cheese and of sausage, are known as *exogenic t.*

TOXINES.—Brieger and his followers assumed at first that the bacterial poisons are ptomaines or poisonous bases, but subsequently he, Fraenkel, Hankin, Martin, Roux, and Yersin proved the existence of toxalbumins in artificial cultures of pathogenic bacteria, and it has been demonstrated that these bodies are the specific bacterial poisons.

The bacterial toxines have been described as toxopeptones and toxalbumoses, but whether this is true is still a matter of doubt; and as it is possible that the toxines are thrown down with pre-existing albumoses or peptones, it is better to adhere to the name toxalbumins. Brieger, Fraenkel, and others assumed that these toxalbumins are formed from the albuminous substances of the body by means of bacterial fermentation. Buchner, however, considers them to be direct products of the bacterial cells, and proved this for tetanus by growing the bacillus on a solution of asparagine. Filtered asparagine cultures produced the typical tetanic lesion in animals. The toxalbumin could not have been formed by a splitting up of the asparagine, but must have been derived directly from the bacterial plasma. We can not as yet separate these toxalbumins in a pure state, since alcohol, ether, etc., will also precipitate other albuminous bodies. We find, however, that they react like the enzymes and so-called alexines or protective proteids. In a moist condition, a temperature of 55 to 70° C., as a rule, destroyed them, while in a dry state they resist much higher temperatures; and substances which limit the action of water, like the neutral salts, especially the sulphates of the alkaline bases, will increase the resistance of these bodies. Their physiological action in most cases is slow; the toxine of tetanus produces the typical symptoms in from eight hours to two or three days.

Their action varies with the quantity administered. It has been assumed by Behring and others that the antitoxines and the toxines neutralize each other, forming a new atoxic compound or substance. This is not true, because if we administer to a mouse a mixture of toxine and antitoxine in such proportion that they exactly "neutralize" each other, the animal does not succumb, but at the same time a certain amount of immunity is established. The antitoxine is therefore stored up in the organism after the toxine has been rendered harmless. It has been assumed that the toxine has been destroyed by the antitoxine, but that the latter remains behind in an active condition. But if this were so, then one and the same quantity of antitoxine should be able out of the body, in time, to destroy a further quantity of toxine than it has already destroyed. Experiment shows that this is not so. If we make an exact mixture of toxine and antitoxine—such that when injected into mice it will not produce death, but is just neutral for mice—and then inject it into guinea pigs (which are more susceptible toward tetanus than mice), we shall find it still poisonous for the same weight of guinea pig; hence the toxine and antitoxine do not react directly on each other either *in vitro* or *in corpore*. The antitoxine acts by immunization, and has no actual curative action; and since guinea pigs are more sensitive, they require a larger dose of antitoxine than mice.

Treatment of Cholera by Toxines.—M. Hoffkine, in experimenting with the cholera vibrio, found that by cultivating it first in diluted, then in undiluted, serum obtained from the rabbit, he succeeded in acclimatizing it so that at length it was unharmed by the bactericidal action of the serum. Small quantities of culture of the bacillus in undiluted serum injected into a rabbit's veins caused death, with symptoms greatly resembling those of human cholera.

Hoffkine inoculated the peritoneal cavity of a guinea pig with an agar culture of the comma bacillus. On its death the peritoneal exudate was removed with a pipette, placed in a test tube, and left for several hours at the temperature of the room. If there were several cubic centimetres, it was then injected into the peritonæum of a small guinea pig; but if there was only one cubic centimetre or less of exudate, a fully grown animal was selected for the injection. With certain precautions the cholera virus may be passed through an indefinitely long series of animals, and each successive culture was more virulent than its predecessor, until the maximum degree of virulence was reached between the twentieth and thirtieth passage. At this stage the peritoneal exudate was fatal to guinea pigs in six to eight hours after its injection into the peritonæum or into the muscular tissues, or its administration *per os* after neutralization of the gastric juice by soda and quieting the intestines with opium.

But if injected only beneath the skin, it did not kill the animal, but caused extensive œdema that eventuated in necrosis of the tissues. In a few days the necrosed mass dropped off, the granulating surface cicatrized, and the animal was immune against the virulent exudate, no matter in what form it was administered.

He then sought some means of preventing the necrosis consequent upon the hypodermic injection of this strong exudate, and he found necrosis might be prevented by previous treatment with attenuated virus. The latter was prepared by allowing the comma bacillus to grow in *bouillon* that was subjected to a slow current of air; and the solution of microbial products thus prepared did not produce necrosis when injected hypodermically, but caused an extensive œdema in twenty-four hours, the swelling subsequently slowly disappearing. A week after inoculating an animal with this attenuated virus the strong virus may be injected and œdema develops, but it is not followed by necrosis. Thereafter the animal is immune to cholera virus in whatever way it may be introduced within the system.

M. Hoffkine subsequently inoculated himself and other persons with these toxines, and found that with the attenuated and the strong virus the same results were produced in man as in rabbits. He therefore concluded that if a human being was rendered immune against the effects of the cholera microbe when injected under the skin, analogy suggested that he was immune against the same microbe when it sought to enter the system by the natural way. Mr. H. Hankin is now applying Hoffkine's method of protective inoculation in India.

Other investigators have studied the cholera toxines in order to discover a method of securing immunity from that disease.

Sautschenko and Sabolotny prepared a toxine by washing agar cultures of cholera twenty-four hours old with sterilized salt solution (one half per cent) and sterilizing by heat the emulsion thus obtained. By evaporating to dryness a known quantity of the fluid and weighing the residue, making due allowance for the added salt, the approximate weight was ascertained of dried bacteria in one gramme of the substance. This substance was carbolized before use. These experimenters took daily, *per os*, a certain quantity of this substance, increasing the amount from time to time during three weeks. Some weeks after the last dose serum from their blood was subcutaneously injected in guinea pigs that were later injected with pure cultures of comma bacilli without any bad effect. The authors believed that persons from whom the serum was taken had been rendered immune to cholera, and, to test the matter, swallowed cultures of the comma bacilli without producing any harmful effects.

Treatment of Tetanus by Toxines.—G. Tizzoni and G. Catanni extracted an alcoholic precipitate from the serum of animals that had been rendered immune to tetanus by experimental procedures. This precipitate, containing the toxines of tetanus, was injected in a watery solution into the tissues of patients affected with tetanus, and these investigators reported good results from the injections. During 1894, however, they have used serum prepared according to Behring's intensification method, in association with these toxines.

Treatment of Tuberculosis by Toxines.—See PHTHISIS, p. 415.

Treatment of Typhoid Fever by Toxines.—Dr. E. Fraenkel published, in the latter part of 1893, a paper detailing the treatment of fifty-seven cases of moderately severe typhoid fever with diluted cultures of the typhoid bacillus. The latter were prepared by taking a quantity of the culture of the typhoid bacillus from an oblique glycerin agar cultivation, placing it in test tubes containing sterile thymus *bouillon*, and keeping the tubes for seventy-two hours at a temperature of from 97° to 98° F. At the end of that time, if there was a luxuriant development of the typhoid bacillus in the *bouillon*, the tube was placed on a water bath and heated to 145° F., and after cooling it was tested to ascertain that it was absolutely sterile.

Deep intramuscular injections of this culture were given in the gluteal region of typhoid patients. The smallest quantity used of the *bouillon* was half a cubic centimetre. Usually no change followed this, and on the next day the dose was doubled and the injection given on the opposite side. This injection was usually followed by an increase in temperature, and occasionally by a more or less severe chill. On the third day of treatment there was a fall of temperature, and the latter phenomenon was more marked in the next twenty-four hours. If the treatment was interrupted the temperature rose again. When this occurred two cubic centimetres were injected and the temperature again fell, reaching the lowest point in two days.

As soon as the temperature ceases to rise above normal the injections are interrupted, but otherwise they are continued at intervals of two days, and with an increase in the dose each time of one cubic centimetre.

From the beginning the fever assumes an intermittent character, and entire absence of fever occurs in a relatively short time.

Of course the rapidity of cure varies with the patient; in general, those who have entered the hospital late are slowest in improving. The earlier relief goes hand in hand with a corresponding and often marked improvement in the general conditions, which is not inconsiderably aided by the profuse perspiration which accompanies the fall in temperature. Along with this there is a more or less rapid diuresis, and in not a few cases the patient passed from two to three thousand cubic centimetres of urine.

The typhoid diarrhœa, which most of the patients had, ceased when the temperature fell. The patients looked like individuals in full convalescence, even while roseola and splenic swelling still existed.

In a few cases the eruption of roseola occurred after commencing defervescence, just as the palpable spleen persists after the entire cessation of fever. But these symptoms disappeared, and the patients rejoiced in excellent general health, an increase in weight sometimes occurring.

The patients can be better nourished, and on leaving bed, fourteen or sixteen days after the fever has ceased, are much stronger than when treated by the expectant plan.

Fraenkel did not find that the treatment prevented complications or relapses, nor does he believe that all cases can be cured by this method; but he considers that it produces a regularity in the course of the disease and a rapidity in convalescence that no former mode of treatment produces.

These experiments of Fraenkel induced Professor T. Rumpf to experiment in typhoid fever with the introduction of cultures of dead micro-organisms that were not connected ætiologically with that fever. He selected micro-organisms that would not, unless under exceptional circumstances, result in a severe illness.

The first preparation of which he made use was prepared from pure cultures of the streptococci, but as it produced no action to compare with that obtained by Dr. Fraenkel, recourse was had to dead cultures of the bacillus pyocyaneus. The use of these gave results differing only slightly from those obtained by Dr. Fraenkel.

As soon as the diagnosis of typhoid fever was certain, half a gramme of the culture, which was prepared just as Dr. Fraenkel did his, was injected with all the aseptic precautions.

The results only differ from those obtained by Dr. Fraenkel in being slightly less favorable. Professor Rumpf thinks that the question whether, after further experiments, typhoid fever shall be treated with dead cultures of the typhus bacilli or the pyocyaneus cultures is less important than the fact that a human disease may be influenced by bacterial products which are quite different from those which produced it.

TOXIPHOBIA. — Monomania characterized by fear of being poisoned.

TRIAKAIDEKAPHOBIA. — A morbid or superstitious dread of the number thirteen.

TRIBADISM. — Unnatural sexual indulgence between two women, in which an abnormally large clitoris takes the part of a penis.

TRICHITIS.—Inflammation of the hair.

TRICHOCLASIS. — Pathological brittleness of the hair.

TRICHOMYCOSIS.—Any disease of the hair caused by a vegetable parasite.

TRICHOPHYTOSIS.—A group of skin diseases due to the presence of the *Trichophyton tonsurans.*

TRICHOPTILOSIS.—A disease in which the hair has a feathered appearance. Devergie applied the term to trichorrhexis nodosa. Michelson uses it to describe a disease of the hair of the axilla and pubes, in which the stripping up of the hair cortex forms featherlike projections about which masses of yellowish material become attached. It is a parasitic disease.

TRICHORRHEXIS.—A budlike swelling on hair. T. nodosa is a disease commonly affecting the hair of the beard and mustache, in which little spindle-shaped, bulbous swellings occur along the hair shaft, and afterward split up into numerous longitudinal divisions, weakening the hair so that it easily breaks and leaves a jagged, brushlike stump.

TRIMBLE SPRINGS. — Two alkaline, saline s's, having temperature of 130° F., in La Plata Co., Col. A resort.

TRINITY SPRINGS.—Three saline, sulphureted s's, flowing 18,000 gallons, containing 32·08 grains per imperial gallon, in Martin Co., Ind.

TRIPP SPRINGS.—Alkaline s's, having temperature of 95°, near Trimble, La Plata Co., Col. Unimproved.

TRITON SPRING.—See SARATOGA S's.

TROPHONEUROSIS. — A neurosis dependent on nutritive changes. In dermatology the term is applied to a cutaneous disorder characterized by nutritive changes in the skin depending on morbid conditions of the nerves.

TROUSSEAU'S SYMPTOM.—The excitation of paroxysms of tonic spasm, chiefly of the arms or legs, in tetany, by pressure on the larger nerves or arteries.

TULE RIVER SODA SPRINGS.—Alkaline, carbonated s's near Portersville, Tulare Co., Cal.

TUSCAN SPRINGS.—Three saline, sulphureted s's near Red Bluff, Tehama Co., Cal. A local resort.

TYPHOBACILLOSIS. — The systemic poisoning produced by the toxines formed by the *Bacillus typhosus.*

TYPHOMANIA.—The low muttering delirium of typhus or of typhoid fever.

TYPHOPNEUMONIA.—Pneumonia occurring in the course of typhoid or of typhus fever.

TYPHOSEPSIS.—The systemic poisoning occurring in and caused by typhoid fever.

UKIAH VICHY SPRINGS.—Carbonated s's, having temperature from 81° to 90° F., containing 272·61 grains of salts per gallon, in Mendocino Co., Cal. The principal salts are sodium carbonate 197·75 grains, magnesium carbonate 22·64 grains, calcium carbonate 17·85 grains, and sodium chloride 27·51 grains.

ULATROPHY.—Atrophy of the gums.

ULITIS.—Inflammation of the gums.

ULORRHŒA. — Hæmorrhage from the gums.

UMBILICATION.—A condition in which there is a central depression resembling the navel, as in variolous and vaccinal pocks. This condition is believed to be produced in variola and varioloid by a hair follicle or sweat gland forming a retinaculum that ties down the roof of the vesicle in its center.

UNION SPRING.—See Saratoga S's.

UNION SPRINGS. — Two sulphureted and chalybeate s's, flowing 10 gallons per hour, in Cayuga Co., N. Y. Unimproved.

UNITED STATES SPRING (BALLSTON).—See Ballston Spa S's.

UNITED STATES SPRING. — See Saratoga S's.

UNITOGA SPRINGS.—See Unity S's.

UNITY SPRINGS.—Ten alkaline or calcic saline s's, flowing 500 gallons per hour, containing 11·67 grains of salts per gallon, in East Unity, Sullivan Co., N. H. A resort.

URANOMANIA.—A form of megalomania involving belief in the subject's divine or celestial origin.

URARTHRITIS.—Arthritis due to uratic deposit.

URATOSIS.—The precipitation of crystalline urates in the tissues or fluids of the body.

URATURIA.—An abnormal excretion of urates in the urine.

URETERITIS. — Inflammation of the ureter.

URETEROSTEGNOSIS. — Stricture of the ureter.

URETHRALGIA.—Pain in the urethra.

URETHRISMUS.—Spasm of the urethra.

URICACIDÆMIA.—The presence of a recognizable amount of uric acid in the blood in consequence of the failure of the red blood corpuscles to oxidize this acid. To detect u., the suspected blood should be diluted with water and treated with acetate of soda and a solution of ferric chloride to five to ten times its volume, the mixture neutralized with caustic potash, and the clear filtrate tested for uric acid by Ludwig's method.

URIDROSIS.—A condition in which certain elements of the urine, especially urea, are excreted in the perspiration.

URINÆMIA.—Poisoning by the retention of various urinary constituents in the blood. It is to be distinguished from uræmia which refers only to the retention of urea.

URNING.—A man or woman who has an aversion for the opposite sex, but who obtains sexual gratification from contact or association with one of the same sex.

UROBILINURIA.—The excretion of urobilin with the urine. The latter is of a dark brown-red color. U. occurs in fever, the various diseases characterized by a disintegration of red blood corpuscles, and in hæmorrhages within the body. Gerhardt has treated a chloroform extract of the urine with solution of iodine, and then added caustic potash; if urobilin is present a green fluorescence develops.

UROSEPSIS.—Septicæmia due to the putrefaction of extravasated urine.

UROTOXY.—The unit of toxicity of urine —i. e., the toxic amount necessary to kill a kilogramme of living matter.

UROTOXIC COEFFICIENT. — The quantity of urotoxics that 1 kilogramme of man can form in twenty-four hours. If a healthy man weighing 60 kilos passes 1,200 cubic centimetres of urine in twenty-four hours, and 50 cubic centimetres of this urine kill 1 kilo of animal, the entire quantity would kill an animal weighing 24 kilos; therefore 1 kilo of man forms in twenty-four hours what would kill 400 grammes of an animal. As it is necessary to have 1 urotoxy in order to kill 1 kilo, the u. c. of a man weighing 60 kilos is 0·4. The average normal coefficient is 0·464. In pathological conditions Professor C. Bouchard has found that the u. c. is rarely greater than 2 or less than 0·1. The u. c. varies in healthy individuals according to cerebral activity, sleep, diet, labor, etc. Bouchard's rule is that the u. c. of an individual is the number of urotoxies formed in twenty-four hours by a kilo of that individual.

UTAH HOT SPRINGS.—Twelve saline, chalybeate s's, flowing 6,500 gallons per hour, containing 23·3 parts of salts in 1,000, having temperature of 132° to 136° F., near Ogden City, Utah.

VALLEIX'S POINTS. – Certain places pressure on which will elicit pain in neuralgia. They are fairly uniform in their position, corresponding either to the site at which a nerve emerges from a bony canal, passes over a hard structure, passes through a fascia to become superficial, anastomoses with another nerve, or divides into smaller nerves.

VALLEJO SULPHUR' SPRINGS. — Warm s's, having temperature of from 80° to 90° F., in Solano Co., Cal.

VALLEY VIEW SPRINGS. — Sulphureted, chalybeate s's near New Market, Shenandoah Co., Va. A resort.

VAN CLEAVE MINERAL SPRINGS. —Four calcic, chalybeate s's, containing 22·84 grains of salts, principally magnesium sulphate and carbonate, per gallon, in Crawfordsville, Montgomery Co., Ind. A resort.

VAN PATTEN'S SPRING.—A chalybeate s. near Walnut Grove, Cross Co., Ark.

VARIETY SPRINGS.—Four chalybeate acid s's, flowing over 160 gallons per hour, near Poad Gap, Augusta Co., Va. A resort.

VERBIGERATION.—The repetition by an insane person of words and phrases in the form of a discourse, but without sense or sequence.

VERONA MINERAL SPRINGS. — Four saline s's, flowing over 160 gallons per hour, containing 781·29 grains of salts, 562·89 of which are sodium chloride, per imperial gallon, in Oneida Co., N. Y. A resort.

VERRUGAS.—An endemic disease, resembling frambœsia in its general appearances, that exists in Peru, on the Pacific slope of the Andes. Fatigue, debility, and nonacclimation are predisposing causes; neither age, sex, nor race seems to have any influence on the disease, and it attacks animals as well as man.

The period of incubation lasts from twenty to forty days, and is characterized by malaise, lassitude, depression, and gastric disturbances; subsequently there are muscular soreness, arthritic and spinal pain, and sometimes muscular spasm that produces torticollis or opisthotonus, etc. A chill initiates a fever that is accompanied by a rise of temperature to from 102° to 104° F., defervescence occurring about midnight.

The pulse is soft and compressible, the blood corpuscles are decreased in number, and there is loss of hæmoglobin.

The mind becomes dull, there is effusion into the serous cavities, and after the twentieth day there is an eruption on the face, body, limbs, and mucous membranes of small reddish spots that become papules and eventually form wart-like, sessile tumors, usually about the size of a pea.

Izguierdo states that they are connective-tissue neoplasms having a strong resemblance to sarcomata. They are very vascular, and contain a bacillus—*Bacillus of verruga peruana*—together with chains of *Micrococci*. The tumors eventually desiccate, leaving no scar. Occasionally they attain a diameter of several centimetres, and exhaust the patient by suppuration and hæmorrhage; they may last from a few weeks to several months. Convalescence is slow.

VERSAILLES MINERAL SPRINGS. —Four calcic and chalybeate s's, one containing 44·62 grains, a second 49·83 grains, a third 26·33 grains of salts per imperial gallon, in Brown Co., Ill. Once a resort.

VESICULITIS.—Inflammation of a vesicle, especially of the seminal vesicles.

VESTA SPRING.—A calcic, saline s., flowing 1,200 gallons per hour, containing 26·46 grains of salts, principally calcium and magnesium bicarbonates, per gallon, in Waukesha, Wis.

VICHY SPRINGS (SARATOGA), N. Y.—See Saratoga S's.

VICHY SPRINGS OF NEW ALMADEN. — Alkaline, carbonated s's in Santa Clara Co., Cal. The water contains in each gallon 200·12 grains of sodium carbonate, 32 grains of calcium carbonate, 40·2 grains of calcium sulphate, 12 grains of magnesium sulphate, 32·16 grains of sodium chloride, 4·08 grains of iron, and 112·08 grains of carbonic acid.

VICTOR SPRING.—An acid, saline s., flowing 40 gallons per hour, in Darien Centre, Genesee Co., N. Y. The water is sold.

VOLCANIC MINERAL SPRINGS.—See Castalian Mineral S's.

WABUSKA SPRINGS.—Hot s's, having temperature of 138° to 162° F., in Lyon Co., Nev.

WAKULLA SPRING.—A calcic s., in Wakulla Co., Fla. A resort.

WALLAWHATOOLA ALUM SPRINGS.—Two saline, chalybeate s's, flowing over 75 gallons per hour, containing 199·4 grains of salts, principally aluminium and magnesium sulphates and iron persulphate and protoxide, per gallon, in Bath Co., Va. A resort.

WALLEY'S HOT SPRINGS.—Six hot s's flowing 600 gallons per hour, in Douglas Co., Nev. A resort.

WALNUT HILL MINERAL WELL. —A saline, sulphureted s., containing 4·95 grains of salts in 1,000, in Fayette Co., Ky.

WALTON SPRING (SARATOGA), N. Y.—See Saratoga S's.

WAMDUSKA LAKE.—A saline spring in Nelson Co., Dak.

WARD'S HOT SPRINGS, GRANITE MOUNTAIN.—Boiling s's in Humboldt Co., Nev.

WARM AND HOT SPRINGS.—Twenty s's, flowing over 500 gallons per hour, of water having a temperature of 116° F., near Midway, Wasatch Co., Utah. In local use.

WARM SPRING, CAL.—An alkaline s., containing 92·1 parts of salts, principally sodium carbonate and chloride, in 100,000, near Little Owen's Lake, Cal.

WARM SPRING, NEAR GRANITE MOUNTAIN, UTAH.—Saline s. containing 22·87 parts of salts in 1,000, in Juab Co., Utah.

WARM SPRINGS. — Calcic s's near Sumterville, Sumter Co., Fla. Unimproved.

WARM SPRINGS, ARK.—Sixty alkaline s's, flowing 500 gallons per hour, containing 18·11 grains of salts per gallon, in Randolph Co., Ark. A resort.

WARM SPRINGS, GA.—Sulphureted and chalybeate s's, flowing 84,000 gallons per hour, of water of temperature from 70° to 90° F., containing 156·88 grains of salts per gallon, in Meriwether Co., Ga. A resort. Each gallon contains iron carbonate 26·32 grains, calcium oxide 37·12 grains, magnesium oxide 93·44 grains, and a large quantity of sulphureted hydrogen.

WARM SPRINGS, IDA.—Five calcareous and chalybeate s's in Oneida Co., Ida.

WARM SPRINGS, N. M. — Springs the waters of which have a temperature of 150° F., near Hudson, Grant Co., New Mexico.

WARM SPRINGS, N. C.—Twenty s's, the water having temperature from 92° to 117° F., containing 35 grains of salts per gallon, in Madison Co., N. C. A resort.

WARM SULPHUR SPRINGS.—Calcic s's, flowing 360,000 gallons per hour, of water having temperature from 96° to 98° F., containing 32·63 grains of salts per gallon, in Bath Co., Va. A resort.

WARNER'S RANCH SPRING.—A sulphureted s., flowing about 1,400 gallons per hour, of water having temperature from 74° to 142° F., near San Diego, Cal. A local resort.

WARNER'S SPRING.—A weak alkaline, calcic s., containing 31·86 grains of salts per gallon, in Albion, Calhoun Co., Mich.

WARWICK NECK MINERAL SPRINGS.—Chalybeate s's in Kent Co., R. I. Unimproved.

WARWICK SPRINGS.—A saline, acid s., containing 112·75 grains of salts per gallon, in Newark, N. J.

WASHINGTON BELL'S SULPHUR SPRING.—A sulphur s. in Nelson Co., Ky. A resort.

WASHINGTON SPRINGS.—See SARATOGA S's.

WASHINGTON LITHIA WATER.—See BALLSTON SPA S's.

WASHINGTON SPRINGS.—Chalybeate s's near Glade Spring, Washington Co., Va. A resort.

WATER JAGS — WATER POX. — Popular synonyms for chicken pox, *q. v.*

WATER PANG—WATER QUALM.—Popular synonyms for pyrosis, *q. v.*

WATER WHISTLING.—A term used by Vierordt to designate a metallic *râle*, or very fine metallic gurgling or splashing that occurs in open pneumothorax if the patient draws a breath when his position is such that the opening in the pleura is directly below the smooth surface of the fluid.

WATKINS'S ARTESIAN WELL.—A carbureted and calcic s., containing 0·47 grain of salts per litre, in Story Co., Iowa. Unimproved.

WATSON'S SPRINGS.—Five sulphureted and chalybeate s's, flowing 75 gallons per hour, in Greensborough, Greene Co., Ga. A resort.

WAYLAND SPRING. — A chalybeate s., containing 5 grains of salts per gallon, in Nottoway Co., Va. A local resort.

WAYLAND'S SPRINGS.—Four saline, chalybeate s's, flowing over 150 gallons per hour, in Lawrence Co., Tenn. A resort.

WEAVER WELL.—An acid, calcic, and chalybeate s., containing 140·25 grains of salts per gallon, in Sulphur Springs, Hopkins Co., Tex. The principal constituents are calcium, magnesium, aluminium, and iron sulphates.

WEBSTER SALT SULPHUR SPRINGS.—Two saline, sulphureted s's in Webster Co., W. Va. A resort.

WELCH SPRINGS.—Four chalybeate s's near White Sulphur Springs, Catahoula Parish, La.

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WESSON'S IRON SPRING.—A chalybeate s., flowing 7,500 gallons per hour, containing 10·45 grains of salts per gallon, near White Springs, Hamilton Co., Fla. A resort.

WEST BADEN SPRINGS.—Five alkaline, saline, sulphureted s's, flowing 1,500 gallons per hour, one containing 282·99 grains, a second 362·24 grains of salts per gallon, in Orange Co., Ind. A resort.

WEST BETHEL SPRING.—A carbonated, chalybeate s., containing 5·92 grains of salts in 6,000, in Oxford Co., Me. Was once a resort.

WESTERN SARATOGA SPRINGS.—Two carbonated s's, flowing over 1,000 gallons per hour, in Union Co., Ill. A resort.

WEST NASHVILLE SULPHUR WELL.—A saline, sulphureted artesian well, containing 122·55 grains of salts per gallon, in Nashville, Tenn. The water is sold to a limited extent.

WEST NEWFIELD SPRING.—A sulphureted s. in York Co., Me.

WEST SARATOGA SPRINGS.—Carbonated s's, one containing 16·28, a second 19·49 grains of salts per imperial gallon, in Pike Co., Ind. A resort.

WEST'S SPRING.—A chalybeate s. in Union Co., S. C. A resort.

WHELAN'S WHITE SULPHUR AND MINERAL SPRINGS.—Three sulphureted hot s's, flowing 5,000 gallons per hour, of water having temperature of from 108° to 112° F., near Mineral Hill, Eureka Co., Nev. A local resort.

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WHITE MOUNTAIN MINERAL SPRING.—An alkaline s., containing 2·08 grains of salts per gallon, in Conway, Carroll Co., N. H.

WHITE ROCK SPRING.—A s., flowing 800 gallons per hour, in Waukesha, Waukesha Co., Wis. An analysis by G. Bode shows that each gallon of the water contains sodium bicarbonate 1·18 grain, calcium bicarbonate 11·72 grains, magnesium bicarbonate 5·31 grains, sodium sulphate 1·09 grain, sodium chloride 1·17 grain, and silica 1·04 grain.

WHITE SULPHUR SPRING.—A sulphureted s., flowing 1,200,000 gallons per hour, containing 165·29 grains of salts per gallon, in Hamilton Co., Fla. A resort. The principal constituents are calcium and sodium carbonates, magnesium sulphates, and sodium and potassium chlorides.

WHITE SULPHUR SPRINGS, ARK.—Six sulphureted s's, flowing 480 gallons per hour, near Pine Bluff, Jefferson Co., Ark. A resort.

WHITE SULPHUR SPRINGS, CAL.—Nine sulphureted s's, containing about 40 grains of salts per gallon, near St. Helena, Napa Co., Cal. A resort.

WHITE SULPHUR SPRINGS, GA.—Five sulphureted, saline, and chalybeate s's, flowing 1,200 gallons per hour, in Meriwether Co., Ga. A resort.

WHITE SULPHUR SPRINGS, IND.—Local name for sulphureted s's in Pike Co., also in Bedford and in Indian Creek township, in Lawrence Co., Ind.

WHITE SULPHUR SPRINGS, KY.—Saline, sulphureted s's in Cloverport, Breckinridge Co., also in Marion Co., and in Ohio Co., Ky.

WHITE SULPHUR SPRINGS, LA.—Sulphureted and chalybeate s's in Catahoula Parish, La. A resort.

WHITE SULPHUR SPRINGS, MISS.—Sulphureted s's near Garlandville, Jasper Co., Miss.

WHITE SULPHUR SPRINGS, MO.—Sulphureted s's in St. Clair Co., also in Benton Co., Mo.

WHITE SULPHUR SPRINGS, MONT.—Nine alkaline and saline, sulphureted s's, flowing 13,000 gallons per hour, of water having a temperature of 128·05° F., in Meagher Co., Mont. A resort.

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WITTER'S SPRINGS. — Sulphureted, chalybeate s's in Lake Co., Cal. A small resort.

WOLF TRAP LITHIA SPRINGS.—Alkaline, calcic s's, containing 20·67 grains of salts per gallon, in Halifax Co., Va. The water is sold. There is but 0·02 grain of lithium carbonate in each gallon.

WOOTAN WELLS.—Four sulphureted, chalybeate acid springs near Bremond, Robertson Co., Tex. The waters contain about 176 grains of salts, principally chlorides and sulphates of aluminium, soda, and magnesium, in each gallon.

WYANDOT MAGNETIC WELL.—A sulphureted spring, flowing 400 gallons per hour, near Upper Sandusky, Ohio. A resort.

WYANDOTTE SPRING.—A saline, sulphureted s., containing 55·3 grains of salts per imperial gallon, near Leavenworth, Crawford Co., Ind.

WYANDOTTE WHITE SULPHUR SPRINGS.—A sulphureted s., containing 293·34 grains of salts per imperial gallon, near Detroit, Mich. A bathing resort.

WYNDHAM SPRINGS. — Chalybeate and sulphureted s's near Oregonia, Tuscaloosa Co., Ala. Once a resort.

WYSER'S SPRING.—A sulphureted s., flowing 75 gallons per hour, in Huntsville, Walker Co., Tex. A local resort.

WYTHEVILLE SPRINGS. — Chalybeate s's in Wythe Co., Va. A resort.

XANTHIURIA.—A urinary condition in which xanthic oxide is deposited.

XANTHOCYANOPIA. — A term proposed by Mauthner for red-green blindness because yellow and blue are the colors that are perceived.

XANTHODERMA. — Yellowness of the skin.

XANTHOPSIA.—A visual functional disturbance in which objects appear yellow.

XYLOTHERAPY.—A term applied by Dujardin-Beaumetz to medical treatment in which certain æsthesiogenous phenomena, similar to those of metalloscopy, are produced by applications of particular woods, such as thuja, rosewood, pitch pine, mahogany, walnut, maple, apple, and especially cinchona. Other woods, such as ebony, ash, poplar, and sycamore, are said to produce no phenomena.

YACUM SPRING. — A chalybeate s., flowing 120 gallons per hour, in Goffstown Centre, Hillsborough Co., N. H. A resort.

YADKIN MINERAL SPRINGS. — Chalybeate, sulphureted s's in Palmerville, Stanley Co., N. C. Unimproved.

YATES MINERAL SPRING.— A saline s. in Boyle Co., Ky.

YELLOW FEVER.—In 1890, Surgeon-General George M. Sternberg, U. S. A., published an account of the elaborate investigations he had made to discover, if possible, the specific infectious agent in yellow fever. He found that the most approved bacteriological methods failed to demonstrate the constant presence of any particular micro-organism in the blood and tissues of yellow-fever cadavers. He therefore sought for the presence of the specific germ in the alimentary canal, but that contained a great variety of bacilli, and not an almost pure culture of some single species, as is the case in cholera. That the yellow-fever germ is strictly anaërobic, or that it will only grow in a special nidus, may be inferred from certain facts relating to the extension of epidemics.

General Sternberg considered that many facts relating to the origin and extension of yellow-fever epidemics gave support to the inference that the specific infectious agent was present in the dejecta of those suffering from the disease, and that accumulations of fæcal matter and of other organic material of animal origin furnished a suitable nidus for the development of the germ when climatic conditions were favorable for its growth. It was possible that such a nidus was essential, and that the culture media usually employed by bacteriologists did not afford a suitable soil for this particular microbe; and it was also possible that its development depended upon the presence of other micro-organisms found in fæcal matter that gave rise to chemical products required for the development of this supposititious germ.

He considered that recorded experimental evidence and collated facts justified the recommendation that the dejecta of yellow-fever patients should be regarded as infectious material, and that such material should never be thrown into privy vaults or upon the soil until it has been completely disinfected.

The intensely acid condition of the urine and of the vomited matters, and the fact that the intestinal contents were more or less acid, suggested the desirability of a very decidedly alkaline treatment; and in view of the probability that the specific infectious agent is located in the alimentary canal, General Sternberg combined an antacid and antiseptic treatment. His formula is:

℞ Bicarbonate of soda....	10·00	grms.
Bichloride of mercury..	·02	„
Water.................	1,000.	„

M. Sig.: Fifty grammes every hour; to be given ice-cold.

No food is given, and nausea and vomiting are combated with ice.

Reports from various clinicians commend the value of this treatment.

YELLOW SPRING, N. Y.—A chalybeate s. in Southampton, Long Island, N. Y.

YELLOW SPRINGS, OHIO.—Alkaline and sulphurous s's in Greene Co., Ohio.

YELLOWSTONE PARK.—A national park or reservation in Wyoming, where there are numerous hot and cold mineral springs.

YELLOW SULPHUR SPRINGS.—Calcic, saline, sulphur s's, flowing 150 gallons per hour, containing 104·98 grains of salts per gallon, in Christiansburg, Montgomery Co., Va.

YORK SULPHUR SPRINGS. — Sulphurous s's in Adams Co., Pa.

YOUNG'S SPRINGS.—Three sulphureted s's, flowing 58 gallons per hour, in Bath Co., Ky. A resort.

YPSILANTI MINERAL SPRINGS.—Saline, sulphureted artesian wells in Ypsilanti, Mich. The waters contain from 1,205 to 3,004 grains of salts, principally sodium chloride (832 to 2,411 grains), and the sulphates and chlorides of calcium, magnesium, and potassium.

ZEISMUS.—From zea, maize. Pellagra, because due to a diet of diseased maize.

ZEM ZEM SPRINGS.—Saline s's in Lake Co., Cal.

ZOANTHROPY.—A variety of insanity in which the patient imagines himself changed into some animal.

ZODIAC SPRINGS.—Twelve saline, chalybeate s's in Vernon Co., Mo. A resort.

ZONIAN SPRING.—A saline, carbureted s. near Elgin, Kane Co., Ill.

ZONES, HYSTEROGENIC. — Hyperæsthetic areas in different parts of the body that when pressed upon or rubbed bring on hysterical paroxysms of various kinds. The most sensitive and common seat of these zones is over the ovaries in women and in corresponding regions, or on the scrotum in men. They are also found on the upper and lower extremities, at the base of the sternum, below the clavicle, below the breasts, between the shoulders, in the lumbar region, and in the inguinal region. The z's can be made to disappear by applications of electricity, by local anæsthesia, or by counter-irritation.

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